

8.0 Summary Comparison of Alternatives

A summary comparison of important water quality impacts is provided in Figures 8-0a and 8-0b. These figures provides information on the magnitude of the most pertinent water quality-related impacts, both adverse and beneficial, that are expected to result from implementation of the alternatives. Important impacts to consider include the potential for increased electrical conductivity, increased mercury levels in fish, and increased production of *Microcystis* in the Delta.

As depicted in Figure 8-0a, the modeling shows that all action alternatives would exceed the water quality objective for electrical conductivity (EC) in the Sacramento River at Emmaton. Alternatives 1A and 6A would exceed the objective more than the other alternatives would. The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing Conditions and 14% under the No Action Alternative late long-term (LLT) to 31% under Alternative 1A and 32% under Alternative 6A. Alternatives 4A, 2D, and 5A would result in the least exceedances of the threshold of 16%, 7%, and 10%, respectively. However, in reality, staff from DWR and Reclamation constantly monitor Delta water quality objectives. Their water system operational decisions take into account real-time conditions and are able to account for many factors that the best available models cannot simulate. It is likely that some of the objective exceedences simulated in the modeling would be avoided under the real-time monitoring and operational paradigm that would be in place to help prevent such exceedences.

Modeling results show that most of the action alternatives, as well as the No Action Alternative, would result in increased mercury levels in fish tissue concentrations at Delta locations. Alternatives 6A and 9 would result in the highest increases in mercury levels in fish tissue, increasing by up to 64% to 66% compared with Existing Conditions at certain Delta locations, and by up to 58% to 59%, compared to the No Action Alternative LLT. Alternative 4A would increase mercury levels in fish tissue by 8% or less compared with Existing Conditions and No Action Alternative early long-term (ELT), Alternative 2D would result in a 10% or less increase compared with Existing Conditions and No Action Alternative (ELT), and Alternative 5A would result in a 5% or less increase compared with Existing Conditions and No Action Alternative (ELT).

Modeling results show that the action alternatives would result in increased production of *Microcystis* in the Delta when compared with the No Action Alternative as a result of a number of factors. Blooms of *Microcystis* require high levels of nutrients and low turbidity, as well as high water temperature and, because the species is fairly slow growing, long residence time (Lehman et al. 2008; Lehman et al. 2013). In addition, low vertical mixing (due to low water flow) associated with high residence time allows *Microcystis* colonies to float to the surface of the water column, where they outcompete other species for light. Increases in ambient air temperature due to climate change relative to Existing Conditions are expected under all action alternatives. Increases in ambient air temperatures are expected to result in warmer ambient water temperatures, and thus conditions more suitable to *Microcystis* growth, in the water bodies of the State Water Project/Central Valley Project Export Service Areas. The incremental increase in long-term average air temperatures would be less at the ELT (2.0°F) than at the LLT (4.0°F). For Figure 8-0b,

1 *Microcystis* predictions were ranked qualitatively, based on a combination of these factors. Lower
 2 numbers (e.g., 1 or 2) signify less suitable conditions for *Microcystis* blooms than higher numbers
 3 indicate (e.g., 4 or 5). The non-HCP alternatives (Alternatives 4A, 2D, and 5A), when compared to the
 4 No Action Alternative (ELT), would have a ranking of 2 because operations and the ELT timeframe
 5 under those alternatives would lead to less suitable conditions for *Microcystis* to bloom. The BDCP
 6 alternatives would have a ranking of 4, with the exception of Alternative 5, which would result in a
 7 ranking factor of 3; these alternatives would provide more suitable conditions for *Microcystis* to
 8 bloom.

9 Additional impacts discussed in the summary table include bromide concentrations, chloride levels,
 10 and increases in organic carbon and selenium. Executive Summary Table ES-8 provides a summary
 11 of all impacts disclosed in this chapter.

12 **8.0.1 Readers Guide**

13 Chapter 8, *Water Quality*, describes the environmental setting and potential impacts of the project
 14 alternatives on water quality in and upstream of the Sacramento-San Joaquin Delta. The chapter
 15 provides the results of the evaluation of the effects of implementing the project on water quality
 16 constituents under No Action Alternative conditions and 18 action alternatives. This guide is
 17 intended to help the reader understand the organization of the chapter and the impact analysis of
 18 the constituents of interest.

19 **8.0.2 Overview**

20 Chapter 8 is organized much like the other chapters in this document, but because of the chapter's
 21 greater scope, this guide is provided to help the reader navigate through the various components of
 22 the chapter.

23 The chapter is divided into three main sections.

- 24 • 8.1 *Environmental Setting/Affected Environment*
- 25 • 8.2 *Regulatory Setting*
- 26 • 8.3 *Environmental Consequences*

27 These sections parallel the same sections in other resource chapters.

28 **8.0.3 Environmental Setting/Affected Environment**

29 The first part of the chapter is the Environmental Setting and Affected Environment section. This
 30 section provides a general description of the existing environment, including the following:

- 31 • Overview of the Sacramento and San Joaquin River Watersheds
- 32 • Water Management and the State Water Project and Central Valley Project Systems
- 33 • Primary Factors Affecting Water Quality
- 34 • Beneficial Uses
- 35 • Water Quality Objectives and Criteria
- 36 • Water Quality Impairments

Chapter 8 – Water Quality	Alternative																			
	Existing Condition	No Action	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9	4A	2D	5A
WQ-5: Bromide (CM1) - Percent increase in long-term average concentration at Barker Slough	-	-2%	38/43%	38/43%	38/43%	22/26%	22/26%	22/26%	34/38%	40/44%	23/27%	19/22%	19/22%	19/22%	-2/1%	4/8%	19/23%	-2/2%	-2/2%	-4/0%
		LTS	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A ^a	S/A ^a	S/A	LTS/NA	LTS/NA
WQ-7: Chloride - Percent of years when 150 mg/L water quality objective exceeded at CCP#1 ^b	7%	0	13%	13%	13%	13%	13%	13%	7%	7%	13%	13%	13%	13%	20%	13%	13%	0%	0%	0%
		S	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA
WQ-11: EC - Percent of days Emmaton objective would be exceeded	6%	14	31%	31%	31%	26%	26%	26%	30%	27-29% ^c	25%	32%	32%	32%	19%	22%	18%	16% ^c	7% ^c	10% ^c
		S	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA
WQ-13: Mercury (CM1) - Maximum percent increase in fish tissue concentrations at Delta locations	6%	6%	8/10%	8/10%	8/10%	13/11%	13/11%	13/11%	6/8%	15/12%	8/7%	64/58%	64/58%	64/58%	45/39%	46/41%	66/59%	8/7%	10/9%	5/3%
		LTS	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA	LTS/NA

Notes

- ^a While the long-term average increases in bromide would be low, the drought period increases would be 34% for Alternative 7 and 50% for Alternative 8, relative to Existing Conditions and the No Action Alternative. These increases in the drought period were considered significant/adverse.
- ^b Water quality degradation as measured by use of available assimilative capacity also played a significant role in determining effects by alternative, and degradation varied by alternative.
- ^c Alternative 4 does not include a change in compliance location from Emmaton to Threemile Slough, but the modeling used to evaluate the alternative did include the change. Thus, although the percent of days the Emmaton objective was exceeded is high, it is expected that under the alternative it would be similar to the No Action.

Key

Level of significance or effect **before** mitigation
(Quantity of impact: number of sites, structures, acres, etc. affected)

	Increasing level of significance →			
Bromide - Percent increase (%)	<0	1 - 20	21 - 40	>40
Chloride - % of years objective exceeded (%)	0	1-12	13-19	>20
EC - percent of days objective exceeded (%)	<10	11 - 20	20 - 30	>30
Mercury (CM1) - Percent increase (%)	<10	10 - 20	21 - 50	>50
Mercury (CM2-CM22) - restoration acres	0	1 - 100	25,000	65,000
Organic Carbon (CM1) - mg/L	<0.1	0.1 - 0.5	0.6 - 1.0	>1.0
Organic Carbon (CM2-CM21) - restoration acres	0	1 - 100	25,000	65,000
Selenium - Exceedance Quotient	0.87	0.88 - 0.93	0.94 - 0.99	>1.0
Microcystis - relative rank	1	2	3	4

Level of significance or effect **after** mitigation
(CEQA Finding / NEPA Finding)

CEQA Finding		NEPA Finding	
NI	No Impact	B	Beneficial
LTS	Less than significant	NE	No Effect
S	Significant	NA	Not Adverse
SU	Significant and unavoidable	A	Adverse

n/a not applicable
> greater than
< less than
≈ about equal to

Continued on Figure 8-0b

Figure 8-0a
Comparison of Impacts on Water Quality

Chapter 8 – Water Quality (continued)	Alternative																			
	Existing Condition	No Action	1A	1B	1C	2A	2B	2C	3	4	5	6A	6B	6C	7	8	9	4A	2D	5A
WQ-14: Mercury(CM2-CM21) - Amount (acres) of new tidal habitat restoration that could contribute additional methylmercury	0	0	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	25,000	65,000	65,000	65,000	65,000	65,000	65,000	59	65	55
		-- ^d	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A
WQ-17: Organic Carbon (CM1) - Maximum increase in long-term average DOC (mg/L) at interior Delta locations	--	<0.1	0.3	0.3	0.3	0.4	0.4	0.4	0.2	0.4	0.2	1.2	1.2	1.2	0.8	0.8	0.7	0.2	0.2	0.1
		LTS	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA
WQ-18: Organic Carbon (CM2-CM21) - Amount (acres) of new tidal habitat restoration that could contribute additional DOC	0	0	65,000	65,000	65,000	65,000	65,000	65,000	65,000	65,000	25,000	65,000	65,000	65,000	65,000	65,000	65,000	59	65	55
		-- ^d	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA
WQ-25: Selenium (CM1) - High threshold exceedance quotient for whole body sturgeon (concentration divided by threshold) during drought period	.87	0.87	0.89	0.89	0.89	0.92	0.92	0.92	0.89	0.93	0.89	1.1	1.1	1.1	1.1	1.1	1.2	0.91	0.89	0.90
		LTS	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	LTS/NA	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA
WQ-32 and 33: Microcystis (CM1-CM21) - potential for increased production in Delta ^e	--	2	4	4	4	4	4	4	4	4	3	4	4	4	4	4	4	2	2	2
		5	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	S/A	LTS/NA	LTS/NA

Notes

- ^d CM2-CM21 are not a component of Existing Conditions or the No Action Alternative, thus, no impact call was made for this effect in the EIR/EIS.
- ^e The Microcystis was qualitative. Thus, the severity of the impact was established as a rank from 1 to 4, with the rankings based on the alternative-specific factors that would contribute to increased Microcystis production, including restoration area, diversions of Sacramento River water at the north intakes, and net Delta outflow.

Key

Level of significance or effect **before** mitigation
(Quantity of impact: number of sites, structures, acres, etc. affected)

	Increasing level of significance →			
Bromide - Percent increase (%)	<0	1 - 20	21 - 40	>40
Chloride - % of years objective exceeded (%)	0	1-12	13-19	>20
EC - percent of days objective exceeded (%)	<10	11 - 20	20 - 30	>30
Mercury (CM1) - Percent increase (%)	<10	10 - 20	21 - 50	>50
Mercury (CM2-CM22) - restoration acres	0	1 - 100	25,000	65,000
Organic Carbon (CM1) - mg/L	<0.1	0.1 - 0.5	0.6 - 1.0	>1.0
Organic Carbon (CM2-CM21) - restoration acres	0	1 - 100	25,000	65,000
Selenium - Exceedance Quotient	0.87	0.88 - 0.93	0.94 - 0.99	>1.0
Microcystis - relative rank	1	2	3	4

Level of significance or effect **after** mitigation
(CEQA Finding / NEPA Finding)

CEQA Finding	NEPA Finding
NI No Impact	B Beneficial
LTS Less than significant	NE No Effect
S Significant	NA Not Adverse
SU Significant and unavoidable	A Adverse

n/a not applicable
> greater than
< less than
≈ about equal to

Figure 8-0b
Comparison of Impacts on Water Quality (continued)

- 1 • Water Quality Constituents of Concern
- 2 • Selection of Monitoring Stations for Characterization of Water Quality
- 3 • Existing Surface Water Quality—this characterization is meant to provide a general
- 4 understanding of water quality conditions and historical monitoring data in the study area. The
- 5 discussion is not meant to explicitly define the Existing Conditions for CEQA purposes. The
- 6 CEQA baseline, *Existing Conditions*, is defined in Appendix 3D, *Defining Existing Conditions, No*
- 7 *Action Alternative, No Project Alternative, and Cumulative Impact Conditions*, and for the
- 8 purposes of quantitative water quality assessments (as described in Sections 8.3.3 and 8.3.4) is
- 9 represented by Existing Conditions modeling runs, not historical water quality monitoring data
- 10 as presented in this section.

11 8.0.4 Regulatory Setting

12 Numerous federal, state and local acts, rules, plans, policies, and programs define the framework for
 13 regulating water quality in California. The second part of the chapter, *Regulatory Setting*, describes
 14 water quality requirements that are applicable to the project alternatives.

15 8.0.5 Environmental Consequences

16 The third part of the chapter describes the anticipated environmental consequences of the no action
 17 alternatives and each of the 18 action alternatives. This part of the chapter is divided into four
 18 sections. The first two sections (Sections 8.3.1 and 8.3.2) provide an important foundation for the
 19 analysis of the environmental effects. The third section contains the analysis of each alternative's
 20 impacts as well as associated environmental commitments and mitigation measures that would be
 21 implemented to reduce those impacts. The final section discusses cumulative effects. The four
 22 sections are as follows:

- 23 • Methods of Analysis (Section 8.3.1), which presents information on models used and their
- 24 linkages, methods specific to three different regions of the affected environment (Upstream of
- 25 the Delta, Plan Area/Delta, and State Water Project (SWP)/Central Valley Project (CVP) Export
- 26 Service Area), mercury and selenium bioaccumulation models, and constituent-specific
- 27 considerations used in the assessment. The constituent-specific considerations used in the
- 28 assessment section specifically identifies the water quality criteria/objectives used in the
- 29 assessments and other methodological details specific to each constituent.
- 30 • Determination of Adverse Effects (Section 8.3.2), which describes results of the constituent
- 31 screening analysis, a description of the comparisons made in the Effects and Mitigation
- 32 Approaches section, and the criteria for determining if an impact is adverse and/or significant.
- 33 • Effects and Mitigation Approaches (Section 8.3.3), which provides a full discussion by
- 34 alternative (No Action Alternative and 15 BDCP alternatives) of impacts and mitigation
- 35 approaches of the BDCP conservation measures on water quality constituents. ***Important***
- 36 ***information about the organization of the Effects and Mitigation Approaches section is***
- 37 ***provided below.***
- 38 • Effects and Mitigation Approaches – Alternatives 4A, 2D, and 5A (Section 8.3.4), which provides
- 39 a full discussion by alternative (No Action Alternative [ELT] and three non-HCP alternatives) of
- 40 impacts and mitigation approaches of the non-HCP alternatives on water quality constituents.

1 ***Important information about the organization of the Effects and Mitigation Approaches***
 2 ***section is provided below.***

- 3 • Cumulative Analysis (Section 8.3.5) addresses the potential for the project alternatives to act in
 4 combination with other past, present, and probable future projects or programs to create a
 5 cumulatively significant adverse impact.

6 **8.0.6 Organization of the Effects and Mitigation Approaches** 7 **Discussion (Sections 8.3.3 and 8.3.4)**

8 The Effects and Mitigation Approaches sections (Sections 8.3.3 and 8.3.4) contains the analysis of
 9 the impacts and mitigation on water quality constituents for each alternative. The sections begin
 10 with an analysis of the No Action Alternative and is then followed by the action alternatives. A
 11 discussion of cumulative effects is included as a standalone section (Section 8.3.5).

12 Each alternative begins with a brief description of the alternative itself, including the capacity of the
 13 North Delta intake structures, the operational scenario, and any other major aspects of the
 14 alternative. Following this is the “Effects of the Alternative on Hydrodynamics” section, which
 15 includes a brief discussion of how water quality constituents would be expected to change in general
 16 due to changes in Delta hydrodynamics, the general changes in hydrodynamics due to the
 17 alternative, and the types of water quality changes seen in the alternative.

18 To the extent there are similarities between the No Action Alternative or Alternative 1A and the
 19 other alternatives, the subsequent alternative analyses refer back to either the No Action Alternative
 20 or the Alternative 1A analysis. This approach allows the analysis of Alternative 1A and the action
 21 alternatives to minimize redundancy and emphasize those aspects of the alternatives that are
 22 different from the No Action Alternative or Alternative 1A. Hence, readers wishing to gain a better
 23 understanding of the impacts and mitigation for Alternatives 1B–2C, 3, 4, 5, and 6A–9 should first
 24 become familiar with the presentation of impacts and mitigation for the No Action Alternative and
 25 Alternative 1A. Alternatives ending in “B” or “C” are different from the corresponding “A” variant of
 26 the alternatives. The difference is the physical type and/or location of water conveyance
 27 infrastructure. In all other respects, including water operations, the B and C variants are identical to
 28 the corresponding A variant. For example Alternative 1B is different from Alternative 1A in that
 29 Alternative 1A would convey water from the north Delta to the south Delta through
 30 pipelines/tunnels, while Alternative 1B would convey water through a surface canal. The effects on
 31 water quality do not differ otherwise, so the analysis of the B and C alternatives is condensed and
 32 refers the reader back to the corresponding A alternative for specific details.

33 Restoration and other conservation measures for the BDCP alternatives are the same among all but
 34 two of the BDCP alternatives. The exceptions are Alternatives 5 and 7. Under Alternative 5, 25,000
 35 acres of tidal habitat would be restored, compared to 65,000 acres for Alternative 1A. Under
 36 Alternative 7, there would be 20,000 acres of seasonally inundated floodplain and 40 miles of
 37 channel enhancement, versus 10,000 acres of seasonally inundated floodplain and 20 miles of
 38 channel margin enhancement under Alternative 1A. However, these differences do not substantially
 39 affect water quality impact conclusions discussed in this chapter, and, thus, for Alternatives 1B
 40 through 2C, 3, 4, 5, and 6A through 9, the reader is referred back to Alternative 1A for details. To
 41 help guide the reader, bookmark their location in the chapter, and maintain consistency with
 42 Alternative 1A, the impact headers are retained in these other alternatives and followed by a general

1 summary in some instances and cross reference to appropriate analysis located elsewhere in the
2 chapter.

3 The conservation measures (see Table 3-3 in Chapter 3, *Description of Alternatives*) that are
4 analyzed for each water quality constituent under each BDCP alternative are treated in two distinct
5 categories for purposes of impact analysis. Those categories are as follows:

- 6 • Potential impacts resulting from water operations and maintenance of Conservation Measure
7 (CM) 1. CM1 provide for the development and operation of a new water conveyance
8 infrastructure and the establishment of operational parameters associated with both existing
9 and new facilities). For the purposes of the assessment, the study area was divided into the
10 three regions which are discussed separately for each constituent for CM1:
 - 11 ○ Upstream of the Delta (including the Sacramento and San Joaquin River watersheds).
 - 12 ○ Plan Area, including the Yolo Bypass, SWP North Bay Aqueduct service area, and Suisun
13 Marsh.
 - 14 ○ SWP/CVP Export Service Area (south of the Delta, areas served by the California Aqueduct,
15 Delta-Mendota Canal, and South Bay Aqueduct).
- 16 • Potential impacts resulting from other conservation measures, under the BDCP alternatives,
17 these are CM2–CM21 (these include habitat restoration measures that provide for the
18 protection, enhancement and restoration of habitats and natural communities and measures to
19 reduce the direct and indirect adverse effects of other stressors on covered species).

20 Operations-related water quality changes (i.e., CM1 under the BDCP alternatives) would be partly
21 driven by geographic and hydrodynamic changes resulting from restoration actions (i.e., altered
22 hydrodynamics attributable to new areas of tidal wetlands (CM4), for example). There is no way to
23 disentangle the hydrodynamic effects of CM4 and other restoration measures from CM1, since the
24 Delta as a whole is modeled with both CM1 and the other conservation measures implemented. To
25 the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing
26 of source waters, these effects were included in the modeling assessment of operations-related
27 water quality changes (CM1 under the BDCP alternatives). Other effects of CM2–CM21 not
28 attributable to hydrodynamics, for example, additional loading of a water quality constituent to the
29 Delta, are discussed within the impact heading for CM2–CM21.

30 After the discussion for each water quality constituent, construction-related water quality effects
31 are discussed. As opposed to discussing construction-related water quality effects for each water
32 quality constituent within the constituent-specific assessments described above, construction-
33 related water quality effects on all constituents are discussed in a single section for all CM1–CM21.
34 Following the discussion of construction-related water quality effects are impact discussions for
35 *Microcystis* and San Francisco Bay. Within each BDCP alternative discussion section, the impacts of
36 the conservation measures are analyzed in the following order:

- 37 • Ammonia
- 38 • Boron
- 39 • Bromide
- 40 • Chloride
- 41 • Dissolved Oxygen

- 1 • Electrical Conductivity
- 2 • Mercury
- 3 • Nitrate
- 4 • Organic Carbon
- 5 • Pathogens
- 6 • Pesticides and Herbicides
- 7 • Phosphorus
- 8 • Selenium
- 9 • Trace Metals
- 10 • TSS and Turbidity
- 11 • Construction-related Activities
- 12 • *Microcystis*
- 13 • San Francisco Bay

14 The presentation and organization of water quality impacts associated with Alternatives 4A, 2D, and
 15 5A (the non-HCP alternatives) follows the same format described above. The primary difference is
 16 that impacts are described for “facilities operations and maintenance” without the label of “CM1,”
 17 because the water conveyance facilities under non-HCP alternative are not proposed as a
 18 conservation measure, a term of art normally associated with Section 10 of the Endangered Species
 19 Act. Similarly, Environmental Commitments are proposed for Alternatives 4A, 2D, and 5A, rather
 20 than conservation measures; therefore, there are separate impact discussions for Environmental
 21 Commitments for each constituent, rather than an impact discussion for CM2–CM21.

22 It should be noted that because aquatic life beneficial uses are the only uses expected to be affected
 23 by temperature changes under the various alternatives, this chapter cross-references to Chapter 11,
 24 *Fish and Aquatic Resources*, for all impact assessments for temperature.

25 **8.0.7 NEPA and CEQA Impact Conclusions**

26 The analysis in Chapter 8 has been prepared in accordance with NEPA and CEQA. Each impact is
 27 presented as a NEPA analysis, using the appropriate terminology for presence or absence of adverse
 28 effects. This analysis is followed by a CEQA conclusion, which is identified as such. The CEQA
 29 conclusion uses the terminology appropriate to describing the presence or absence of significant
 30 impacts.

31 In some instances, the NEPA and CEQA discussions differ for a particular impact discussion because
 32 NEPA and CEQA have different points of comparison (or “baselines” in CEQA terms). The NEPA point
 33 of comparison for each alternative is based on the comparison of the action alternatives,
 34 Alternatives 1A–2C, 3, 4, 5, and 6A– 9, at 2060 and Alternatives 4A, 2D, and 5A at 2025, with the No
 35 Action Alternatives considered at 2060 (No Action Alternative [LLT]) and 2025 (No Action
 36 Alternative [ELT]) in the absence of the action alternatives. The CEQA baseline is based on the
 37 comparison of the action alternatives with existing conditions. Consistent with this, the NEPA point
 38 of comparison accounts for anticipated climate change conditions at 2060 and 2025, whereas the
 39 CEQA baseline is assumed to occur during existing climate conditions. Therefore, differences in

1 model outputs between the CEQA baseline and the action alternatives are due primarily to both the
 2 impacts of proposed alternative as well as future climate change conditions (sea level rise and
 3 altered precipitation patterns).

4 **8.1 Environmental Setting/Affected Environment**

5 This section defines the environmental setting/affected environment for surface water quality,
 6 reviews the environmental and regulatory setting with respect to water quality, and provides an
 7 assessment of existing water quality conditions in the study area (the area in which impacts may
 8 occur), shown in Figure 1-4, which includes the Plan Area (the area covered by the BDCP), upstream
 9 of the Delta, and the State Water Project/Central Valley Project (SWP/CVP) Export Service Areas.
 10 Water quality conditions refer to the chemical and physical properties of the surface water in the
 11 study area.

12 Conveying, using, and disposing of water occurs in association with domestic, industrial, and
 13 agricultural uses. Natural and anthropogenic contaminants, or *constituents of concern*, can enter
 14 Delta waters from various point and nonpoint sources. Point sources are any discernible, confined
 15 and discrete conveyance, including any pipe, ditch, channel, tunnel, conduit, or well from which
 16 pollutants (constituents of concern) are or may be discharged (Clean Water Act [CWA], Section
 17 502[14]), and include treated water from industrial and municipal facilities, or points of agricultural
 18 discharge. The term *nonpoint source* is defined to mean any source of water pollution that does not
 19 meet the legal definition of *point source* in Section 502(14) of the CWA and includes urban and
 20 irrigation runoff. In the case of nonpoint sources, constituents of concern may enter receiving
 21 waters at multiple discrete and diffuse points throughout a watershed (i.e., not traceable to a single
 22 point). Daily tidal action has a major water quality influence from the high salinity of the Pacific
 23 Ocean and specific salinity constituents (e.g., sodium, potassium, chloride) transported inland to the
 24 Delta through the San Francisco Bay.

25 Temperature, pH, dissolved oxygen (DO), nutrients, and concentrations of other various
 26 constituents such as methylmercury and total organic carbon (TOC) can be affected by tidal marsh
 27 and floodplain habitats, especially when marsh waters are exchanged with other Delta waters both
 28 upstream and downstream of the tidal marsh/floodplain habitats. Because the primary concern of
 29 water temperature is effects on fish and aquatic organisms, temperature is addressed in Chapter 11,
 30 *Fish and Aquatic Resources*.

31 **8.1.1 Affected Environment**

32 For the purposes of characterizing the existing water quality conditions and evaluating the
 33 consequences of implementing the project alternatives on surface water quality, the affected
 34 environment is defined as anywhere an effect could occur, which includes but is not necessarily
 35 limited to the statutory Delta, Suisun Bay and Marsh, and areas to the north and south of the Delta,
 36 which are defined in various parts of this chapter as Upstream of the Delta and the SWP/CVP Export
 37 Service Areas, as shown in Figure 1-4. When compared to the watershed boundaries, it is noted that
 38 the affected environment falls primarily within the Sacramento and San Joaquin River watersheds.

39 This section identifies the watershed factors that affect water quality, the water quality standards
 40 applicable to the affected environment, and the known impairments (i.e., CWA Section 303[d], the
 41 primary constituents of concern in these areas, the regulatory framework, and the key water quality

1 monitoring stations). Finally, water quality data from selected monitoring stations were reviewed
2 for specific constituents in Section 8.1.3.

3 Because of the very distinct hydrologic and hydraulic characteristics (including the various
4 inflow/outflow conditions) and specific operational details, the water quality in the Delta is
5 described separately from the northern and southern parts of the study area. The Delta environment
6 is much more complex and dynamic than the rest of the study area and requires a more detailed
7 approach. Hence, the water quality conditions in the Delta were reviewed at a greater level of detail.

8 To characterize the existing water quality conditions in the Delta, it is important to evaluate the
9 water quality of the primary inflows to and outflows from the Delta. Consequently, the water quality
10 data compiled and described in this section include monitoring data from the three major rivers in
11 the north (Sacramento, Feather, and American Rivers), the tributaries from the east (Cosumnes,
12 Mokelumne, and Calaveras Rivers), the San Joaquin River from the south (including its major
13 tributaries), San Francisco Bay water from the west, and agricultural runoff in the Delta. It also is
14 important to characterize water quality at points where water is pumped out of the Delta (e.g.,
15 Harvey O. Banks Pumping Plant [Banks pumping plant], C. W. "Bill" Jones Pumping Plant (Jones
16 pumping plant), Contra Costa Water District [CCWD] Pumping Plant #1 (CCWD pumping plant #1),
17 North Bay Aqueduct Pumping Plant), and in areas south of the Delta where exported water is
18 conveyed and stored. Examples of the latter include the Delta-Mendota Canal, the California
19 Aqueduct, and San Luis Reservoir. Similarly, net outflow from the Delta occurs into Suisun Bay at
20 Mallard Island, which is on the western boundary of the Delta and is the approximate boundary
21 between limnetic (salinity of 0–0.5 parts per thousand [ppt]) and oligohaline (salinity of 0.5–5 ppt)
22 areas during median flow conditions (Jassby 2008:4).

23 **8.1.1.1 Organization of the Section**

24 Sections 8.1.1.2 through 8.1.3.18 describe the Existing Conditions in the study area with respect to
25 surface water quality and are organized in the following sequence.

- 26 • **Overview of the Sacramento and San Joaquin River Watersheds**—Brief overview of the
27 watersheds and the Delta environment; location, physical description, and characteristics of the
28 watersheds; climate; and hydrology.
- 29 • **Water Management and the State Water Project and Central Valley Project Systems**—Brief
30 overview of the SWP and CVP, their key features, and the complex hydrodynamics of the study
31 area.
- 32 • **Primary Factors Affecting Water Quality**—Brief discussion and listing of point and nonpoint
33 pollutant sources, including historical and recent drainage from inactive and abandoned mines,
34 industrial and municipal wastewater treatment plant (WWTP) discharges, agricultural and
35 urban storm water runoff, recreational uses, and wildlife.
- 36 • **Beneficial Uses**—Brief overview of the designated beneficial uses in the study area, as defined
37 in the Regional Water Quality Control Boards' (Regional Water Boards') water quality control
38 plans (WQCPs or Basin Plans).
- 39 • **Water Quality Objectives and Criteria**—Brief discussion of regulatory water quality standards
40 as described in the California Toxics Rule (CTR), water quality control plans, and California
41 drinking water standards.

- 1 • **Water Quality Impairments**—Description of Section 303(d) list of impaired water bodies in
2 the study area, existing Total Maximum Daily Loads (TMDLs), and descriptions of major ongoing
3 water quality monitoring programs.
- 4 • **Water Quality Constituents of Concern**—Rationale for selecting specific water quality
5 constituents of concern that are important to maintaining the water quality in the study area,
6 and discussion of sensitive receptors affected by water quality.
- 7 • **Selection of Monitoring Stations for Characterization of Water Quality**—Brief description
8 of the data sources, selection of monitoring stations to be analyzed, and data availability at the
9 selected locations.
- 10 • **Regulatory Setting**—Brief description of federal, state, and regional/local regulatory agencies
11 and the applicable guidance related to surface water quality.

12 Section 8.1.2, *Selection of Monitoring Locations for Characterization of Water Quality*, includes
13 detailed discussions of the selected water quality constituents of concern in the study area. For each
14 constituent, the discussion is organized by: (1) background information available in the literature;
15 (2) importance of the constituent in the study area, including its potential effects on other resources;
16 (3) Existing Conditions, including concentrations at various monitoring locations; and (4) spatial
17 and temporal trends.

18 **8.1.1.2 Overview of the Sacramento River and San Joaquin River** 19 **Watersheds**

20 **Geographic Location and Physical Description**

21 The Delta watershed includes the watersheds of the Sacramento and San Joaquin Rivers, the two
22 largest rivers in the state. Together, the watersheds make up roughly one third of the state's land
23 area. These rivers originate in the Coast Range, Cascade Range, and Sierra Nevada and flow through
24 the Central Valley before entering the Delta. Following is a brief overview of watershed
25 characteristics of the study area; for additional detailed discussion, refer to Chapter 5, *Water Supply*,
26 and Chapter 6, *Surface Water*.

27 The Delta is a complex system of stream channels, sloughs, marshes, canals, and islands in northern-
28 central California at the confluence of the Sacramento and San Joaquin Rivers. The Delta covers
29 738,000 acres, which includes 59 islands, 1,100 linear miles of levees, hundreds of thousands of
30 acres of farmland, and various habitat types (California Department of Water Resources 1995:91).
31 The Delta lands and waterways support communities, agriculture, and recreation while providing
32 essential habitat for a multitude of fish and wildlife species.

33 Delta inflow consists of runoff from the Sacramento River watershed, the San Joaquin River
34 watershed, and the eastside tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Long-term
35 average annual Delta inflow is approximately 22 million acre-feet (MAF), with a range of less than
36 8 MAF to more than 74 MAF (CALFED Bay-Delta Program 2000). Dry and critical year Delta inflow
37 averages about 12 MAF annually under Existing Conditions (CALFED Bay-Delta Program 2000). As a
38 contributor to the state's agricultural irrigation system and a major source of drinking water for two
39 thirds of California's population, the Delta is a critical component of the state's water supply
40 infrastructure.

1 Area Climate, Hydrology, and Watershed Characteristics

2 Sacramento River Watershed

3 The Sacramento River watershed drains the northern part of California's Central Valley. The
 4 Sacramento River, California's longest river, is approximately 447 miles long and drains
 5 approximately 27,000 square miles of land. Predominant land uses in the Sacramento River
 6 watershed are agriculture, natural (undeveloped), and urban areas. The major Sacramento River
 7 watershed drainages are the upper Sacramento, Feather, Yuba, and American Rivers (Figure 8-1).

8 The climate in the Sacramento River watershed is Mediterranean in character, typified by cool, wet
 9 winters and warm, dry summers. Daily high air temperatures in the Sacramento Valley range from
 10 around 45 degrees Fahrenheit (°F) in the winter to over 100°F in the summer. Average air
 11 temperatures in the mountainous regions of the watershed are typically 5–10° less than the
 12 temperature on the valley floor. Annual precipitation in the Sacramento River watershed ranges
 13 from 80 to 90 inches of primarily snowfall in the mountainous regions, to 41 inches of rain in
 14 Redding and 19 inches in Sacramento. Average annual precipitation for the entire watershed is
 15 approximately 36 inches. Most precipitation falls between November and April, with little or no
 16 precipitation falling between May and October (CALFED Bay-Delta Program 2000).

17 The majority of the runoff in the Sacramento River watershed is in the upper Sacramento River
 18 watershed and in the rivers flowing out of the western slope of the Sierra Nevada. Numerous
 19 reservoirs are located in the Sacramento River watershed. The major reservoirs in the Sacramento
 20 River watershed are Shasta Lake, Lake Oroville, and Folsom Lake. Trinity Lake lies in the coastal
 21 watershed, and water is diverted from it to the Sacramento River watershed. Total reservoir
 22 capacity in the Sacramento River watershed, including Trinity Lake, is approximately 16 MAF
 23 (California Department of Water Resources 2005).

24 An important characteristic of the Sacramento River watershed is that precipitation patterns are
 25 highly variable from year to year and within years. Figure 8-2 illustrates the precipitation pattern in
 26 the Sacramento Valley for water years from 1977 to 2008. Surface water supply is measured by
 27 water year. A *water year* is defined as the 12-month period of October 1 through September 30 of
 28 the following year. The water year is designated by the calendar year in which it ends (e.g., the year
 29 ending September 30, 2010, is called the *2010 water year*). The Sacramento River Index is a
 30 yardstick of northern California water supply or water availability from the Sacramento River
 31 watershed. The index is used to project the current water-year type and is based partially on the
 32 previous year's index and on the sum of the unimpaired runoff (in MAF) of four rivers: Sacramento
 33 River above Bend Bridge near Red Bluff, Feather River inflow to Lake Oroville, Yuba–River at
 34 Smartville, and American River inflow to Folsom Lake. Unimpaired runoff is an estimate of the
 35 runoff that would occur in a watershed if unaltered by upstream diversions, storage, or
 36 export/import of water to/from other watersheds. Based on the unimpaired runoff, the water year–
 37 type classifications are defined as follows.

- 38 • Wet: equal to or greater than 9.2 MAF.
- 39 • Above normal: greater than 7.8 and less than 9.2 MAF.
- 40 • Below normal: greater than 6.5 and less than or equal to 7.8 MAF.
- 41 • Dry: greater than 5.4 and less than or equal to 6.5 MAF.
- 42 • Critical: equal to or less than 5.4 MAF.

1 Relative water availability from the watershed is greatest in wet years and lowest in critical years. In
 2 the water years from 1977 to 2008, 10 years were wet (31%), six years were above normal (19%),
 3 two years were below normal (6%), seven years were dry (22%), and seven years were critical
 4 (22%), as shown in Figure 8-2.

5 **San Joaquin River Watershed**

6 The San Joaquin River watershed drains the southern part of the Central Valley. The San Joaquin
 7 River, California's second longest river, is approximately 330 miles long and drains approximately
 8 15,200 square miles of land. Similar to the Sacramento River watershed, predominant land uses in
 9 the San Joaquin River watershed consist of agriculture, natural (undeveloped), and urban areas. The
 10 main San Joaquin River watershed drainages are the upper San Joaquin, Merced, Tuolumne, and
 11 Stanislaus Rivers (Figure 8-1).

12 The climate in the San Joaquin River watershed is similar to the Sacramento River watershed but is
 13 generally warmer and drier. Air temperatures in the city of Fresno range from 37°F in the winter to
 14 over 100°F in the summer. Annual precipitation in the San Joaquin Valley ranges from 8 to 12 inches
 15 of rain.

16 The warmer and drier conditions in the San Joaquin River watershed result in considerably less
 17 runoff compared to the Sacramento River watershed. The annual unimpaired runoff of the San
 18 Joaquin River watershed is approximately 5.5 MAF, with 60% of runoff occurring on the Merced,
 19 Tuolumne, and Stanislaus Rivers. Of the 5.5 MAF total unimpaired runoff, losses account for
 20 approximately 2.5 MAF via diversions for agricultural or municipal water supply, or losses to
 21 evaporative and groundwater infiltration, and 3 MAF flows into the Delta, past Vernalis (CALFED
 22 Bay-Delta Program 2000). Major reservoirs and impoundments in the San Joaquin River watershed
 23 are New Melones Lake, Hetch Hetchy, New Don Pedro Lake, Lake McClure, and Millerton Lake. Total
 24 reservoir capacity in the San Joaquin River watershed is approximately 11 MAF (California
 25 Department of Water Resources 2005). Figure 8-3 illustrates the highly variable precipitation
 26 pattern in the San Joaquin Valley for water years from 1977 to 2008. The water year-type
 27 classification used in Figure 8-3 is determined based partially on the previous year's index and on
 28 the sum of unimpaired flow (in MAF) at Stanislaus River below Goodwin Reservoir (inflow to New
 29 Melones Lake), Tuolumne River below LaGrange (inflow to New Don Pedro Lake), Merced River
 30 below Merced Falls (inflow to Lake McClure), and San Joaquin River inflow to Millerton Lake. The
 31 water year-type classifications are defined as follows.

- 32 ● Wet: equal to or greater than 3.8 MAF.
- 33 ● Above normal: greater than 3.1 and less than 3.8 MAF.
- 34 ● Below normal: greater than 2.5 and equal to or less than 3.1 MAF.
- 35 ● Dry: greater than 2.1 and equal to or less than 2.5 MAF.
- 36 ● Critical: equal to or less than 2.1 MAF.

37 In the water years from 1977 to 2008, 12 years were wet (37%), four years were above normal
 38 (13%), one year was below normal (3%), five years were dry (16%), and 10 years were critical
 39 (31%), as shown in Figure 8-3.

1 East Side Tributaries Watersheds

2 The east side tributaries to the Delta include the Cosumnes, Mokelumne, and Calaveras Rivers. All
 3 three rivers drain the west slope of the Sierra Nevada. The Cosumnes River is approximately 50
 4 miles long, drains approximately 725 square miles, and is the only river draining the west slope of
 5 the Sierra Nevada without a major dam. The Cosumnes River empties into the Mokelumne River just
 6 within the Delta. The Mokelumne River is approximately 95 miles long, drains approximately 2,140
 7 square miles, and feeds both Pardee Reservoir and Camanche Reservoir. The Calaveras River is
 8 approximately 50 miles long, drains approximately 470 square miles, and feeds New Hogan Lake.
 9 The Calaveras River empties into the San Joaquin River north of Stockton. The climate and
 10 watershed characteristics of these drainages vary, but are generally similar to those described for
 11 the Sacramento and San Joaquin River watersheds above.

12 8.1.1.3 Water Management and the State Water Project and 13 Central Valley Project Systems

14 The management of the SWP and CVP systems to meet water supply, flood management, and
 15 environmental obligations has a substantial effect on the quantity and timing of inflows to the Delta
 16 and on water quality in the study area. This section provides a brief overview of the SWP and CVP
 17 facilities and their operations. Following is a brief overview of surface water management in the
 18 study area; for additional detailed discussion, refer to Chapter 5, *Water Supply*, and Chapter 6,
 19 *Surface Water*, which provide an overview of key facilities in the SWP and CVP systems.

20 State Water Project

21 The SWP's 33 water storage facilities, 600 miles of aqueducts, and multiple pumping plants and
 22 hydroelectric plants supply water to over 25 million Californians and to approximately
 23 700,000 acres of farmland. Depending on the water-year type (i.e., available water supply) and
 24 demands, the SWP annually delivers up to about 3.7 MAF to meet contract demands. However, in
 25 drier water-year types when supply is limited, deliveries are considerably lower with an estimated
 26 50% delivery reliability in any given water year of less than 2.7 MAF (California Department of
 27 Water Resources 2010). The primary objectives of the SWP are water supply; flood control; power
 28 generation; recreation, fish, and wildlife protection; and water quality improvements in the
 29 Sacramento–San Joaquin Delta.

30 Distribution of SWP water begins with releases from Oroville Dam into the Feather River, which
 31 flows into the Sacramento River at River Mile 80 and, ultimately, to the Delta. SWP pumps water into
 32 the North Bay Aqueduct from Barker Slough in the north Delta for use in Napa and Solano Counties.
 33 In the south Delta, water also is pumped into the South Bay Aqueduct to serve areas of Alameda
 34 County and Santa Clara County, and via the Banks pumping plant into the 444-mile-long California
 35 Aqueduct (California Department of Water Resources 2009a). The California Aqueduct conveys
 36 water south primarily to meet potable water demands of SWP contractors serving Central Valley
 37 and southern California counties, and to meet agricultural demands in the San Joaquin Valley and
 38 Tulare basin. The California Aqueduct delivers water to O'Neill Forebay and the San Luis Reservoir,
 39 a storage reservoir jointly owned by the SWP and CVP. Water is delivered to Santa Clara County and
 40 San Benito County from San Luis Reservoir via the Santa Clara and Hollister conduits. The Coastal
 41 Branch Aqueduct diverts water from the California Aqueduct to areas west in San Luis Obispo and
 42 Santa Barbara Counties. In southern California, water is delivered to the major storage reservoirs of
 43 Lake Perris, Silverwood Lake, Castaic Lake, and Lake Pyramid.

1 California Department of Water Resources (DWR), in its management of the SWP to supply the 29
2 contracting public agencies with water supply and provide flood control, additionally provide
3 recreation opportunities, generate hydroelectric power, and protect fish and wildlife. These benefits
4 of the SWP operations are achieved by increasing or decreasing upstream water releases, changing
5 Delta pumping rates, or storing river flows south of the Delta at the San Luis Reservoir (Water
6 Education Foundation 2004). During February through June, DWR reduces the ratio of water
7 exports to inflows to reduce potential impacts on migrating salmon and spawning delta smelt,
8 Sacramento splittail, and striped bass (Jassby et al. 1995). SWP facilities are operated to meet
9 numerous water quality objectives, such as the X2 location objective. X2 refers to the horizontal
10 distance from the Golden Gate up the axis of the Delta estuary to where tidally averaged near-
11 bottom salinity concentration of 2 parts of salt in 1,000 parts of water occurs; the X2 standard was
12 established to improve shallow water estuarine habitat in the months of February through June and
13 relates to the extent of salinity movement into the Delta (Jassby et al. 1995). The location of X2 is
14 important to both aquatic life and water supply beneficial uses. Chapter 5, *Water Supply*, describes
15 the multiple water supply, flood control, and water quality targets that are used for SWP facilities
16 management and operations.

17 **Central Valley Project**

18 The CVP annually delivers approximately 7 MAF of water for agricultural, urban, and wildlife use
19 and is the largest water storage and delivery system in California (Bureau of Reclamation 2009a;
20 CALFED Bay-Delta Program 2000). The CVP system consists of 20 dams and reservoirs, 11
21 hydropower plants, 500 miles of major canals, and additional related facilities (Bureau of
22 Reclamation 2009a).

23 Transfer of water through the CVP system and the Delta begins with the release of water from
24 reservoirs located on the Trinity, Sacramento, American, and Stanislaus Rivers (Bureau of
25 Reclamation 2009a) Water released from Trinity and Shasta Dams flows into Keswick Reservoir and
26 then is released into the Sacramento River from Keswick Dam at River Mile 303. A portion of the
27 river's flow is diverted into the Tehama-Colusa and Corning Canals to irrigate the western side of the
28 Sacramento Valley (Water Education Foundation 2002). The remainder of the Trinity and Shasta
29 releases continue flowing south in the Sacramento River, combining with CVP releases from Folsom
30 and Nimbus Dams at the confluence of the Sacramento and American Rivers and, ultimately, flowing
31 to the Delta in the vicinity of Freeport. The Stanislaus River releases of water from New Melones
32 Lake serve as a water source for CVP users in the Stanislaus River watershed and in the northern
33 San Joaquin Valley (Bureau of Reclamation 2009a).

34 In the Delta, the released water is used to meet D-1641 Delta outflow and water quality objectives
35 and to support export from the Delta at the Jones pumping plant into the Delta-Mendota Canal,
36 which conveys water south for agricultural uses in the San Joaquin Valley. Water transported in the
37 117-mile Delta-Mendota Canal can be used as an irrigation supply, a source of San Luis Reservoir
38 water, for managed wetland refuges, or as a replacement for upper San Joaquin River water used in
39 the Friant-Kern and Madera Canal systems (Bureau of Reclamation 2009a). The San Luis Reservoir
40 is an off stream storage reservoir that is used by both SWP and CVP to provide water to Central
41 Valley and Bay Area users (Bureau of Reclamation 2009b). The Friant-Kern and Madera Canal
42 systems originate at Friant Dam and transport upper San Joaquin River water approximately 152
43 miles south to Bakersfield and approximately 36 miles to the north, respectively (Water Education
44 Foundation 2002). Additionally, CVP's Contra Costa Canal conveys Delta water from Rock Slough.

1 CCWD's Los Vaqueros Pipeline diverts water from Old River to the west to meet potable demands of
2 Bay Area users served by CCWD (Bureau of Reclamation 2009a).

3 The Bureau of Reclamation (Reclamation) operates the CVP to meet the following objectives
4 (Bureau of Reclamation 2009a).

- 5 • Regulate rivers and improve flood management and navigation.
- 6 • Provide water for irrigation and domestic use.
- 7 • Generate power.
- 8 • Provide recreation opportunities.
- 9 • Protect fish and wildlife.
- 10 • Improve water quality.

11 Reclamation's operation of the CVP facilities changes seasonally based on varying management
12 objectives. During the winter and early spring months when flood management is a priority, CVP
13 reservoirs are operated to store winter runoff (Water Education Foundation 2002). Releases during
14 May through October are timed to meet a variety of water supply needs, manage water quality, and
15 create available storage capacity for flood flows (Water Education Foundation 2002).

16 **Hydrodynamics in the Delta**

17 Delta hydrodynamics are a product of a complex interaction of tributary inflows, tides, in-Delta
18 diversions, and SWP and CVP operations, including conveyance, pumping plants, and operations of
19 channel barriers and gates designed to direct tributary inflows to certain regions of the Delta. Each
20 region is affected differently by these variables, and the nature of the effect varies daily, seasonally,
21 and from year to year, depending on the magnitude of inflows, the tidal cycle, and the extent of
22 pumping at the SWP and CVP pumping plants.

23 For example, the SWP and CVP pumping plants can affect the direction of flow of water in the Delta
24 channels, particularly during periods of low water flow and high export quantities. Normally, net
25 flows in the Delta travel toward Suisun and San Francisco Bays. However, SWP and CVP pumping
26 can cause the net flows within the interior south Delta to reverse, which causes more saline water to
27 move farther inland (Bureau of Reclamation 2009a).

28 The Delta Cross Channel is a controlled diversion channel that transports Sacramento River water to
29 Snodgrass Slough and then to the Mokelumne River, where it flows into the central and south Delta.
30 Opening the Delta Cross Channel's gates generally can reduce salinity in some channels of the
31 central and southern Delta, particularly during the summer months, through the transport of
32 relatively low-salinity Sacramento River water into the Delta (Bureau of Reclamation 2009a).

33 Flow in the Delta channels can change direction as a result of tidal exchange, ebbing and flooding
34 with the two tides per day, which is a major factor of Delta hydrodynamics. The daily, seasonal, and
35 year-to-year differences in source water contributions to various locations throughout the Delta
36 affect the water quality in the Delta, particularly with regard to salinity. Figure 8-4 and Figure 8-5
37 show the variations in maximum intrusion of chloride into the Delta since 1921, which demonstrate
38 that variability and intrusion distance generally have been reduced following construction of the
39 major storage reservoirs and implementation of Delta water management facilities and operations.

1 **8.1.1.4 Primary Factors Affecting Water Quality**

2 Primary factors affecting water quality in the study area include patterns of land use in the upstream
 3 watersheds and the Delta; SWP and CVP operations; and in-Delta/upstream activities and sources of
 4 pollutants. Point and nonpoint pollutant sources include historical and recent drainage from
 5 inactive and abandoned mines and related debris/sediment, industrial and municipal WWTP
 6 discharges, agricultural drainage, urban storm water runoff, atmospheric deposition, recreational
 7 uses, and metabolic waste (e.g., pathogens) from wildlife.

8 Figure 8-6 shows land uses and major point sources (consisting primarily of municipal WWTPs) and
 9 nonpoint sources (e.g., urban storm water runoff) of pollutants. Natural erosion and in stream
 10 sediments, atmospheric deposition, and geothermal inputs (CALFED Bay-Delta Program 2000) also
 11 affect Delta water quality. The magnitude of the effect of each of these sources is correlated with the
 12 relative contribution from each source and can differ, for different constituents or with conditions
 13 (e.g., hydrologic and climatic), during different times of a given year. The principal contaminants and
 14 conditions affecting water quality in the Delta are as follows (CALFED Bay-Delta Program 2000).

- 15 • Historical drainage and sediment discharged from upstream mining operations in the late 1800s
 16 and early 1900s has contributed metals, such as cadmium, copper, and mercury.
- 17 • Storm water runoff can contribute metals, sediment, pathogens, organic carbon, nutrients,
 18 pesticides, dissolved solids (salts), petroleum products, oil and grease, and other chemical
 19 residues.
- 20 • Wastewater discharges from treatment plants can contribute salts, metals, trace organics,
 21 nutrients, pathogens, pesticides, organic carbon, personal care products, pharmaceuticals, and
 22 oil and grease.
- 23 • Agricultural irrigation return flows and nonpoint discharges can contribute salts (including
 24 bromide), organic carbon, nutrients, pesticides, pathogens, and sediment.
- 25 • Large dairies and feedlots can contribute nutrients, organic carbon, pathogenic organisms,
 26 hormones, and veterinary pharmaceuticals/antibiotics.
- 27 • Water-based recreational activities (such as boating) can contribute hydrocarbon compounds,
 28 nutrients, and pathogens.
- 29 • Atmospheric deposition can contribute metals, nutrients, pesticides, and other synthetic organic
 30 chemicals and may lower pH.
- 31 • Seawater intrusion can contribute salts, including bromide, which affect total dissolved solids
 32 (TDS) concentrations and can contribute to formation of unwanted chemical disinfection by-
 33 products (DBPs) in treated drinking water. Additionally, seawater can contribute sulfate, which
 34 can influence the methylation of mercury.
- 35 • Selenium can originate from the Sacramento River and San Joaquin River. Major sources of
 36 selenium include irrigation drainage from agricultural lands of the western San Joaquin Valley.
 37 Refinery wastewater discharges in North San Francisco Bay also serve as a source of selenium in
 38 the Delta.
- 39 • Organic loading from the San Joaquin River can contribute to low DO conditions in the Delta.

40 Both variations in watershed hydrology and SWP and CVP operations affect the variability of water
 41 quality in the study area; also both SWP/CVP and non-SWP/CVP water diversions reduce the

1 amount of water available for dilution and assimilation of contaminant inputs and hydrodynamic
 2 conditions associated with channel flows and tidal action in the Delta. Water quality can vary
 3 seasonally in response to winter-spring runoff and summer-fall lower-flow periods or seasonal
 4 agricultural practices and cropping; water quality also can vary from year to year as a result of
 5 precipitation and snowpack levels in the upper watersheds and the resulting releases from
 6 upstream reservoirs for water supply, flood management, and environmental obligations (e.g., fish
 7 flows, Delta water quality objective compliance), operations of the Delta Cross Channel, and
 8 seasonal and annual variations in SWP and CVP pumping rates.

9 **8.1.1.5 Beneficial Uses**

10 Beneficial uses are designated for specific water bodies, either as existing or potential, by each
 11 Regional Water Board in their respective WQCPs or Basin Plans. Water bodies in the study area are
 12 used for many purposes as evidenced by the number of beneficial uses shown in Table 8-1. For
 13 water bodies where beneficial uses have not been identified specifically in a Basin Plan, the *tributary*
 14 *rule* allows a Regional Water Board to apply the designated beneficial uses that exist in the nearest
 15 downstream tributary. Established in the 1978 WQCP for the San Francisco Bay/Sacramento-San
 16 Joaquin Delta estuary (Bay-Delta WQCP), designated beneficial uses of Delta water remain
 17 unchanged in the 1991, 1996, and 2006 WQCPs. Additionally, the individual Basin Plans for the San
 18 Francisco Bay Regional Water Quality Control Board (San Francisco Bay Water Board) and Central
 19 Valley Regional Water Quality Control Board (Central Valley Water Board) identify beneficial uses of
 20 the Delta areas within their jurisdictions.

21 **Table 8-1. Designated Beneficial Uses for Water Bodies in the Study Area**

Name ^a	Abbreviation ^a	Beneficial Uses ^a
Designated Beneficial Uses Common to Inland Waters in All Basin Plans and the Delta		
Municipal and Domestic Supply	MUN	Uses of water for community, military, or individual water supply systems including drinking water supply
Agricultural Supply	AGR	Uses of water for farming, horticulture, or ranching including irrigation (including leaching of salts), stock watering, or support of vegetation for range grazing
Industrial Service Supply	IND	Uses of water for industrial activities that do not depend primarily on water quality, including mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization
Industrial Process Supply	PRO	Uses of water for industrial activities that depend primarily on water quality
Groundwater Recharge	GWR	Uses of water for natural or artificial recharge of groundwater for purposes of future extraction, maintenance of water quality, or halting of saltwater intrusion into freshwater aquifers
Navigation	NAV	Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels
Water Contact Recreation	REC-1	Uses of water for recreational activities involving body contact with water where ingestion of water is reasonably possible, including swimming, wading, water-skiing, skin and scuba diving, surfing, white-water activities, fishing, and use of natural hot springs

Name ^a	Abbreviation ^a	Beneficial Uses ^a
Non-Contact Water Recreation	REC-2	Uses of water for recreational activities involving proximity to water but where there is generally no body contact with water or any likelihood of ingestion of water, including picnicking, sunbathing, hiking, beachcombing, camping, boating, tide pool and marine life study, hunting, sightseeing, and aesthetic enjoyment in conjunction with the above activities
Commercial and Sport Fishing	COMM	Uses of water for commercial or recreational collection of fish, shellfish, or other organisms, including uses involving organisms intended for human consumption or bait purposes
Warm Freshwater Habitat	WARM	Uses of water that support warm water ecosystems, including preservation or enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates
Cold Freshwater Habitat	COLD	Uses of water that support cold water ecosystems, including preservation or enhancement of aquatic habitats, vegetation, fish, and wildlife, including invertebrates
Wildlife Habitat	WILD	Uses of water that support terrestrial or wetland ecosystems, including preservation and enhancement of terrestrial habitats or wetlands, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), and wildlife water and food sources
Preservation of Biological Habitats of Special Significance	BIOL	Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance, where the preservation or enhancement of natural resources requires special protection
Rare, Threatened, or Endangered Species	RARE	Uses of water that support aquatic habitats necessary, at least in part, for the survival and successful maintenance of plant and animal species established under state or federal law as rare, threatened, or endangered
Migration of Aquatic Organisms	MIGR	Uses of water that support habitats necessary for migration and other temporary activities by aquatic organisms, such as anadromous fish
Spawning, Reproduction, and/or Early Development	SPWN	Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish
Shellfish Harvesting	SHELL	Uses of water that support habitats suitable for the collection of filter feeding shellfish (e.g., clams, oysters, mussels) for human consumption, commercial, or sport purposes
Additional Beneficial Uses of the Delta		
Estuarine Habitat	EST	Uses of water that support estuarine ecosystems, including preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, and wildlife (e.g., estuarine mammals, waterfowl, shorebirds)
Additional Beneficial Uses of Inland Waters (not common to all Basin Plans)		
Freshwater Replenishment ^b	FRSH	Uses of water for natural or artificial maintenance of surface water quantity or quality
Hydropower Generation ^c	POW	Uses of water for hydropower generation
Aquaculture ^c	AQUA	Uses of water for aquaculture or mariculture operations, including propagation, cultivation, maintenance, and harvesting of aquatic plants and animals for human consumption or bait purposes
Inland Saline Water Habitat ^d	SAL	Uses of water that support inland saline water ecosystems, including preservation or enhancement of aquatic saline habitats, vegetation, fish, and wildlife, including invertebrates

Name ^a	Abbreviation ^a	Beneficial Uses ^a
Limited Warm Freshwater Habitat ^e	LWRM	Waters that support warm water ecosystems that are severely limited in diversity and abundance as the result of concrete-lined watercourses and low, shallow dry weather flows, which result in extreme temperature, pH, and/or DO conditions; naturally reproducing finfish populations are not expected to occur in LWRM waters

Sources: Central Coast Regional Water Quality Control Board 2011; Central Valley Regional Water Quality Control Board 2009a; Los Angeles Regional Water Quality Control Board 1994; Santa Ana Regional Water Quality Control Board 2008; San Diego Regional Water Quality Control Board 2007; San Francisco Bay Regional Water Quality Control Board 2007; State Water Resources Control Board 2006.

^a The names, abbreviations, and beneficial use descriptions are not identical in each Basin Plan.

^b Potential beneficial use identified in Sacramento–San Joaquin, San Francisco Bay, Central Coast, Los Angeles, and San Diego Basin Plans.

^c Potential beneficial use identified in Sacramento–San Joaquin, Central Coast, Los Angeles, Santa Ana, and San Diego Basin Plans.

^d Potential beneficial use identified in Central Coast, Los Angeles, and San Diego Basin Plans.

^e Potential beneficial use identified in Santa Ana Basin Plan only.

1

2 There are several additional beneficial uses in the Central Valley Water Board Basin Plan that are
3 applicable to surface waters other than the Delta in the Sacramento River basin and south of the
4 Delta export service area. Additionally, south-of-Delta exports are conveyed to service areas of SWP
5 contractors that lie within the jurisdictions of the Central Coast, Los Angeles, Santa Ana, and San
6 Diego Regional Water Boards, which address several other beneficial uses that are unique to those
7 geographic regions.

8 **8.1.1.6 Water Quality Objectives and Criteria**

9 It is important to define the terms *standards*, *numerical and narrative Basin Plan water quality*
10 *objectives*, *CTR criteria*, and U.S. Environmental Protection Agency (USEPA) *recommended criteria* as
11 they relate to the assessment of water quality. As defined by USEPA, water quality standards consist
12 of: 1) the designated beneficial uses of a water segment; 2) the water quality criteria (referred to as
13 *objectives* by the state) necessary to support those uses; and 3) an antidegradation policy that
14 protects existing uses and high water quality. Each Regional Water Board's Basin Plan identifies
15 numeric and narrative water quality objectives, together with the beneficial uses assigned to water
16 bodies and the state antidegradation policy. By definition, Basin Plan objectives have gone through
17 the standard-setting process, which includes public participation, consideration of economics,
18 environmental review, and state and federal agency review and approval. Consequently, Basin Plan
19 objectives are legally applicable and enforceable. In addition, the *Water Quality Control Plan for the*
20 *San Francisco Bay/Sacramento–San Joaquin Delta Estuary* (Bay-Delta WQCP) (State Water Resources
21 Control Board 2006) identifies beneficial uses of water in the Delta to be protected, water quality
22 objectives for the reasonable protection of beneficial uses, and an implementation program to
23 achieve the water quality objectives. The CTR criteria were established through the USEPA-led
24 water quality standard-setting process. Hence, the CTR criteria, together with the beneficial uses
25 assigned to water bodies and the state antidegradation policy, constitute additional water quality
26 standards for the regions (beyond those specified in the Basin Plans). Finally, USEPA periodically
27 recommends ambient water quality criteria to states for their consideration in adopting state
28 standards. As stated by USEPA, the USEPA recommended criteria (also referred to as 304[a][1]
29 criteria) “...are not regulations, and do not impose legally binding requirements on EPA, States,
30 tribes or the public.” Therefore, USEPA-recommended criteria and other nonenforceable guidance

1 values are referred to as *advisory* when discussed in this chapter in order to distinguish them from
2 adopted objectives and criteria.

3 Applicable ambient surface water quality criteria and objectives for the study area are contained in
4 the following sources.

- 5 • CTR (criteria applicable to all surface waters in California).
- 6 • 2006 Bay-Delta WQCP (or the 1995 Bay-Delta WQCP)(objectives applicable to the Delta only,
7 regulated through water rights conditions by the State Water Resources Control Board [State
8 Water Board]).
- 9 • Central Valley Water Board and San Francisco Bay Water Board Basin Plans (objectives
10 applicable to the Delta and other surface waters in the study area, regulated through point and
11 nonpoint source controls).
- 12 • Basin Plans for the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards
13 (applicable to surface waters in the south-of-Delta areas served by SWP exports).

14 State objectives can be narrative or numeric. A narrative objective establishes a *desired level of*
15 *protection* or describes a *favorable condition to be achieved* rather than defining a specific numerical
16 concentration. An example of a narrative objective is “Waters shall not contain chemical constituents
17 in concentrations that adversely affect beneficial uses.” A numeric objective defines a concentration
18 that must not be exceeded for a parameter (e.g., 10 milligrams per liter [mg/L]). Along with the
19 concentration value, numerical water quality objectives also typically specify an averaging period to
20 which the concentration value applies to protect the beneficial use of interest. Averaging periods
21 typically depend on the sensitivity of the use, such as a 1-hour averaging period for objectives
22 designed to prevent acute toxicity in aquatic life, to longer averaging periods (e.g., 30-day, annual
23 average) for less-sensitive effects (e.g., human health effects, industrial uses, agricultural crop
24 production). The value of some numerical water quality objectives (primarily for aquatic life)
25 depends on the prevailing ambient freshwater and saltwater salinity conditions. With regard to
26 these objectives, the salinity conditions across the large majority of the Delta are sufficiently low
27 that the Delta channels are subject to the freshwater regulatory water quality criteria/objectives.
28 However, tidal influence and associated saltwater intrusion can result in salinity concentrations in
29 areas of the west Delta that require regulation with saltwater criteria/objectives. Salinity standards
30 themselves are discussed in the section below on the Bay-Delta WQCP. Appendix 8A, *Water Quality*
31 *Criteria and Objectives*, summarizes the specific water quality criteria/objectives that apply to the
32 Delta.

33 **California Toxics Rule**

34 CTR criteria are established only for aquatic life and human health protection. CTR criteria for
35 aquatic life protection for some constituents (most metals, cyanide, various organic compounds) are
36 specified for freshwater and saltwater conditions. The CTR states that the salinity characteristics
37 (freshwater versus saltwater) of the receiving water must be considered in determining the
38 applicable criteria. Freshwater criteria apply to waters with salinity equal to or less than 1 ppt at
39 least 95% of the time. Saltwater criteria apply to waters with salinity equal to or greater than 10 ppt
40 at least 95% of the time. For waters with salinity between these two categories, or tidally influenced
41 freshwaters that support estuarine beneficial uses, the applicable criteria are the lower of the
42 freshwater or saltwater values for each substance. CTR criteria for the protection of human health
43 are specified that apply to any receiving water where human consumption of water and/or

1 organisms occurs. Refer to Section 8.2, *Regulatory Setting*, for additional detail about the CTR and
 2 other applicable water quality regulations. Appendix 8A, *Water Quality Criteria and Objectives*,
 3 provides the applicable CTR criteria specified for aquatic life protection and human health
 4 protection.

5 **Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin** 6 **Delta Estuary**

7 The Bay-Delta WQCP (State Water Resources Control Board 2006) identifies the beneficial uses of
 8 the Bay–Delta to be protected, the water quality objectives for reasonable protection of beneficial
 9 uses, and a program of implementation for achieving the water quality objectives. Unless otherwise
 10 indicated, water quality objectives cited for a general area, such as for the south Delta, are applicable
 11 for all locations in that general area, and specific compliance locations are used to determine
 12 compliance with the cited objectives within the area. Numeric objectives for chloride are included
 13 for the protection of municipal and industrial water supply beneficial uses. Objectives for EC) are
 14 included for multiple western, interior, and south Delta compliance locations for the protection of
 15 agricultural supply beneficial uses. Salinity objectives also are specified for fish and wildlife
 16 protection in the form of EC objectives for eastern and western locations in Suisun Marsh, a
 17 narrative salinity objective for brackish tidal marshes of Suisun Bay, and the X2 standard that
 18 regulates the location and number of days of allowable encroachment into the west Delta of salinity
 19 exceeding 2 ppt. In general, the chloride and EC objectives (and Delta inflow/outflow operational
 20 objectives) vary depending on the month of the year and the water-year type. EC and DO objectives
 21 are included for the protection of fish and wildlife beneficial uses. Additionally, Delta inflow and
 22 outflow operational objectives (Delta outflow, river flows, export limits, and Delta Cross Channel
 23 gate operations) are specified for the protection of fish and wildlife beneficial uses. Compliance with
 24 salinity objectives in particular is largely dependent on Delta inflows and outflows. The current
 25 water quality objectives under this plan are included in Appendix 8A, *Water Quality Criteria and*
 26 *Objectives*.

27 The State Water Board is now in the midst of a four-phased process of developing and implementing
 28 updates to the Bay-Delta WQCP and flow objectives for priority tributaries to the Delta to protect
 29 beneficial uses in the Bay-Delta watershed. Phase 1 of this work involves updating San Joaquin River
 30 flow and southern Delta water quality requirements included in the Bay-Delta WQCP. Phase 2
 31 involves other comprehensive changes to the Bay-Delta WQCP to protect beneficial uses not
 32 addressed in Phase 1. Phase 3 involves changes to water rights and other measures to implement
 33 the changes to the Bay-Delta WQCP from Phases 1 and 2. Phase 4 involves developing and
 34 implementing flow objectives for priority Delta tributaries outside of the Bay-Delta WQCP updates
 35 (State Water Resources Control Board 2013).

36 **Water Quality Control Plan for the Sacramento and San Joaquin River Basins**

37 The Basin Plan for the Sacramento and San Joaquin Rivers defines the beneficial uses, water quality
 38 objectives, implementation programs, and surveillance and monitoring programs for waters of the
 39 Sacramento and San Joaquin River basins. The Basin Plan contains specific numeric water quality
 40 objectives that are applicable to certain water bodies, or portions of water bodies. Numerical
 41 objectives have been established for bacteria, DO, pH, pesticides, EC, TDS, temperature, turbidity,
 42 and trace metals. The Basin Plan also contains narrative water quality objectives for certain
 43 parameters that must be attained through pollutant control measures and watershed management.
 44 Narrative water quality objectives also serve as the basis for the development of detailed numerical

1 objectives. The narrative water quality objectives and numeric freshwater criteria/objectives
 2 adopted for the Delta are included in Appendix 8A, *Water Quality Criteria and Objectives* (Regions 2
 3 and 5).

4 **Water Quality Control Plan for San Francisco Bay**

5 The Basin Plan for the San Francisco Bay basin (San Francisco Bay Water Board 2007) is similar to
 6 the Basin Plan for the Central Valley and defines numerical and narrative water quality objectives
 7 for San Francisco Bay (including San Pablo Bay) and portions of the west Delta. The designated
 8 beneficial uses for the Delta are consistent with the Central Valley Basin Plan. This Basin Plan
 9 contains both freshwater and saltwater criteria for several priority pollutant trace metals.
 10 Freshwater objectives apply to waters lying outside the zone of tidal influence and having salinities
 11 lower than 5 ppt at least 75% of the time. Saltwater objectives apply to waters with salinities greater
 12 than 5 ppt at least 75% of the time. For waters with salinities between the two categories, or tidally
 13 influenced freshwaters that support estuarine beneficial uses, the objectives are the lower of the
 14 freshwater or saltwater objectives, based on ambient hardness, for each substance. Appendix 8A,
 15 *Water Quality Criteria and Objectives*, provides the numeric freshwater and saltwater objectives
 16 adopted for the Delta.

17 **Water Quality Control Plans Applicable to the State Water Project South-of-Delta** 18 **Service Area**

19 The Basin Plans for the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards
 20 similarly define beneficial uses and numeric and narrative water quality objectives for inland and
 21 coastal waters and other water bodies in the service areas of SWP contractors that use water from
 22 the California Aqueduct and are located generally south of the Central Valley and in the central and
 23 southern California coastal counties. In general, the narrative and numeric water quality objectives
 24 for inland waters established in these Basin Plans are similar to the Central Valley and San Francisco
 25 Bay Regions. However, because salinity is a primary water quality constituent of concern in the
 26 inland and coastal counties of arid southern California, the Basin Plans for these regions all contain
 27 specific numeric water quality objectives for salinity constituents (e.g., TDS, hardness, sodium,
 28 chloride, sulfate) for the protection of municipal/domestic and agricultural water supply beneficial
 29 uses. The established salinity-based objectives for specific water bodies in these Basin Plans can
 30 vary based on specific base-level conditions.

31 **Water Quality Control Plans Applicable to Suisun Marsh**

32 Suisun Marsh is located at the northern edge of Suisun Bay, just west of the confluence of the
 33 Sacramento and San Joaquin Rivers and is not within the statutory Delta. Suisun Marsh consists of
 34 tidal wetlands, sloughs, managed diked wetlands, managed seasonal wetlands, and upland
 35 grasslands. The marsh contains approximately 59,000 acres of marsh, managed wetlands, and
 36 adjacent grasslands, plus 30,000 acres of open-water areas. Most of the managed wetlands are
 37 within levee systems with a majority owned by private duck hunting clubs. About 14,000 acres are
 38 state-owned and managed by the California Department of Fish and Wildlife (CDFW), and about
 39 1,400 acres on channel islands are federal lands. Elevation and salinity are the principal factors
 40 controlling the distribution of tidal marsh plants in the marsh. Within the diked wetlands, water
 41 diversion and release operations are managed to maximize the production of aquatic vascular plants
 42 that traditionally have been considered important for wintering waterfowl.

1 The regulatory framework for managing water quality conditions in Suisun Marsh began in the
2 1970s with the development of the Suisun Marsh Protection Plan by the Bay Conservation and
3 Development Commission and the adoption of salinity objectives for marsh channels in the 1978
4 Bay-Delta WQCP to protect the beneficial uses for fish and wildlife. The State Water Board water
5 rights decision D-1485, applicable to DWR and Reclamation for the management of SWP and CVP
6 operations, was adopted with provisions to meet the Suisun Marsh salinity objectives. DWR's 1984
7 Plan of Protection for Suisun Marsh was developed to meet the D-1485 requirements and outlined a
8 staged implementation for a combination of proposed physical salinity management initial facilities,
9 monitoring, a wetlands management program for marsh landowners, and supplemental releases of
10 water from SWP and CVP reservoirs. In 1987, federal and state agencies adopted the Suisun Marsh
11 Preservation Agreement (SMPA) to mitigate impacts on marsh salinity from the SWP, CVP, and other
12 upstream diversions. The SMPA identified the schedule for construction of large-scale facilities in
13 Suisun Marsh that would enable the salinity objectives to be met. The 1991 Bay-Delta WQCP
14 increased to seven the number of locations in the marsh where numerical salinity objectives were to
15 be met. The 1994 Principles of Agreement on Bay-Delta Standards (Bay-Delta Accord that formed
16 CALFED), the 1995 Bay-Delta WQCP, and the adoption of State Water Board water rights decision D-
17 1641 in 1999 all resulted in refinements to the Suisun Marsh salinity standards, added narrative
18 salinity objectives for the tidal marshes of the surrounding Suisun Bay, and mandated the formation
19 of a Suisun Marsh Ecological Work Group that would provide recommendations for water quality
20 objectives to improve conditions for beneficial uses (wildlife habitat; rare, threatened and
21 endangered species; and estuarine habitat) and recommend future research and monitoring needs
22 for the marsh. Because evidence showed a potential for actions to meet the salinity objectives at two
23 compliance stations within the marsh might cause harm to the beneficial uses they were intended to
24 protect, the State Water Board in D-1641 did not require that DWR and Reclamation attain the
25 objectives at these stations. The salinity objectives for the marsh remained unchanged in the 2006
26 Bay-Delta WQCP, but it notes that salinity objectives will be finalized, including adoption of
27 numerical objectives for brackish marshes in Suisun Bay and other locations (if necessary), by 2015
28 and following development and implementation of a comprehensive Suisun Marsh Plan. Federal and
29 state agencies recently completed environmental compliance documentation for the Suisun Marsh
30 Plan (Bureau of Reclamation et al. 2011), which assesses a comprehensive 30-year plan designed to
31 address use of resources within about 52,000 acres of wetland and upland habitats in the marsh,
32 restoration of tidal wetlands, and the enhancement of managed wetlands and their functions.

33 The Suisun Marsh Salinity Control Gates (SMSCG) were constructed on Montezuma Slough near
34 Collinsville and began operating in late 1988. The gates are operated periodically from September to
35 May to meet the salinity standards of the 1995 Bay-Delta WQCP and D-1641 requirements. The
36 SMSCG operation acts to restrict the inflow of high-salinity flood-tide water from Grizzly Bay into
37 the marsh but allow passage of freshwater ebb-tide flow from the mouth of the Delta. Operation of
38 the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of
39 water from east to west. When Delta outflow is low to moderate and the gates are not operating, net
40 movement of water is from west to east, resulting in higher-salinity water in Montezuma Slough.
41 Because the SMSCG operations have been more effective than anticipated, and as a result of
42 additional freshwater Delta outflows required by the 1995 Bay-Delta WQCP, other previously
43 proposed large physical facilities to promote further salinity controls in the marsh have not been
44 implemented. The SMSCG are operated only as needed and generally do not operate from June
45 through August.

1 **Other Water Quality Plans**

2 The State Water Board has begun development of a statewide mercury regulatory program to
3 address reservoirs on the state's Section 303(d) list for mercury. The plans are at the scoping level
4 as of first quarter 2012.

5 In 2005, the State Water Board directed the San Francisco and Central Valley Water Board to
6 address the public health impacts of mercury in fish. In response, the Central Valley Basin Plan
7 requires all entities subject to controlling methylmercury in the Delta and Yolo Bypass to participate
8 in a program to reduce human exposure to mercury through eating fish. The Mercury Exposure
9 Reduction Program (MERP) was developed to meet this objective. The primary goals of the Delta
10 MERP are to increase understanding of contaminants in fish and reduce exposure to mercury among
11 people who eat fish from the Delta.

12 The Delta Regional Monitoring Program (RMP) is currently under development by the Central Valley
13 Water Board as of August 2013. The RMP was initiated by the Central Valley Water Board to
14 establish a system for coordinating among the many agencies and groups that monitor water
15 quality, flows, and ecological conditions in the Delta, whereby all data are synthesized and assessed
16 on a regular basis, with the primary goal of tracking and documenting the effectiveness of beneficial
17 use protection and restoration efforts through comprehensive monitoring of contaminants and
18 contaminant effects in the Delta.

19 **California Drinking Water Standards Incorporated by Reference in Basin Plans**

20 Both the Central Valley and San Francisco Bay Basin Plans incorporate by reference the California
21 Department of Public Health (DPH) numerical drinking water maximum contaminant levels (MCLs).
22 The incorporation of the MCLs, which apply to treated drinking water systems regulated by DPH,
23 makes the MCLs also applicable to ambient receiving water with respect to the regulatory programs
24 administered by the Regional Water Boards. DPH establishes state drinking water standards,
25 enforces both federal and state standards, administers water quality testing programs, and issues
26 permits for public water system operations. The drinking water regulations are found in Title 22 of
27 the California Code of Regulations (CCRs). The state drinking water standards consist of primary and
28 secondary MCLs. Primary MCLs are established for the protection of environmental health, and
29 secondary MCLs are established for constituents that affect the aesthetic quality of drinking water,
30 such as taste and odor. The incorporation by reference of the MCLs in Basin Plans is meant to
31 ensure, to the extent possible, that adequate source water quality is maintained to support the
32 domestic and municipal water supply beneficial use, particularly from constituents that WWTPs are
33 not typically designed to remove. The state primary and secondary MCLs applicable to the Central
34 Valley and San Francisco Bay Basin Plans are provided in Appendix 8A, *Water Quality Criteria and*
35 *Objectives*.

1 **8.1.1.7 Water Quality Impairments**

2 **Water Quality–Limited Water Bodies, Watershed Monitoring Programs, and Total** 3 **Maximum Daily Loads**

4 Constituents of concern in the study area have been identified through ongoing regulatory,
5 monitoring, and environmental planning processes. Important programs are CALFED, the Basin Plan
6 functions of the Central Valley and San Francisco Bay Water Boards, Bay-Delta planning functions of
7 the State Water Board, and the CWA Section 303(d) listing process for state water bodies that do not
8 meet applicable water quality objectives.

9 The CALFED Bay-Delta Program was established in 1995 to develop a long-term comprehensive
10 plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta
11 System. Senate Bill 1653 established the California Bay-Delta Authority to act as the governance
12 structure, as of January 1, 2003, and is housed within the California Resources Agency.

13 Under CWA Section 303(d), states, territories, and authorized tribes are required to develop a
14 ranked list of water quality–limited segments of rivers and other water bodies under their
15 jurisdiction. Listed waters are those that do not meet water quality standards even after point
16 sources of pollution have installed the minimum required levels of pollution control technology. The
17 law requires that action plans, or TMDLs, be developed to monitor and improve water quality. TMDL
18 is defined as the sum of the individual waste load allocations from point sources, load allocations
19 from nonpoint sources and background loading, plus an appropriate margin of safety. A TMDL
20 defines the maximum amount of a pollutant that a water body can receive and still meet water
21 quality standards. TMDLs can lead to more stringent National Pollutant Discharge Elimination
22 System (NPDES) permits (CWA Section 402).

23 The State Water Board and USEPA have approved TMDLs for organic enrichment/low DO and
24 methylmercury in the Delta, and for salt and boron in the San Joaquin River at Vernalis. TMDLs for
25 other constituents remain under planning or development. Additionally, the San Francisco Bay
26 Water Board is currently developing a TMDL for Suisun Marsh to address impairment by
27 methylmercury, DO, and nutrient enrichment (San Francisco Bay Regional Water Quality Control
28 Board 2012). Although Suisun Marsh is not within the officially designated Delta, the mercury and
29 salinity impairments are primarily associated with loading from the Delta. Low DO is associated
30 with seasonal organic loading from wetland and water management systems within the marsh. The
31 salinity impairment was identified in the 1970s as an issue of changing marsh vegetation and
32 potential adverse effects on marsh vegetation that was important to ducks as feed. The SMSCG were
33 installed in Montezuma Slough in 1988 to provide the means to control salinity intrusions from
34 Suisun Bay during the periods of low Delta outflow.

35 The State Water Board compiled the 2010 Section 303(d) list of impaired waters based on
36 recommendations from the Regional Water Boards and information solicited from the public (and
37 other interested parties). In October 2011, USEPA gave final approval to the list. Table 8-2 lists the
38 constituents identified in the Section 303(d) list for impaired Delta waters (State Water Resources
39 Control Board 2011).

1 **Table 8-2. Clean Water Act Section 303(d) Listed Pollutants and Sources in the Delta**

Pollutant/Stressor	Listing Region	Listed Source	Delta Location of Listing
Boron	Central Valley	Agriculture	Exp
Chlordane	Central Valley and San Francisco Bay	Agriculture, nonpoint source	N, W
Chloride	Central Valley	Source unknown	TomP
Chlorpyrifos	Central Valley	Agriculture, urban runoff/ storm sewers	N, S, E, W, NW, C, Exp, Stk, CalvR, Duck, Five, French, MokR, Morm, Mosh, OldR, Pix
Copper	Central Valley	Resource extraction	MokR
DDT	Central Valley and San Francisco Bay	Agriculture, nonpoint source	N, S, E, W, NW, C, Exp, Stk
Diazinon	Central Valley	Agriculture, urban runoff/storm sewers	N, S, E, W, NW, C, Exp, Stk, CalvR, Five, French, Mosh, Pix
Dieldrin	San Francisco Bay	Nonpoint source	N, W
Dioxin compounds	Central Valley and San Francisco Bay	Source unknown, atmospheric deposition	W, Stk
Disulfoton	Central Valley	Agriculture	Pix
E. coli	Central Valley	Source unknown	E, French, Pix
Invasive species	Central Valley and San Francisco Bay	Source unknown, ballast water	N, S, E, W, NW, C, Exp, Stk
Furan compounds	Central Valley and San Francisco Bay	Contaminated sediments, atmospheric deposition	Stk
Group A pesticides ^a	Central Valley	Agriculture	N, S, E, W, NW, C, Exp, Stk
Mercury	Central Valley and San Francisco Bay	Resource extraction, industrial-domestic wastewater, atmospheric deposition, nonpoint source	N, S, E, W, NW, C, Exp, Stk, CalvR, MokR, Mosh
Pathogens	Central Valley	Recreational and Tourism Activities (nonboating), Urban Runoff/Storm Sewers	Stk, CalvR, Five, Morm, Mosh, Walk
PCBs	Central Valley and San Francisco Bay	Source unknown	W, N, Stk
Unknown toxicity ^b	Central Valley	Source unknown	N, S, E, W, NW, C, Exp, Stk, French, MokR, Morm, Pix
EC	Central Valley	Agriculture	S, W, NW, Exp, Stk, OldR, TomP
Organic enrichment/ low DO	Central Valley	Municipal point sources, urban runoff/storm sewers	Stk, CalvR, Five, MidR, MokR, Morm, Mosh, OldR, Pix, TomP
Sediment toxicity	Central Valley	(Not specified)	French
Selenium	San Francisco Bay	Refineries, invasive species, natural sources	W
TDS	Central Valley		S, OldR
Zinc	Central Valley	Resource extraction	MokR

Source: State Water Resources Control Board 2011.

Notes: DDT = dichlorodiphenyltrichloroethane, PCB = polychlorinated biphenyls, EC = electrical conductivity, DO = dissolved oxygen, TDS = total dissolved solids.

Delta Locations: C = Central, E = East, Exp = export area, N = north, NW = northwest, S = south, Stk = Stockton Deep Water Ship Channel, W = west (includes Central Valley list and San Francisco Bay list for Bay-Delta category).

Specific Delta Waterways: CalvR = Calaveras River, Duck = Duck Slough, Five = Five Mile Slough, French = French Camp Slough, MidR = Middle River, MokR = Mokelumne River, Morm = Mormon Slough, Mosh = Mosher Slough, OldR = Old River, Pix = Pixley Slough, TomP = Tom Paine Slough, Walk = Walker Slough.

^a Group A pesticides include aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, benzene hexachloride (BHC; including lindane), endosulfan, and toxaphene.

^b Toxicity is known to occur, but the constituent(s) causing toxicity is unknown.

1 There are several ongoing watershed-monitoring programs in the study area. These monitoring
 2 programs are associated with Section 303(d) TMDL programs, the State Water Board Surface Water
 3 Ambient Monitoring Program, and numerous other efforts of local governments and public/private
 4 entities.

5 Section 303(d) requires that states evaluate and rank water quality impairments that cannot be
 6 resolved through point source controls and, in accordance with the priority ranking, the TMDL for
 7 those pollutants the USEPA identifies under Section 304(a)(2) as suitable for such calculation. The
 8 TMDL must be established at a level necessary to implement the applicable water quality standards
 9 with seasonal variations and a margin of safety that takes into account any lack of knowledge
 10 concerning the relationship between effluent limitations and water quality. The TMDL is the amount
 11 of loading that the water body can receive and still meet water quality standards. The TMDL must
 12 include an allocation of allowable loadings to point and nonpoint sources, with consideration of
 13 background loadings. Table 8-3 summarizes the TMDLs that have been completed or are being
 14 developed for Section 303(d) listed constituents in the Delta, and the portion of the study area in the
 15 Sacramento and San Joaquin River basins (Central Valley Regional Water Quality Control Board
 16 2009b).

17 **Table 8-3. Summary of Completed and Ongoing Total Maximum Daily Loads in the Bay-Delta and**
 18 **Sacramento and San Joaquin River Portions of the Study Area**

Pollutant/Stressor	Water Bodies Addressed	TMDL Status
Chlorpyrifos and diazinon	Sacramento County Urban Creeks	TMDL report completed—September 2004 State-Federal approval—November 2004
Chlorpyrifos and diazinon	Lower San Joaquin River	TMDL report completed—October 2005 State-Federal approval—December 2006
Chlorpyrifos and diazinon	Sacramento and San Joaquin Rivers and Delta	TMDL report completed—June 2006 State-Federal approval—October 2007
Chlorpyrifos and diazinon	Sacramento and Feather Rivers	TMDL report completed—May 2007 State-Federal approval—August 2008
Chlorpyrifos and diazinon	Lower San Joaquin River	TMDL report completed—October 2005 State-Federal approval—December 2006
DO	Stockton Deep Water Ship Channel	TMDL report completed—February 2005 State-Federal approval—January 2007
Mercury/methylmercury	Delta	TMDL report completed—April 2010
Mercury/methylmercury	Reservoirs	Ongoing
Pathogens	Tributaries affected by city of Stockton urban runoff	Ongoing
Pesticides	Basin-wide	Ongoing
Organochlorine pesticides	Specific Sacramento and San Joaquin River tributaries; Delta	Ongoing
Salt and Boron	San Joaquin River at Vernalis	TMDL report completed—October 2005 State-Federal approval—February 2007
Selenium	San Joaquin River at Vernalis	TMDL report completed—August 2001 State-Federal approval—March 2002

Source: Central Valley Regional Water Quality Control Board 2009b.

Notes: DO = dissolved oxygen; TMDL = Total Maximum Daily Load.

19

1 Table 8-4 summarizes only the total number of Section 303(d) listed water bodies in the regions of
 2 the Central Coast, Los Angeles, Santa Ana, and San Diego Regional Water Boards where SWP south-
 3 of-Delta exports are conveyed. This information is presented at a lesser level of detail than for the
 4 Delta and Sacramento–San Joaquin regions because the effects of storage and conveyance of Delta
 5 export water in the southern SWP service areas to the large majority of these listed water bodies are
 6 only indirect or nonexistent. Moreover, not all of the Section 303(d)–listed water bodies in these
 7 regions necessarily occur in the SWP service areas because the SWP service areas do not cover the
 8 entire regions.

9 **Table 8-4. Clean Water Act Section 303(d) Listed Water Bodies in Regions of the Study Area Served**
 10 **by SWP South-of-Delta Exports**

Pollutant	Regional Water Board				
	San Francisco	Central Coast	Los Angeles	Santa Ana	San Diego
Hydromodification			10		
Mercury	36	6	11	2	2
Other metals	27	44	142	24	159
Miscellaneous	17	147	52	11	36
Nuisance		3	27		14
Nutrients	15	321	183	29	179
Other inorganics	2		39		14
Other organics	64	11	102	10	18
Pathogens	32	451	171	44	324
Pesticides	95	142	187	16	32
Salinity	1	194	72	2	46
Sediment	10	168	23	10	20
Toxicity	7	105	49	8	109
Trash	27		87		7

Source: State Water Resources Control Board 2011.

12 8.1.1.8 Water Quality Constituents of Concern

13 Constituents that are of concern in the study area are those that, at elevated concentrations, have
 14 the potential to adversely affect or impair one or more beneficial uses (Table 8-1), such as the
 15 constituents identified from the Section 303(d) listing process described above (Tables 8-2 and 8-4).

16 Salinity is an important parameter of concern for the Delta that reflects the total ionic content of the
 17 water, ranging from very low levels deemed freshwater to the high salinity content of seawater.
 18 Chloride, bromide, and boron are specific ions that contribute to overall salinity and are constituents
 19 of concern. Salinity can affect multiple beneficial uses, including defining the types and distribution
 20 of aquatic organisms that are adapted to freshwater versus brackish, or saline, water conditions in
 21 the Delta.

22 Other constituents of concern for the Delta in particular are of importance to municipal water
 23 suppliers, including organic carbon (total and dissolved) and bromide, which are precursors for the
 24 formation of DBPs such as trihalomethanes (THMs), haloacetic acids (HAAs), bromate, chlorite, and
 25 nitrosamines at treated drinking water treatment processes. The DBPs mentioned are of concern

1 because they are known or suspected human carcinogens when consumed at elevated
2 concentrations over many years. Pathogens are of importance to municipal water suppliers as well
3 as recreational uses.

4 In addition, elevated nutrient concentrations can affect municipal water suppliers that store
5 diverted Delta water in reservoirs. Elevated nutrient levels contribute to algae growth and affect the
6 taste and odor of treated water, filter clogging at WWTPs, and increased levels of organic carbon.
7 Increased salinity concentrations also can alter the taste of finished drinking water.

8 Constituents of concern to agricultural users in the study area include boron and salinity. Many
9 crops are sensitive to these constituents, which can affect their yield.

10 Numerous constituents, including temperature, turbidity and suspended sediment, DO, pesticides,
11 herbicides, nutrients, and trace metals, can cause adverse effects on aquatic life in the study area.
12 Trace metals, pesticides, and herbicides can be toxic to aquatic life at relatively low concentrations.
13 Temperature and DO are of concern because the Delta serves as a migration and rearing corridor for
14 anadromous salmonids, which are sensitive to these parameters. Because the primary concern of
15 water temperature is effects on fish and aquatic organisms, temperature is addressed in Chapter 11,
16 *Fish and Aquatic Resources*. Excess nutrients can cause blooms of nuisance algae and aquatic
17 vegetation, and their decay can result in depleted DO.

18 Finally, an emerging class of constituents of concern is endocrine-disrupting compounds (EDCs),
19 pharmaceutical and personal care products (PPCPs), and nitrosamines. EDCs and PPCPs are thought
20 to have potential to cause adverse effects on aquatic resources, and their potential presence in
21 drinking water supplies has received significant attention (World Health Organization 2002; U.S.
22 Geological Survey 2002). Nitrosamines have long been suspected carcinogens, but their more recent
23 discovery as a DBP, along with lower detection limits for the analytical methods used to measure
24 them, has spurred more attention in recent years.

25 As noted in Table 8-2, the entire Delta is identified on the Section 303(d) list as impaired by
26 unknown toxicity. Aquatic toxicity refers to the mortality of aquatic organisms or sublethal (e.g.,
27 growth, reproductive success) effects. Aquatic toxicity can be caused by any number of individual
28 constituents of concern, or through additive and synergistic effects attributable to the presence of
29 multiple toxicants. No TMDLs have been developed for the Delta to address the sources of toxicity,
30 identify alternatives to reduce toxicity, or identify the allocation of the allowable loading of
31 constituents that would result in achieving the Basin Plan narrative toxicity objective that forms the
32 basis for the Section 303(d) listing. Because unknown toxicity is a primary concern for fish and
33 other aquatic organisms, Chapter 11, *Fish and Aquatic Resources*, addresses the subject in detail.

34 In light of these issues, the constituents of concern identified in Table 8-5 are addressed in detail for
35 the purposes of characterizing existing water quality in the study area (Section 8.1.3, *Existing*
36 *Surface Water Quality*) and to support the water quality impact assessments. Table 8-5 also relates
37 the constituents of concern to the various receptors in the study area that could be adversely
38 affected by their concentrations. For purposes of this characterization, the receptors are categorized
39 by the designated beneficial uses specified in the Bay-Delta WQCP. The constituent-specific sections
40 described subsequently (Section 8.1.3) characterize the potential effects on beneficial uses and
41 various receptors, including known information regarding specific locations in the Delta most
42 affected by the constituents.

8.1.2 Selection of Monitoring Locations for Characterization of Water Quality

8.1.2.1 Water Quality Monitoring Programs and Sources of Data

In compiling water quality data for the constituents of concern (Table 8-5), data sets from the following monitoring programs/entities were obtained through the Bay-Delta and Tributaries Project (BDAT) database for the period from 1990 through 2009 (Bay Delta and Tributaries Project 2009). This effort began in early 2010, when data more recent than 2009 were not available. Revision of the data summarized below to account for more recent monitoring data was not considered necessary because there was no reason to expect that water quality conditions as represented by these monitoring databases would be substantially changed relative to the data already collected. Also, any differences would not be of a magnitude that would alter the nature of the characterization or the assessment in any substantial way.

- California National Water Information System Water Quality Data (U.S. Geological Survey [USGS]).
- Environmental Monitoring Program (DWR) (continuous and discrete data).
- Municipal Water Quality Investigations Program data (DWR).
- Surface Water Ambient Monitoring Program (State Water Resources Control Board and Regional Water Boards).

BDAT contains environmental data concerning the Bay-Delta and provides public access to those data. More than 50 organizations voluntarily contribute biological, water quality, meteorological, and other data to this database. In the event the monitoring programs listed above, as accessed through BDAT, did not provide data for all the constituents of interest, additional data were obtained from one or more of the following monitoring programs/databases to provide a more comprehensive characterization of Delta water quality.

- California Data Exchange Center (DWR).
- Interagency Ecological Program (multiagency).
- National Water Information System (USGS).
- San Francisco Estuary Institute ([SFEI] multi-agency in Bay Area).
- Sacramento River Coordinated Monitoring Program (Sacramento Stormwater Quality Partnership and the Sacramento Regional County Sanitation District (SRCSD)).
- Sacramento River Watershed Program (nonprofit 501[c][3] organization).
- Water Data Library (DWR).

1 8.1.2.2 Surface Water Quality Monitoring Locations

2 Based on data availability, data continuity, and geographic location, a total of 20 water quality
3 monitoring stations were selected to characterize the water quality conditions in the study area
4 (Figure 8-7). Because of the complexity of the Delta environment, a detailed characterization of
5 water quality was necessary for the statutory Delta to represent the effects of water quality on the
6 broad beneficial use categories (e.g., agriculture, aquatic life, recreation) and more specific issues
7 such as major water diversion locations. For example, major water diversions include CCWD's three
8 intakes at Rock Slough, Old River, and Victoria Canal; the North Bay Aqueduct; Jones and Banks
9 pumping plants; seasonal Antioch and Mallard Slough diversions; and the City of Stockton's new
10 diversion from the central Delta. The following section provides a brief illustration of how the data
11 from these stations were used to represent various parts of the study area. Table 8-6 presents the
12 specific reasons for selecting these locations and describes the spatial area of the study area for
13 which specific stations provide adequate representation.

14 North of Delta

15 The hydrology north of the Delta is dominated by three major rivers—the Sacramento, Feather, and
16 American. To characterize the water quality for the area north of the Delta, it is important to review
17 the water quality entering these three rivers from their major reservoirs (Shasta Lake, Lake Oroville,
18 and Folsom Lake, respectively). For the purpose of this assessment, the water quality of the area
19 north of the Delta is represented by locations downstream of these three lakes, as well as a
20 monitoring location at the Sacramento River at Verona (immediately downstream of the confluence
21 of the Feather and Sacramento Rivers, representing the water quality of the combined flow after
22 mixing) Figure 8-7 shows the selected locations.

- 23 ● Sacramento River at Keswick.
- 24 ● Feather River at Oroville.
- 25 ● American River at the E. A. Fairbairn Water Treatment Plant (WTP).
- 26 ● Sacramento River at Verona.

27 Because organic carbon data were not monitored at the Verona location, data from a monitoring
28 location approximately 9 miles downstream of the Verona location (Sacramento River at Vietnam
29 Veterans Memorial Bridge [Interstate 5] [Veterans Bridge]) were reviewed and analyzed for organic
30 carbon. Water quality downstream of the confluence of American and Sacramento Rivers is
31 represented by the monitoring station at Hood, which is addressed in Section 8.1.2.3, *Delta Source*
32 *Waters*.

Table 8-5. Receptors Affected by Water Quality—Characterized by the Designated Beneficial Uses of the Study Area

Constituent	Freshwater Replenishment	Municipal and Domestic Supply and Groundwater Recharge	Agricultural Supply	Industrial Process Supply	Recreation		Shellfish Harvesting and Aquaculture	Commercial/Sport Fishing	Freshwater Habitat		Migration/Spawning	Estuarine Habitat	Wildlife Habitat	Endangered Species and Areas of Biological Significance
					Contact	Non-Contact			Warm	Cold				
Physical Parameters														
Temperature		X					X	X	X	X	X	X		X
Turbidity/suspended solids	X	X		X	X	X			X	X	X	X		X
Inorganic parameters														
Salinity (EC/TDS)	X	X	X	X			X	X	X	X	X	X	X	X
Bromide	X	X												
Chloride	X	X	X	X			X	X	X	X	X	X	X	X
Boron	X		X											
Organic carbon	X	X												
Ammonia (nitrogen)		X					X	X	X	X	X	X		X
Other nutrients (nitrogen, phosphorus)	X	X					X	X	X	X	X	X	X	X
DO							X	X	X	X	X	X		X
Trace Metals														
Mercury	X	X					X	X	X	X	X	X	X	X
Selenium	X		X						X	X	X	X	X	X
Others (e.g., copper, lead, zinc,)	X	X					X	X	X	X	X	X		X
Other														
Pathogens	X	X			X		X	X						
Pesticides and herbicides	X	X					X	X	X	X	X	X	X	X
Dioxins/furans and PCBs	X	X					X	X	X	X	X	X	X	X
Polycyclic aromatic hydrocarbons	X	X					X	X	X	X	X	X	X	X
Emerging pollutants (EDCs/PPCPs)	X	X					X	X	X	X	X	X	X	X
Applicable Basin Plan	N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D, N, S, Ext	D	D, N, S, Ext	D, N, S, Ext

Notes:

- D = Delta.
- EDC = endocrine-disrupting compound.
- Ext = export area.
- N = north.
- PCB = polychlorinated biphenyl.
- PPCP = pharmaceutical and personal care product.
- S = south.

Applicable Basin Plans

- Delta: Central Valley and San Francisco Bay Water Boards
- Export Area: Central Valley, San Francisco Bay, Central Coast, Santa Ana, and Los Angeles Water Boards
- North: Central Valley Water Board
- South: Central Valley Water Board

1 **Table 8-6. Locations Selected to Represent Existing Water Quality in the Delta**

Location	Data Sources	Justification for Selecting Location
North of Delta Locations		
Sacramento River at Keswick	DWR	Characterizes water quality in the area north of the Delta
Feather River at Oroville	DWR	Characterizes water quality in the area north of the Delta
American River at the E.A. Fairbairn Water Treatment Plant	DWR	Characterizes water quality in the area north of the Delta
Sacramento River at Verona	DWR	Characterizes water quality in the area north of the Delta
Delta Source Water Locations		
Sacramento River at Hood	BDAT, CDEC, MWQI	Characterizes water quality at the northern boundary of the Delta
San Joaquin River near Vernalis	BDAT, CDEC, MWQI	Characterizes water quality at the southern boundary of the Delta
Mokelumne River (South Fork) at Staten Island	BDAT, WDL	Characterizes EC from a major eastern Delta boundary river
Suisun Bay at Bulls Head Point near Martinez	BDAT	Characterizes water quality at the western export area of the Delta; represents saltwater intrusion into the Delta
Delta Interior		
San Joaquin River at Buckley Cove	BDAT	Represents effects of Stockton Deep Water Ship Channel in the eastern Delta near the city of Stockton
Franks Tract at Russo's Landing	BDAT	Characterizes water quality in a reclaimed area in the central portion of the Delta
Old River at Rancho del Rio	BDAT	Characterizes water quality in the central portion of the Delta
Major Outflows		
Sacramento River above Point Sacramento	BDAT, SFEI	Characterizes Sacramento River water quality prior to its confluence with the San Joaquin River; essentially the same location as the SFEI's BG20 station
San Joaquin River at Antioch Ship Channel	BDAT, SFEI	Characterizes San Joaquin River water quality prior to its confluence with the Sacramento River; essentially the same location as the SFEI's BG30 station
Sacramento River at Mallard Island	DWR, MWQI	Characterizes water quality at the western boundary of the Delta; essentially the same location as Sacramento River at Chipps Island
Major Diversions		
North Bay Aqueduct at Barker Slough Pumping Plant	CDEC, MWQI	Major municipal water supply intake in northwestern portion of the Delta
Contra Costa Pumping Plant No. 1	MWQI	Major municipal water supply intake in western portion of the Delta
Harvey O. Banks Pumping Plant	CDEC, MWQI	Major water supply intake; pumps SWP water into the California Aqueduct
C. W. "Bill" Jones Pumping Plant	BDAT, CDEC, MWQI	Major water supply intake; pumps CVP water into the Delta-Mendota Canal
South-of-Delta Locations		
California Aqueduct at Check 13	DWR	Characterizes water quality in the area south of the Delta
California Aqueduct at Check 29	DWR	Characterizes water quality in the area south of the Delta
Notes: BDAT = Bay Delta and Tributaries Project; CDEC = California Data Exchange Center; DWR = California Department of Water Resources; EC = electrical conductivity; MWQI = Municipal Water Quality Investigations; SFEI = San Francisco Estuary Institute; WDL = Water Data Library; WTP = water treatment plant.		

2

1 **8.1.2.3 Delta Source Waters**

2 Water quality in the Delta at any given location and time is primarily the result of the sources of
 3 water to that location (i.e., the percentage of the water at the site comprising water from the
 4 Sacramento River, the San Joaquin River, eastside tributaries, Bay water, in-Delta runoff, and
 5 agricultural return flows). Consequently, it is important to characterize the quality of the major
 6 sources of water entering the Delta to determine how Delta water quality may change, as the source
 7 fractions of water to various locations change with implementation of alternative activities. For the
 8 purpose of this section, the water quality of the major Delta source waters will be represented by
 9 the following locations.

- 10 • Sacramento River at Hood.
- 11 • San Joaquin River at Vernalis.
- 12 • Mokelumne River at Staten Island.
- 13 • Bay water intrusion to Suisun Bay at Martinez.

14 Figure 8-7 shows the selected locations. It should be noted that the selected Sacramento, San
 15 Joaquin, and Mokelumne Rivers monitoring stations are within the statutory Delta and can be
 16 affected by tidal action, depending on the stream flow rates. Additionally, the Mokelumne River is
 17 directly affected by the flow of Sacramento River water when the Delta Cross Channel is open.
 18 However, these locations generally represent the water quality occurring at these perimeter
 19 locations in the Delta.

20 **Interior Delta and Outflow Locations**

21 In addition to characterizing the quality of the major source water inputs to the Delta, a number of
 22 interior Delta locations were identified for characterizing existing interior Delta water quality. The
 23 locations chosen for this purpose were selected based on the following criteria.

- 24 • Availability of water quality data (locations used by the various water quality monitoring
 25 programs).
- 26 • Geographic location in the Delta, in an effort to have one or more stations in the northern,
 27 central, eastern, western, and southern portions of the Delta.
- 28 • Locations of the primary water supply intakes.
- 29 • Bay-Delta WQCP EC compliance locations.
- 30 • Other related considerations (e.g., locations of output nodes for Delta Simulation Model 2
 31 [DSM2], reasonable number of locations to support the water quality impact assessments).

32 Based on the selection criteria listed above, 10 interior and outflow Delta locations were chosen
 33 (Figure 8-7) to characterize existing water quality in the Delta and to support the water quality
 34 impact assessments.

35 **South of the Delta**

36 The system south of the Delta is influenced primarily by the numerous dams and reservoirs and
 37 hundreds of miles of canal that constitute the SWP and CVP (described previously). The SWP and
 38 CVP serve as a major source of municipal water supply for Central Coast, San Joaquin Valley, and

1 southern California water contractors and also as one of the major sources of agricultural water
 2 supply for the San Joaquin Valley. For the purpose of this assessment, the water quality of the area
 3 south of the Delta is represented by two locations along the California Aqueduct.

- 4 • California Aqueduct at Check 13.
- 5 • California Aqueduct at Check 29.

6 Figure 8-7 shows the selected locations for the area south of the Delta.

7 The San Luis Reservoir is a major storage reservoir 50 miles south of the Delta that is used for
 8 various control purposes within the system (e.g., storing water from the San Joaquin River and
 9 Sacramento River to re-release into the aqueducts). Hence, the water quality downstream of this
 10 reservoir is of great importance in characterizing the water quality in the service area. Water exiting
 11 the San Luis Reservoir passes through the O'Neill Forebay, which also is fed by water from the
 12 California Aqueduct and the Delta-Mendota Canal. The water quality monitoring location at the exit
 13 point of the O'Neill Forebay is called the California Aqueduct at Check 13.

14 South of O'Neill Forebay, there are inflows to the aqueduct, including storm water and flood flows at
 15 crossings of several streams and groundwater inflows, prior to water being pumped over the
 16 Tehachapi Mountains and into watersheds of water supply reservoirs in the Los Angeles region and
 17 areas to the south. DWR accepts the introduction of local groundwater into the aqueduct ("Pump-In"
 18 Projects) in accordance with California Water Code provisions that state that nonproject water may
 19 be conveyed, wheeled, or transferred in the SWP provided that water quality is protected.

20 **8.1.3 Existing Surface Water Quality**

21 In the following subsections, each constituent of concern (or category of similar constituents) is
 22 reviewed in detail to characterize the general patterns of concentrations that exist in the study area
 23 at present. The review process followed the steps outlined below.

- 24 • Literature review—A wide range of scientific articles, agency reports, and site-specific studies
 25 was reviewed to collect the following information:
 - 26 ○ The various structural and nonstructural features and operations in the study area that
 27 affect water quality.
 - 28 ○ The importance and relevance of each of the constituents of concern in the study area.
 - 29 ○ The interaction of various constituents and the combined effect on water quality.
 - 30 ○ The historical and current patterns in concentrations of the constituents at selected
 31 locations.
 - 32 ○ The variation in concentrations in wet and dry years.
 - 33 ○ Applicable standards and regulatory criteria, and known impairments.
- 34 • Some of the key documents reviewed include:
 - 35 ○ Basin Plan for the Sacramento and San Joaquin River basins.
 - 36 ○ Bay-Delta WQCP.
 - 37 ○ CALFED Bay-Delta Program 2000 Water Quality Program Plan.
 - 38 ○ CALFED 2008 State of Bay-Delta Science.

1 Water quality data for the identified constituents were collected from various monitoring programs
 2 and databases. Data were downloaded for selected locations (described in previous section) for each
 3 constituent for the period between 1990 and 2009 and stored in a database. In the discussions
 4 below, various periods of record are discussed for different constituents and different purposes. The
 5 time period of data used to characterize present conditions varied by constituent according to what
 6 was available in the database, but in general, data from 2001–2006 are presented as a
 7 representative time period that contained both wet and dry years and for which data were available
 8 for the entirety of all water years. It must be noted that the characterization provided below is
 9 meant to provide a general understanding of water quality conditions and historical monitoring data
 10 in the study area. The discussion below is not meant to explicitly define the Existing Conditions for
 11 CEQA purposes. The CEQA baseline, *Existing Conditions*, is defined in Appendix 3D, *Defining Existing*
 12 *Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*, and for
 13 the purposes of quantitative water quality assessments (as described in Section 8.3.3, *Effects and*
 14 *Mitigation Approaches*, and Section 8.3.4, *Effects and Mitigation Approaches—Alternatives 4A, 2D, and*
 15 *5A*) is represented by Existing Conditions modeling runs, not historical water quality monitoring
 16 data as presented below. For more information on the comparisons made to the Existing Conditions
 17 modeling run for assessment purposes, see Section 8.3.2.2, *Comparisons*. For these reasons, the time
 18 period 2001–2006 was generally considered sufficient for characterization purposes because
 19 inclusion of more recent data that have been made available since the start of the environmental
 20 review process would not alter the nature of the characterization or the assessment in any
 21 substantial way. For instances in which it would be expected that water quality conditions would
 22 have changed since this time period, for example, if major sources of a constituent of concern to the
 23 Delta were created or eliminated, more recent data was examined and characterized. Appendix 8B,
 24 *Summary of Data Availability Used in Environmental Setting*, summarizes the data availability for
 25 each of the constituents of concern and locations where substantial information exists for
 26 characterizing the Existing Conditions. Depending on the availability of data, the information was
 27 presented in various forms.

- 28 • Spatial distribution—data presented in a map for individual constituents identifying the location
 29 of the sampling station; the date range; and the maximum, minimum, average, and median
 30 values.
- 31 • Seasonal patterns—plots showing the change in concentrations over time.
- 32 • Tabular—tables showing concentrations of constituents where data are discrete or
 33 discontinuous.

34 **8.1.3.1 Ammonia**

35 **Background and Importance in Study Area**

36 Ammonia, a form of nitrogen, exists primarily in two forms: un-ionized ammonia (NH_3) and an
 37 ionized form—ammonium (NH_4^+). In general terms, ammonia and ammonia-N refer to total
 38 ammonia (i.e., un-ionized ammonia plus ammonium) in this chapter. The relative levels of un-
 39 ionized ammonia and ammonium in a water body depend primarily on pH, and to a lesser extent on
 40 temperature and salinity (U.S. Environmental Protection Agency 2009a). Un-ionized ammonia is a
 41 gas that is toxic to animals, while ammonium is a solid dissolved in water and an important nutrient
 42 for plants and algae. Both ammonium and ammonia are present in effluent from WWTPs that
 43 employ only secondary treatment methods, in some types of agricultural runoff (e.g., fertilizers,
 44 animal wastes), fish and other wildlife wastes, urban runoff, and atmospheric depositions (Ballard et

1 al. 2009:2). Concern about total ammonia effects in the Delta have led to focused efforts to define
2 and assess the issue (e.g., March 2009 CALFED Science Program Workshop, August 2009 Ammonia
3 Summit). The Sacramento Regional Wastewater Treatment Plant (SRWTP) discharge into the
4 Sacramento River at Freeport is a large point source of ammonia in the Delta. The SRWTP's output
5 has increased with human population growth, and it has contributed to an increase in ammonium
6 concentrations in the Delta downstream of the discharge (Ballard et al. 2009:3). The primary source
7 of total ammonia-N at Hood location is the SRWTP (Central Valley Regional Water Quality Control
8 Board 2010a). The discharge from the SRWTP accounts for 90% of the ammonium load in the
9 Sacramento River at Hood (Jassby 2008).

10 In the aquatic environment ammonia-N may rapidly cycle among the water, organisms, and
11 sediments. The presence of high concentrations of ammonia-N usually is associated with reducing
12 conditions and/or proximity to locally high concentrations of ammonia-N discharge such as WWTP
13 discharges. Ammonia-N is rapidly oxidized in the flowing river environment to nitrate-N (NO_3^-).
14 More than three quarters of the ammonia present in the Sacramento River downstream of Freeport
15 is converted to nitrate by the time the water reaches Chippis Island (Central Valley Regional Water
16 Quality Control Board 2010a Update memo:4).

17 Concerns regarding ammonia in the Delta include potential toxicity to fish and other organisms,
18 shifts in algal community structure (e.g., dominant species), and inhibition of nitrate uptake by
19 diatoms. Ammonia can be toxic to aquatic organisms at very low concentrations. The results of a
20 2008 pilot study to assess the potential acute toxicity of ammonia in treated wastewater effluent
21 from the SRWTP to larval delta smelt suggest that ammonia concentrations present in the
22 Sacramento River below the SRWTP were not acutely toxic to 55-day-old delta smelt. In general, un-
23 ionized ammonia concentrations in the Delta appear to be too low to cause acute mortality of even
24 the most sensitive species. It is unclear whether lower concentrations of ammonia may have chronic
25 effects on species survival, growth, or reproduction (Ballard et al. 2009:7).

26 There may be a potential for toxic ammonia concentrations in very productive areas in the southern
27 Delta, or smaller productive sloughs or shallow areas throughout the Delta, when high
28 concentrations of un-ionized ammonia coincide with warm temperatures and elevated pH
29 (phytoplankton productivity increases pH, which influences how much un-ionized ammonia is
30 present). In addition, the potential for combined effects of un-ionized ammonia with other toxicants
31 and stressors, and differences in fish sensitivity depending on health status, age, and physiological
32 state, add uncertainty to data analyses (Ballard et al. 2009:7).

33 Human-induced excesses in nitrogen concentrations, which includes ammonia, can cause
34 eutrophication, or increased biological production. Eutrophic conditions result in enhanced death
35 and decay of biomass and create an oxygen demand in sediments that lowers DO concentrations in
36 the water column (Wetzel 2001). Eutrophic conditions also can affect turbidity and, therefore, the
37 light regime, which can cause changes in the balance of benthic and planktonic productivity.
38 Increases in algal and macrophyte growth can add to the concentrations of dissolved organic carbon
39 (DOC) and TOC in water. Organic carbon in source waters is a constituent of drinking water concern
40 because of DBP formation during water treatment. See the organic carbon section for more on water
41 quality concerns associated with organic carbon and DBPs. Additionally, NH_3 can form nitrogenous
42 DBPs when combined with chlorine.

43 Nutrient concentrations currently in the Delta are high enough that they are probably not a true
44 limiting factor for overall algal growth, and therefore increases in ammonia generally will not lead to

1 an increase in algal growth (Jassby et al. 2002:1). However, it is unclear whether nutrient levels are
2 adversely affecting algal composition and thus primary productivity. For example, recent work has
3 suggested that elevated cyanobacteria (blue-green algal) concentrations in the Delta interior were
4 associated with nitrogen (including ammonia) and phosphorus concentrations (Lehman et al. 2010).
5 The composition of the phytoplankton community has generally shifted from diatoms toward green
6 algae, cyanobacteria, and miscellaneous flagellate species (Lehman 2000). The changes in
7 phytoplankton composition, and especially the now regularly occurring *Microcystis* blooms, have
8 been implicated as possible factors in the decline of important Delta pelagic fish species, but the
9 connection with ammonia is not clear (Ballard et al. 2009:5).

10 In addition, Glibert (2010) analyzed more than 30 years of Delta water quality data, concluding that
11 aquatic organism population shifts were associated with changes in the quality and quantity of
12 nutrients discharged from the SRWTP. Subsequently, others have criticized this work by
13 demonstrating that the statistical techniques used were not appropriate and, therefore, that the
14 conclusions were flawed (Cloern et al. 2012:1). Glibert and others agreed that the statistical
15 conclusions of the 2010 review paper should be disregarded (Lancelot et al. 2012). However, a
16 subsequent paper emphasized that changes in nutrient concentrations and nutrient ratios
17 (primarily nitrogen to phosphorus) over time fundamentally affect biogeochemical nutrient
18 dynamics that can lead to conditions conducive to invasions of rooted macrophytes, benthic grazing
19 bivalve mollusks, and blooms of potentially harmful cyanobacteria (Glibert et al. 2011).

20 Research also has indicated that ammonia, while stimulating diatom growth at very low
21 concentrations, also can inhibit uptake of nitrate in diatoms as concentrations increase above about
22 4 micromoles per liter ($\mu\text{mol/L}$) (0.056 mg/L-N) (Dugdale et al. 2007:23). This may be of concern in
23 Suisun Bay, where algal blooms may be prevented when conditions otherwise would be favorable
24 (Wilkerson et al. 2006:1). A recent study showed that, indeed, ammonia concentrations downstream
25 of the SRWTP appeared to inhibit phytoplankton nitrate uptake, and that chlorophyll a and primary
26 productivity were also concurrently reduced for many miles downstream (Parker et al. 2012). The
27 authors attribute the reduced chlorophyll a and primary productivity to the nitrate uptake
28 inhibition, though primary productivity decreases in the reach of the Sacramento River upstream of
29 the SRWTP. Therefore, there is some uncertainty as to the cause of the declines, as the Central Valley
30 Water Board discussed in its findings of the SRWTP NPDES permit issued in 2010: “the SRWTP
31 discharge cannot be cause of pigment decline upstream of the discharge point, and may not be
32 contributing to the decline downstream of the discharge point” (Central Valley Regional Water
33 Quality Control Board 2010b).

34 Elevated concentrations of ammonium-N and other nutrients also may benefit invasive aquatic
35 plants in the Delta, which are controlled in Delta channels through chemical herbicides and
36 mechanical removal (Ballard et al. 2009:6). However, it is not clear how often ammonia
37 concentrations rise above those concentrations (Engle and Suverkropp 2010).

38 Research assessing the effects of nitrogen and phosphorus on phytoplankton in the Delta is far from
39 complete due in part to the large number of physical, chemical, and biological interactions occurring
40 in the Delta, e.g., Glibert et al. (2011). In addition to nutrients, Delta phytoplankton can be affected
41 by light conditions, filtration feeders (e.g., *Corbula amurensis*, *Corbicula fluminea*), and microbial
42 processing of organic carbon, to name a few factors (Sacramento Regional County Sanitation District
43 2009). Manipulation of all these factors to determine their relative contribution to Delta
44 phytoplankton quantity/quality is a significant task that likely will require a broad array of
45 experiments (both laboratory and field) and modeling studies to tease apart causal relationships.

1 The beneficial uses (Table 8-1) that could be affected most by ammonia concentrations include
2 aquatic organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat) or
3 activities that depend on aquatic life (shellfish harvesting, commercial and sport fishing). Drinking
4 water supplies (municipal and domestic supply) and recreational activities (water contact
5 recreation, noncontact water recreation) are indirectly affected by nuisance eutrophication effects
6 of ammonia.

7 As mentioned above, the SRWTP discharge to the Sacramento River at Freeport is a large point
8 source of ammonia in the Delta. In 2010, the Central Valley Water Board issued an updated NPDES
9 permit for the SRWTP requiring nitrification (i.e., conversion of ammonia to nitrate) and partial
10 denitrification (i.e., removal of nitrate). In its findings, the permit states: "However, as described
11 above, the ammonia discharged by the Discharger is impacting beneficial uses of the Sacramento
12 River, Delta and the Suisun Bay. Therefore, Best Practical Treatment and Control (BPTC)
13 technologies in the form of nitrification and denitrification is required to assure that a pollution or
14 nuisance will not occur and the highest water quality consistent with maximum benefit to the people
15 of the State will be maintained" (Central Valley Regional Water Quality Control Board 2010b). The
16 term BPTC appears in the state antidegradation policy, however BPTC is not defined specifically.
17 BPTC is generally recognized to refer to best available and cost-effective methods that meet
18 performance requirements, such as federal CWA requirements in the case of wastewater treatment
19 plants, and maintain water quality standards. In the discussion leading up to this statement, many
20 concerns regarding ammonia in the discharge are discussed, including potential toxicity concerns,
21 inhibition of diatom primary production, algal community shifts, effects on DO, and nitrosamine
22 formation during disinfection. Subsequently, the permit was appealed to the State Water Board, and
23 the State Water Board upheld requirements related to ammonia removal (State Water Resources
24 Control Board 2012). Further lawsuits were also settled, and therefore the SRWTP will begin
25 ammonia removal in 2021.

26 **Existing Conditions in the Study Area**

27 Most examined locations in the Delta have had low concentrations of ammonia-N in recent years
28 (water years 2001–2006), with mean values typically ranging from 0.03 to 0.11 mg/L (Figure 8-8).
29 The two exceptions are the Sacramento River at Hood and the San Joaquin River at Buckley Cove.
30 The Hood station had a mean value of 0.27 mg/L, a median value of 0.23 mg/L, and a maximum
31 value of 0.84 mg/L. The source of the majority of the ammonia-N at Hood is the SRWTP. The Buckley
32 Cove station had instances of elevated ammonia prior to 2007, due to ammonia-N discharged from
33 the City of Stockton Regional Wastewater Control Facility (RWCF). However, the City of Stockton has
34 since installed a nitrifying biotower system that converts nearly all ammonia in the wastewater to
35 nitrate in the final effluent that is discharged to the San Joaquin River. Therefore, data summarized
36 for this monitoring location in Figure 8-8 is from water years 2008–2012, to reflect current
37 conditions.

38 Mean values for the north-of-Delta area ranged from 0.01 mg/L at the Feather River at Oroville to
39 0.07 mg/L at the Sacramento River at Keswick (Table 8-7). South-of-Delta mean values ranged from
40 0.02 to 0.03 mg/L.

Table 8-7. Ammonia Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Ammonia (mg/L as N)				
	Samples	Min	Max	Mean	Median
Sacramento River at Keswick	25	0.03	0.24	0.07	0.03
Sacramento River at Verona	9	0.01	0.10	0.04	0.03
Feather River at Oroville	8	0.01	0.03	0.01	0.01
American River at WTP	14	0.01	0.06	0.02	0.02
California Aqueduct at Check 13	26	0.01	0.12	0.03	0.02
California Aqueduct at Check 29	20	0.01	0.04	0.02	0.01

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Time series data indicate that ammonia-N concentrations at the examined stations generally fluctuate on an annual basis (Figures 8-9a, 8-9b, and 8-10). Higher values have tended to occur during the months of November through March.

Regulatory criteria with respect to ammonia are as follows. Regarding narrative objectives, as stated in the San Francisco Bay Water Board Basin Plan and Central Valley Water Board Basin Plan, ammonia might be considered a biostimulatory substance because it is the preferred form of nitrogen for plant nutrient uptake, and a toxic compound under certain circumstances (e.g., high un-ionized ammonia concentrations). There are no numerical water quality criteria for the CTR or the Central Valley Water Board Basin Plan, and there is no California drinking water MCL associated with ammonia. The San Francisco Bay Water Board Basin Plan water quality objective of 0.025 mg/L ammonia-N 4-day average for fresh water refers to un-ionized ammonia, which is a function of ionized ammonia, pH, temperature, and salinity. Available data are inadequate to assess whether the sites examined herein exceeded this standard. Because the Central Valley Water Board Basin Plan and CTR lack objectives/criteria for ammonia, the Regional Water Board regulates ammonia through its narrative toxicity objective. Water Board staff rely on the USEPA National Recommended Water Quality Criteria for ammonia (U.S. Environmental Protection Agency 1999a, 2009a) to numerically interpret the narrative standard with regard to ammonia. The USEPA has established criteria for ammonia-N with respect to the toxicity of un-ionized ammonia-N, which is dependent on water temperature and pH (U.S. Environmental Protection Agency 1999a, 2009a). The 2009 document represents draft criteria. A final relevant threshold includes a recommended goal for sensitive crops of 1.5 mg/L-N (Ayers and Westcot 1994).

8.1.3.2 Boron

Background and Importance in Study Area

Boron is a naturally occurring compound found in sediments and sedimentary rocks in the form of borates (e.g., boron oxide, boric acid, borax). Natural weathering of rocks is thought to be the primary source of boron compounds in water and soil (Agency for Toxic Substances and Disease Registry 2007). The richest deposits in the United States are located in California (sediments and brines). Natural sources include releases to air from oceans, volcanoes, and geothermal steam. Total

1 natural global releases of boron from weathering, volcanoes, and geothermal steam are
2 approximately 360,000 metric tons per year (U.S. Environmental Protection Agency 2008a), while
3 releases from seawater range from 800,000 to 4,000,000 metric tons per year (U.S. Environmental
4 Protection Agency 2008b).

5 Human uses of boron compounds include production of glass, ceramics, soaps, fire retardants,
6 pesticides, cosmetics, photographic materials, and high-energy fuels (U.S. Environmental Protection
7 Agency 2008a). Anthropogenic releases of boron compounds occur through such pathways as air
8 emissions (power plants, chemical plants, manufacturing facilities), soils (fertilizers, herbicide, and
9 industrial wastes), and water (industrial wastewaters, municipal sewage) (Agency for Toxic
10 Substances and Disease Registry 2007). Approximately 180,000 to 650,000 metric tons of boron are
11 released annually into the atmosphere from the industries that use boron and boron-containing
12 products (U.S. Environmental Protection Agency 2008b).

13 Even though it is found naturally in many fruits and vegetables, boron does not accumulate in
14 human tissues (Waggot 1969; Butterwick et al. 1989). While boron may serve as a trace mineral
15 nutrient for humans, it has potential detrimental health effects such as nausea, vomiting, swallowing
16 difficulties, diarrhea, and rashes due to acute overdoses (U.S. Environmental Protection Agency
17 2008b). Related effects have occurred in animals. Aquatic plants and animals accumulate boron, but
18 residues do not increase through the food chain (U.S. Environmental Protection Agency 2008a).

19 USEPA recently evaluated boron and its potential for contamination of drinking water supplies (73
20 Federal Register [FR] 44251–44261) and made a determination not to regulate boron with a
21 National Primary Drinking Water Regulation. Because boron is not likely to occur at concentrations
22 of concern when considering both surface and groundwater systems, USEPA believes that a National
23 Primary Drinking Water Regulation does not present a meaningful opportunity for health risk
24 reduction.

25 Agricultural supply uses, specifically crop irrigation, are the most sensitive receptor to boron
26 because of issues related to boron deficiency (Nable et al. 1997) and boron toxicity (Chauhan and
27 Powar 1978; Nable et al. 1997) in crops. Ayers and Westcot (1994) provide a discussion of boron
28 toxicity to plants. Very sensitive plants, which include lemons and blackberries, may show signs of
29 toxicity at concentrations less than 500 micrograms per liter ($\mu\text{g}/\text{L}$) but are not widely grown in the
30 Delta and areas upstream (refer to Chapter 14, *Agricultural Resources*, Table 14-2). Sensitive crops
31 begin to show signs of toxicity between 500 and 750 $\mu\text{g}/\text{L}$ and include a variety of fruit and nut trees
32 that are commonly grown in the Delta.

33 In a study of groundwater from the Sacramento Valley aquifer, boron was detected in all 31 samples,
34 in concentrations ranging from 12 $\mu\text{g}/\text{L}$ to 1,100 $\mu\text{g}/\text{L}$ (Dawson 2001). The median concentration
35 was 42 $\mu\text{g}/\text{L}$. Two of the 31 samples had concentrations in excess of the then-current Health
36 Advisory Level of 600 $\mu\text{g}/\text{L}$.

37 Assessment of how human atmospheric emission sources of boron in the Delta directly affect the
38 Delta would be difficult, given the complexity of area meteorology. Such sources would need to be
39 identified and undergo air transport modeling to determine deposition rates onto land and water in
40 the study area. Human activities related to boron land and water emissions may be more easily
41 quantified. Land applications of boron in the Delta may include fertilizer, herbicide, and industrial
42 waste; water sources may include industrial wastewaters, municipal sewage, and agricultural return
43 drains.

1 Approximately 85% of the boron load to the Delta originates from the western side of the lower San
 2 Joaquin River, represented by the Grasslands and Northwest Side Subareas. Agricultural drainage,
 3 discharge from managed wetlands, and groundwater accretions are the principal sources of boron
 4 loading to the river. Additionally, large-scale, out-of-basin water transfers have reduced the
 5 assimilative capacity of the river, thereby exacerbating the water quality issues associated with
 6 boron.

7 The source analysis contained in the Central Valley Water Board's TMDL describes the magnitude
 8 and location of the sources of boron loading to the lower San Joaquin River. The watershed is
 9 divided into seven component subareas to elucidate differences in boron loading between different
 10 geographic areas (Figure 8-11).

11 Contributions of boron to the Delta also originate from other sources, including the Sacramento
 12 River, the eastside tributaries, Delta agricultural return drains, and San Francisco Bay. The next
 13 section describes how these sources, in addition to the San Joaquin River, contribute to boron
 14 concentrations in the Delta.

15 Existing Conditions in the Study Area

16 Most examined locations in the Delta have had low concentrations of boron in recent years (water
 17 years 2001–2006), with mean values ranging from 0.1 to 0.5 mg/L (Figure 8-12). The Sacramento
 18 River at Mallard Island location had a mean value of 0.5 mg/L. Maximum boron values were in the
 19 0.1 to 1.5 mg/L range, with higher values at the San Joaquin River near Vernalis (0.8 mg/L) and the
 20 Sacramento River at Mallard Island (1.5 mg/L).

21 Minimal data were available for the north-of-Delta area, while the mean value for the south-of-Delta
 22 stations was 0.2 mg/L (Table 8-8).

23 **Table 8-8. Boron Concentrations at Selected North- and South-of-Delta Stations, Water Years**
 24 **2001–2006^a**

Location	Boron (dissolved, mg/L)				
	Samples ^a	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	1	–	–	0.1	–
Sacramento River at Verona	NA	–	–	–	–
Feather River at Oroville	NA	–	–	–	–
American River at WTP	NA	–	–	–	–
California Aqueduct at Check 13	64	0.1	0.4	0.2	0.2
California Aqueduct at Check 29	74	0.1	0.3	0.2	0.2

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; NA = not available; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

25
 26 Time series data indicate that boron concentrations at the examined stations generally fluctuate on
 27 an annual basis (Figure 8-13 and Figure 8-14). Higher values have tended to occur during the
 28 months of November through March.

29 Regulatory criteria with respect to boron are as follows. Because boron is not a priority pollutant,
 30 there are no criteria established for boron in the National Toxics Rule (NTR) or CTR. The Bay-Delta

1 WQCP also does not contain objectives for boron, and there are no California drinking water MCLs.
 2 The lower San Joaquin River is listed on the Section 303(d) list as impaired for boron. The
 3 impairment extends from downstream of the Mendota Pool to the Airport Way Bridge near Vernalis.
 4 As an outcome of the Section 303(d) listing for the lower San Joaquin River and associated TMDL
 5 development process, the Central Valley Basin Plan contains a monthly average boron objective for
 6 the lower San Joaquin River to Vernalis of 800 µg/L for the irrigation season (March 15 through
 7 September 15), and 1,000 µg/L for the non-irrigation season (Central Valley Regional Water Quality
 8 Control Board 2009a). Additionally, the San Francisco Bay Basin Plan contains agricultural
 9 objectives, with a lower value of 500 µg/L for irrigation and a value of 5,000 µg/L for stock watering.

10 **8.1.3.3 Bromide**

11 **Background and Importance in the Study Area**

12 Bromide is an inorganic anion that is generally present at low concentrations in freshwater bodies.
 13 Bromide has the potential to most directly affect municipal and domestic supply, agricultural supply,
 14 and industrial service supply beneficial uses (Table 8-1). Typical drinking water source
 15 concentrations of bromide in the United States average 0.062 mg/L (Amy et al. 1998); typical
 16 seawater concentrations of bromide are 65–67 mg/L (Morris and Riley 1966: 699; Hem 1985).

17 In addition to its contribution to salinity, bromide is of concern in water as a precursor to the
 18 formation of bromate, bromoform and other brominated THMs, and HAAs, which are potentially
 19 harmful DBPs in municipal water supplies (CALFED Bay-Delta Program 2003). These compounds
 20 have been shown to cause carcinogenic, negative developmental, and negative reproductive effects
 21 in laboratory animals (U.S. Environmental Protection Agency 2010). DBP formation is increased
 22 when the source water contains both dissolved organic compounds and halides (CALFED Bay-Delta
 23 Program 2007a). Bromate forms when water that contains bromide is disinfected with ozone, a
 24 technique employed by many drinking water treatment plants as an alternative to chlorination to
 25 reduce DBP formation (in compliance with THM Rule, DBP Stage 1 and Stage 2 Rules).

26 The primary source of bromide in the Delta is seawater intrusion from the west (CALFED Bay-Delta
 27 Program 2000). As discussed in the salinity subsection with respect to salinity, bromide in the Delta
 28 is the result of a complex interplay between hydrology (dilution), water operations, bromide
 29 sources, and hydrodynamics. Because there are several major water diversions in the Delta for
 30 municipal water supplies, bromide in the source water is of concern because of the potential for DBP
 31 formation. Bromide concentrations also can be generally higher in the lower San Joaquin River and
 32 Delta island agricultural drainage as a result of agricultural irrigation practices and evaporative
 33 concentration that occurs in water diverted from the Delta for irrigated agriculture. Recirculation, or
 34 the process of agricultural drainage entering the San Joaquin River and its subsequent and repetitive
 35 diversion for agricultural practices, has also contributed to elevated bromide concentrations in the
 36 San Joaquin River.

37 Median concentrations at the southern Delta export pumps are about 16 times higher than in the
 38 Sacramento River at Hood, and other tributaries upstream of any seawater influence (CALFED Bay-
 39 Delta Program 2007b). Based on historical data and current conditions, bromide concentration in
 40 water diverted from the southern Delta can be estimated from EC or chloride data, with chloride
 41 being the most reliable indicator (Public Policy Institute of California 2008).

1 Existing Conditions in the Study Area

2 Locations in the northern Delta have had low concentrations of bromide in water years 2001–2006
3 with mean values of 0.02 and 0.04 mg/L at the Sacramento River at Hood and Barker Slough pump
4 locations, respectively (Figure 8-15). Higher mean concentrations typically are seen in the southern
5 Delta, with values of 0.18 mg/L at the Banks pumps, 0.27 mg/L at the San Joaquin River near
6 Vernalis, and 0.28 mg/L at CCWD pumping plant #1. The highest mean value examined was 5.18
7 mg/L at the Sacramento River at Mallard Island.

8 Time series data indicate that bromide concentrations at the examined stations generally fluctuate
9 on an annual basis (Figure 8-16) but depend on location. For example, higher values have tended to
10 occur during the months of March through May at the Barker Slough pumps, while higher values
11 occurred during the October to early January period at CCWD pumping plant #1. Bromide data for
12 the north and south-of-Delta stations were sparse; values were available for the American River at
13 WTP and were all reported as 0.01 mg/L.

14 There are presently no regulatory water quality objectives for bromide in the Delta. Bromide is not a
15 priority pollutant; thus, the CTR has no criteria for bromide. There are no state or federal regulatory
16 water quality objectives/criteria for bromide, or any USEPA-recommended criteria. The state
17 drinking water primary MCL for bromate is 0.01 mg/L. To reduce the potential for DBP formation in
18 municipal water supplies, the CALFED Drinking Water Quality Program has the goal of achieving
19 either a bromide concentration of 0.05 mg/L at the southern and central Delta water export
20 locations, along with an average TOC concentration of 3 mg/L (CALFED Bay-Delta Program 2000),
21 or an “Equivalent Level of Public Health protection” for municipal water supply purveyors.
22 Specifically, the goal of the CALFED Drinking Water Program is to:

23 achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central
24 Delta drinking water intakes of 50 µg/L [0.05 mg/L] bromide and 3.0 mg/L total organic carbon, or
25 (b) an equivalent level of public health protection using a cost-effective combination of alternative
26 source waters, source control, and treatment technologies. (CALFED Bay-Delta Program 2000)

27 In general, bromide concentrations are frequently above 0.05 mg/L at Delta locations influential to
28 the water quality of surface water supply purveyors.

29 The basis of the bromide goal is described in the Final Draft of the CALFED Water Quality Program
30 Stage 1 Final Assessment as follows:

31 In 1998, a panel of three water quality and treatment experts, engaged by the California Urban Water
32 Agencies (CUWA), produced a report titled “Bay-Delta Water Quality Evaluation, Draft Final Report”.
33 CUWA had charged the panel with developing potential regulatory scenarios, defining appropriate
34 treatment process criteria, and estimating the Delta source water quality required to achieve
35 compliance under the anticipated regulatory scenarios...The panel identified two regulatory
36 scenarios for their evaluation, a near-term scenario consisting of the then current treatment rules
37 governing pathogen inactivation and disinfection and a long-term scenario which included the
38 anticipated more stringent versions of these rules then under development. The long term scenario,
39 referred to in this report as the CALFED ELPH targets, were regulatory levels of 40 µg/L total
40 trihalomethanes (TTHMs), 30 µg/L haloacetic acids (HAA5s), and 5 µg/L bromate (as running annual
41 averages) as well as an additional 1 to 2-log inactivation of *Giardia* and 1-log inactivation of
42 *Cryptosporidium*. The panel focused on inactivation requirements and the DBP precursors TOC and
43 bromide as the constituents in Delta water that would be most likely to drive treatment technology
44 decisions. Their basic finding was that, under the more stringent long-term scenario, it would be
45 necessary to keep Delta water diverted for municipal use to no more than 3 mg/L TOC and 50 µg/L
46 [0.05 mg/L] bromide to give users flexibility in their choice of treatment method (enhanced

1 coagulation or ozone disinfection)...For the less stringent near-term regulatory scenario, TOC from 4
 2 to 7 mg/L and bromide from 100 to 300 µg/L [0.1 to 0.3 mg/L] was determined to be acceptable.
 3 (CALFED Water Quality Program 2007).

4 The more stringent regulations envisioned at the time the 0.05 mg/L bromide goal for source waters
 5 was recommended have not yet been realized. The only changes implemented compared to the less
 6 stringent near-term regulatory scenario evaluated are that the running annual average bromate
 7 MCL has been changed to a locational running average that must be met at all points in the
 8 treatment and distribution system, and additional *Cryptosporidium* inactivation is required for
 9 higher risk systems, dependent on monitoring outcomes. In general, these do not affect the levels of
 10 bromide in source water that would require drinking water treatment or source water modification
 11 for compliance with current MCLs.

12 Although the projected long-term reduction in the bromate MCL has not occurred, it is still possible
 13 that it will be reduced in the future. The U.S. EPA maximum contaminant level goal (MCLG) for
 14 bromate is 0 mg/L, and the current MCL of 0.01 mg/L is set at the current analytical practical
 15 quantitation limit (PQL) for bromate, determined by the U.S. EPA through an analytical feasibility
 16 analysis. While the U.S. EPA's most recent Analytical Feasibility Support Document for the Second
 17 Six-Year Review of Existing National Primary Drinking Water Regulations (U.S. EPA 2010) did not
 18 recommend a lowering of the bromate PQL, and thus MCL, below 0.01 mg/L, recent adoption of new
 19 analytical methods could lead to an improved PQL, and thus reduced MCL. This means that in 2016,
 20 or the time of the next Six-Year Review of National Primary Drinking Water Regulations, it is
 21 possible the bromate MCL will be lowered to the 0.005 mg/L value assumed in the derivation of the
 22 0.05 mg/L CALFED bromide goal.

23 **8.1.3.4 Chloride**

24 **Background and Importance in the Study Area**

25 Chloride is an inorganic anion generally found at low concentrations in freshwater bodies; however,
 26 chloride is the dominant anion in seawater at about 19,000 mg/L (Hem 1985). Chloride commonly
 27 occurs in nature as salts of sodium, potassium, and calcium. Tidal seawater intrusion is the primary
 28 source of chloride in the Delta. Delta tidal water containing elevated levels of chloride, which is
 29 subsequently diverted for agricultural irrigation uses on Delta islands or exported from the Delta via
 30 the Banks and Jones pumping plants to the San Joaquin valley, returns to the Delta as agricultural
 31 drainage (CALFED Bay-Delta Program 2007a). Chloride concentrations in these return flows to the
 32 Delta can contain additional chloride as a result of evaporative concentration of salts that occurs in
 33 water diverted for agricultural irrigation. Chloride is a potential concern for crop yields in
 34 agricultural irrigation water, and excess chloride can impart an unpalatable, "salty" taste in drinking
 35 water supplies. Taste thresholds for chloride range from 200 to 300 mg/L, depending on the
 36 associated cation (World Health Organization 2003).

37 **Existing Conditions in the Study Area**

38 Locations in the northern Delta had low concentrations of chloride in water years 2001–2006, with
 39 mean values of 6 and 22 mg/L at the Sacramento River at Hood and Barker Slough pump locations,
 40 respectively (Figure 8-17). Higher mean concentrations typically are seen in the southern Delta,
 41 with values ranging from 59 mg/L at the Banks pumps to 90 mg/L at both CCWD pumping plant #1
 42 and Franks Tract. Chloride mean concentrations increased at the mouths of the Sacramento River

1 and San Joaquin River, with the highest value of 6,380 mg/L at Suisun Bay at Bulls Head near
2 Martinez.

3 Chloride mean concentrations in the north-of-Delta locations were very low (water years 2001–
4 2006), ranging from 1 to 5 mg/L (Table 8-9). South-of-Delta locations had mean values of 69 mg/L,
5 which were higher than that reported at the Banks headworks (59 mg/L, Figure 8-17).

6 **Table 8-9. Chloride Concentrations at Selected North of Delta and South-of-Delta Stations, Water**
7 **Years 2001–2006^a**

Location	Chloride (dissolved, mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	46	1	6	2	2
Sacramento River at Verona	21	2	15	5	4
Feather River at Oroville	29	1	3	1	1
American River at WTP	69	1	3	2	2
California Aqueduct at Check 13	69	23	138	69	64
California Aqueduct at Check 29	81	16	127	69	66

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

8
9 Time series data for chloride displayed annual fluctuations (Figures 8-18a, 8-18b, and 8-19), with
10 peaks typically occurring in fall/winter.

11 The Bay-Delta WQCP contains chloride objectives for municipal and industrial water supply
12 beneficial uses protection, including a maximum mean daily concentration of 250 mg/L year-round
13 at the five major municipal water supply diversion locations—Contra Costa Canal at pumping plant
14 #1, West Canal at mouth of Clifton Court Forebay, Jones pumping plant, Barker Slough at North Bay
15 Aqueduct, and Cache Slough at the City of Vallejo intake (abandoned). Table 8-9a summarizes the
16 record of compliance with the Delta chloride objectives that are specified in the Bay-Delta WQCP.
17 The 250 mg/L standard has been exceeded at the CCWD pumping plant #1 on several occasions in 4
18 of the past 20 years. Additionally, the Bay-Delta WQCP contains a chloride objective for Contra Costa
19 Canal at pumping plant #1 or the San Joaquin River at Antioch Water Works intake that specifies the
20 number of days each calendar year that the maximum mean daily chloride concentration must be
21 less than 150 mg/L (must be provided in intervals of not less than 2 weeks' duration). The days per
22 year depend on water-year type, ranging from 155 days for critical water-year types to 240 days in
23 wet water-year types. The industrial uses for which this objective was established (cardboard
24 manufacturing in Antioch) no longer exist; however, the objective has been retained for general
25 municipal use protection (CALFED Bay-Delta Program 2007a). Delta water supply operations have
26 been able to maintain compliance with the 150 mg/L standard.

1 **Table 8-9a. Summary of Compliance with Delta Chloride Objectives (1995–2014)**

Location	Objective ^{a, b}		Exceedances of Objective		
	Applicable Period (and narrative description)	Days/Year ^c	Years with Objective Exceeded	Maximum Days Exceeded	Median Days Exceeded ^d
Municipal and Industrial Water Supply Objectives					
CCF	Jan 1–Dec 31 md Cl ≤ 250 mg/L	365	0	0	0
DMC at Tracy PP	Jan 1–Dec 31 md Cl ≤ 250 mg/L	365	0	0	0
CCC at PP#1	Jan 1–Dec 31 md Cl ≤ 250 mg/L	365	4	7	2.5
CCC PP#1 or SJR @ Antioch Intake	Jan 1–Dec 31 Chloride (days <150 mg/L Cl varies by water year).	Varies by water year- type	0	0	0

Notes: CCF = Clifton Court Forebay; CCC = Contra Costa Canal; Cl = chloride; DMC= Delta-Mendota Canal; md = mean daily; mg/L = milligrams per liter; PP=Pumping Plant; SJR = San Joaquin River.

^a This table also includes objectives/standards set by Water Rights Orders 95-6 and 98-6.

^b Only partial description of objective provided; refer to Bay-Delta Water Quality Control Plan for full text of objective.

^c Total number of days in year that requirement is applicable.

^d Median calculated using only years when exceedances occurred.

2

3 The secondary MCL for chloride is specified as a range: 250 mg/L (recommended), 500 mg/L
4 (upper), and 600 mg/L (short-term) and is applicable to all surface waters in the affected
5 environment, other than the Delta, that have the municipal and domestic supply beneficial use
6 designation. The USEPA's recommended chloride ambient water quality criteria for the protection of
7 freshwater aquatic life are 230 mg/L (chronic 4-day average) and 860 mg/L (acute 1-hour average).
8 The San Francisco Bay Water Board Basin Plan has a 355 mg/L chloride objective for agricultural
9 supply. CCWD has a goal of delivering treated water that has less than 65 mg/L chloride.

10 One channel in the southern Delta (Tom Payne Slough) and Suisun Marsh is on the state's CWA
11 Section 303(d) list because of elevated chloride (State Water Resources Control Board 2011).
12 Additionally, the lower San Joaquin River is on the 303(d) list as impaired for salt and boron, and a
13 TMDL has been developed with chloride identified as composing about 23% of the total ions
14 contributing to salinity in the lower San Joaquin River at the Vernalis location in the Delta (Central
15 Valley Regional Water Quality Control Board 2002).

16 **8.1.3.5 Dioxins, Furans, and Polychlorinated Biphenyls**

17 **Background**

18 Dioxins and dioxin-like compounds are a chemical compounds with similar chemical structures and
19 biotic effects (U.S. Food and Drug Administration 2009). There are several hundred of these

1 compounds, which can be grouped into three families: chlorinated dibenzo-p-dioxins, chlorinated
2 dibenzofurans, and certain polychlorinated biphenyls (PCBs). One of the most toxic (and most
3 studied) dioxins is 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Chlorinated dibenzo-p-dioxins and
4 chlorinated dibenzofurans are created unintentionally, usually through combustion processes. PCBs
5 are manufactured products but are no longer produced in the United States. Dioxin/furan
6 compounds and PCBs break down very slowly in the environment, indicating that past and present
7 emissions will continue to interact with soils, water, and biota (e.g., Wenning et al. 1999; Gullett et
8 al. 2003; Brown et al. 2006).

9 The most common health effect in people exposed to large amounts of dioxins is chloracne, possibly
10 followed by skin rashes, skin discoloration, and excessive body hair and possibly mild liver damage
11 (U.S. Food and Drug Administration 2009). A concern is the cancer risk associated with dioxins. High
12 exposures over long periods (animal studies, human workplace studies) have suggested an
13 increased cancer risk as well as possible reproductive and developmental effects. Toxicity levels are
14 very broad between the various dioxin compounds, up to several orders of magnitude. The health
15 effects associated with dioxins depend on a variety of factors, including the level, timing, duration,
16 and frequency of exposure.

17 The class of PCBs consists of 209 individual congeners, of which 12 have dioxin-like properties. In
18 general, PCBs can cause developmental abnormalities, growth suppression, disruption of the
19 endocrine system, impairment of immune function, and cancer (State Water Resources Control
20 Board 2007). PCBs can bioaccumulate and reach higher concentrations in higher levels of aquatic
21 food chains; predatory fish, birds, and mammals (including humans that consume fish) at the top of
22 the foodweb are particularly vulnerable to the effects of PCB contamination. Consequently, the
23 beneficial uses (Table 8-1) most directly affected by dioxin/furan compounds and PCBs are aquatic
24 organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat); rare,
25 threatened and endangered species if the community population level were to be reduced by
26 exposure through the aquatic environment; harvesting activities that depend on aquatic life
27 (shellfish harvesting, commercial and sport fishing); and drinking water supplies (municipal and
28 domestic supply).

29 Dioxins may enter the environment through air, water, and land pathways. Because the majority of
30 dioxin releases are to the atmosphere, some dioxins can be transported very long distances and can
31 be found in most places in the world (National Research Council 2006; U.S. Food and Drug
32 Administration 2009). In water, dioxins tend to settle into sediments where they can move up the
33 food chain. Dioxins can also be deposited on plants and enter the food chain. Animals tend to
34 accumulate dioxins in fatty tissues.

35 USEPA (2006a) estimated that the primary pathway of dioxin releases to the environment is
36 atmospheric (92.4%), with 5.7% to the land and 1.8% to water. It is important to note that this
37 estimate did not include natural sources of dioxins, which exceed those produced by human
38 activities (Centers for Disease Control 2005). Dioxins are ubiquitous, and all living organisms have
39 had some form of low-level exposure. Natural brush and forest fires produce dioxins, so it is
40 reasonable to assume that organisms have been exposed to dioxins for centuries. For example, 54%
41 of global dioxin emissions were from natural forest fires in 2004, with the remainder coming from
42 anthropogenic sources (Figure 8-20).

43 PCBs were used commonly in the United States for the production of transformers and capacitors in
44 electrical equipment (Brinkmann and de Kok 1980). Other uses included hydraulic fluids, lubricants,

1 inks, and as a plasticizer (State Water Resources Control Board 2007). While production of
2 transformers and capacitors containing PCBs ended in the United States in 1979, the persistent
3 nature of PCBs in the environment is still a source of concern (Davis et al. 2007).

4 **Importance in the Study Area**

5 Assessment of how human atmospheric emission sources of dioxins, furans, and PCBs in the study
6 area directly affect the Delta would be difficult, given the complexity of area meteorology. Based on
7 the USEPA (2006b) analysis, the major sources likely would be backyard barrel burning of refuse
8 and medical waste/pathological incineration. Such sources would need to be identified and undergo
9 air transport modeling to determine deposition rates onto land and water in the study area.

10 Human activities related to land and water emissions may be more easily quantified and, based on
11 the USEPA (2006b) analysis, likely would be dominated by application of municipal wastewater
12 treatment sludge (land), ethylene dichloride/vinyl dichloride production (land, water), chlor-alkali
13 facilities (water), and bleached, chemical wood pulp and paper mills (water).

14 **Existing Conditions in the Study Area**

15 There are two portions of the study area that are on the Section 303(d) listing for impairment with
16 respect to dioxins, furans, and PCBs. The Stockton Deep Water Ship Channel is listed for
17 dioxins/furans for the overall channel, and 3.3 miles of the channel are listed for PCBs. The north
18 Delta has a PCB impairment listing for 15.5 miles of drainage canal near Sacramento.

19 Hayward et al. (1996) found that sediment concentrations of dioxins and furans near a USEPA
20 Superfund site in the Stockton area (specifically, a wood treatment facility) were highly localized
21 and likely attributable to pentachlorophenol use at the facility.

22 Contributions of dioxins to the Delta originate from several sources, including the Sacramento River,
23 the San Joaquin River, the eastside tributaries, Delta agricultural return drains, and San Francisco
24 Bay. The section below quantifies how these sources contribute to concentrations in the Delta.

25 Minimal dioxin and furan data have been collected as part of water quality monitoring programs in
26 the study area. For example, pentachlorophenol and carbofuran have been analyzed at the Banks
27 pumping plant three times a year since 1995 with no detections.

28 There was a large monitoring effort from 1988 to 1993 to assess PCBs in the Delta. The study
29 examined the seven most common commercial mixtures of PCBs produced prior to the production
30 ban in 1977 identified as PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and
31 PCB-1260 (Bay Delta and Tributaries Project 2009). The stations from this monitoring that coincide
32 with the stations examined in this section are the San Joaquin River at Buckley Cove, Sacramento
33 River at Hood (actually collected at Greene's Landing), Sacramento River above Point Sacramento,
34 San Joaquin River at Antioch Ship Channel, Old River at Rancho Del Rio, Suisun Bay at Bulls Head
35 Point near Martinez, and Franks Tract. Analysis of the monitoring results indicated that no
36 detections of PCBs occurred in any samples from these locations.

37 Recent monitoring efforts to assess PCBs in the study area are limited to four of the selected
38 locations, including the Banks pumping plant, the Barker Slough pumping plant, the Sacramento
39 River above Point Sacramento, and the San Joaquin River at Antioch Ship Channel. The latter two
40 stations were sampled for forty of the individual PCB congeners (ranging from PCB 008 to PCB 203)
41 on an annual basis by SFEI as part of its monitoring program (denoted as stations BG20 and BG30,

1 respectively). The SFEI laboratory reporting limits are on the order of 0.01 picograms per liter
 2 (pg/L), which are about 10,000,000 times more sensitive than the laboratory reporting limits for the
 3 Banks and Barker Slough pumping plants.

4 Analytes examined in the present effort for the Banks and Barker Slough pumping plants included
 5 the PCB mixtures (i.e., PCB-1016, PCB-1221, PCB-1232, PCB-1242, PCB-1248, PCB-1254, and PCB-
 6 1260). The monitoring program sampled for each of these analytes approximately 16 times during
 7 the water years 2001 to 2006 for each location. No detections were found. The very low detection
 8 limits of the SFEI monitoring has enabled the detection of many PCBs at the Sacramento River above
 9 Point Sacramento and the San Joaquin River at Antioch Ship Channel locations examined in the
 10 current study, which are presented as the sum of all PCB congeners in Table 8-10.

11 **Table 8-10. Sum of All Polychlorinated Biphenyls at the Mouths of the Sacramento and San**
 12 **Joaquin Rivers, Water Years 2001–2006**

Sum of all PCBs	Samples	Minimum (pg/L)	Maximum (pg/L)	Mean (pg/L)	Median (pg/L)
Sacramento River above Point Sacramento					
Dissolved	7	35	70	52	50
Total	6	67	138	99	95
San Joaquin River at Antioch Ship Channel					
Dissolved	5	47	60	53	53
Total	5	70	254	120	98

Source: San Francisco Estuary Institute 2010.

Notes: All concentrations in picograms per liter (pg/L). Sample size represents water quality samples
 having values at or greater than the reporting limit.

PCB = polychlorinated biphenyl.

13
 14 The samples were taken between late July and late August, which does not allow examination of wet
 15 versus dry season effects. The results indicate that PCBs are still present in the Sacramento and San
 16 Joaquin River outflows during summer conditions, albeit at low concentrations. Values for the sum
 17 of all PCBs were comparable at the two locations.

18 Sampling at south-of-Delta locations at California Aqueduct Check 13 and Check 29 for the same
 19 constituents also resulted in no detections during the same time period. Sampling at the north-of-
 20 Delta locations (approximately 35 to 60 visits per site) resulted in multiple detections at the
 21 Sacramento River at Keswick, the Feather River at Oroville, and the Sacramento River at Verona;
 22 however, the sampling and analytical protocol for these data were not available, and the validity of
 23 the data could not be confirmed.

24 Regulatory criteria with respect to dioxins, furans, and PCBs are as follows. Dioxin compounds are
 25 on the Section 303(d) list for San Francisco Bay (source of contamination unknown) and the Central
 26 Valley (source: unknown point source near the Stockton Deep Water Ship Channel). Furan
 27 compounds are on the Section 303(d) list for San Francisco Bay (source: atmospheric deposition)
 28 and the Central Valley (source: contaminated sediments). PCBs and dioxin compounds are on the
 29 Section 303(d) list for San Francisco Bay (sources: unknown nonpoint, unknown).

1 With regard to Basin Plan narrative objectives, any of the compounds above might be considered
 2 toxic at high concentrations. There are no numerical water quality objectives for the San Francisco
 3 Bay Water Board or Central Valley Water Board Basin Plans. The California drinking water standard
 4 MCL for 2,3,7,8-TCDD is 0.00003 µg/L; the MCL for carbofuran is 18 µg/L. The CTR for 2,3,7,8-TCDD
 5 is 0.000013 ng/L for Human Health: Water and Organisms, and 0.000014 ng/L for Human Health:
 6 Organisms Only. Data are inadequate to assess whether the sites examined in this SFEI monitoring
 7 exceeded this standard.

8 The CTR criteria for PCBs (sum of six aroclors) is 0.014 µg/L (freshwater chronic), 0.03 µg/L
 9 (saltwater chronic), 0.00017 µg/L (Human Health: Water and Organisms), and 0.00017 µg/L
 10 (Human Health: Organisms Only). Data examined in this study indicate that these criteria have not
 11 been exceeded.

12 **8.1.3.6 Dissolved Oxygen**

13 **Background and Importance in the Study Area**

14 DO is a measure of the concentration of oxygen carried in a water body. Water gains oxygen from
 15 the atmosphere and from aquatic plant photosynthesis. DO in water is consumed through
 16 respiration by aquatic animals, decomposition of plant and animal material (microbial respiration),
 17 sediment oxygen demand, and various chemical processes. DO depletion affects primarily aquatic
 18 life beneficial uses, which include warm freshwater habitat; cold freshwater habitat; migration of
 19 aquatic organisms and spawning, reproduction, and/or early development; estuarine habitat; and
 20 rare, threatened, or endangered species (Table 8-1). The most sensitive receptors are cold
 21 freshwater habitat and migration of aquatic organisms and spawning, reproduction, and/or early
 22 development because of the relatively high DO requirements of coldwater fish, such as Chinook
 23 salmon and steelhead. Low DO concentrations in water bodies can have adverse effects on aquatic
 24 life, including fish kills, fish egg mortality, and growth rate reductions, and can serve as a barrier to
 25 migration of anadromous fish such as Chinook salmon (Central Valley Regional Water Quality
 26 Control Board 2005; Schmieder et al. 2008).

27 Seasonal declines in DO are typical in many estuaries, and DO concentrations are negatively affected
 28 by increases in water temperature (Schmieder et al. 2008). Nutrient loading from point and
 29 nonpoint sources can result in increased algal growth, thereby causing higher DO levels when
 30 blooms are photosynthesizing and lowering DO levels during night time hours and when the blooms
 31 die and decompose (Schmieder et al. 2008) Activities that disturb sediments and aquatic plants such
 32 as dredging and clearing of aquatic plants from ship channels can cause increased decomposition of
 33 organic material, resulting in decreases in DO concentrations (Greenfield et al. 2007; Schmieder et
 34 al. 2008). However, removal of aquatic plants, especially invasive surface-covering plant species,
 35 may allow light to better penetrate the water column, increasing photosynthesis and thereby
 36 increasing DO concentrations (Greenfield et al. 2007). On the other hand, submerged macrophytes
 37 tend to cause suspended sediment to settle and increase water clarity (Madsen et al. 2001)

38 Although localized incidents of depressed DO concentrations may occur in the study area, notable
 39 low DO concentrations occur in the Stockton Deep Water Ship Channel, and to a lesser extent in
 40 Middle River and Old River. Additionally, low DO conditions occur in areas of the Suisun Marsh
 41 channels, particularly in small, isolated, backwater slough areas that receive little exchange of water
 42 (San Francisco Bay Regional Water Quality Control Board 2012). The San Joaquin River experiences
 43 regular periods of low DO concentrations in the Stockton Deep Water Ship Channel from the city of

1 Stockton downstream to Disappointment Slough. These conditions often violate the Basin Plan
2 water quality objective for DO in the Stockton Deep Water Ship Channel; they occur most often
3 during the months of June through October, although severe conditions have occurred in the winter
4 months as well (Central Valley Regional Water Quality Control Board 2005; Schmieder et al. 2008).
5 Data also show that the frequency and severity of low DO concentrations are generally worse during
6 dryer water years (Table 8-11) (Central Valley Regional Water Quality Control Board 2005). Jassby
7 and Van Nieuwenhuysse (2005) found that low DO was due to a combination of low flow and high
8 nutrient loads. The 2012 draft *Pulse of the Delta* reports that DO in the lower San Joaquin River has
9 increased since the early 2000s, primarily due to the implementation of algae removal ponds and
10 nitrification treatment by the Stockton RWCF. However, monthly minimum values continue to fall
11 frequently below the statutory limits of 5 mg/L (December 1 to August 31) and 6 mg/L (September
12 1 to November 30) (Aquatic Science Center 2012:56).

13 The Stockton Deep Water Ship Channel is a portion of the San Joaquin River that has been dredged
14 by the U.S. Army Corps of Engineers (USACE) to a depth of 35 feet to allow the navigation of cargo
15 vessels between San Francisco Bay and the Port of Stockton. Upstream of the channel, the San
16 Joaquin River is otherwise about 10 feet deep. The entire length of the channel is within the tidal
17 prism and experiences regular flow reversals (Central Valley Regional Water Quality Control Board
18 2005). Increased water depth increases the time required to aerate the water column and the
19 residence time of water in the channel and promotes stronger thermal stratification during summer
20 months, which lessens the amount of mixing; these conditions negatively affect DO concentrations in
21 the channel (Schmieder et al. 2008).

22 The occurrence of low DO concentrations also coincides with periods of low-flow conditions,
23 indicating that flow and channel morphology in the San Joaquin River are important factors
24 influencing DO conditions in the Stockton Deep Water Ship Channel. Table 8-11 demonstrates that
25 the frequency of violations of the 5.0 mg/L objective since 1983 is highest, on the average, during
26 the months of June through October (Central Valley Regional Water Quality Control Board 2005;
27 California Department of Water Resources 2009b). Oxygen concentrations less than 5.0 mg/L,
28 however, have occurred during all months of the year. The frequency of violations is worse in dry
29 years (1991 through 1993) and less frequent during wet years (1998) (Central Valley Regional
30 Water Quality Control Board 2005). An analysis of more than 20 years of time series data suggests
31 that the low DO problem is attributable to a combination of river discharge, river phytoplankton,
32 and formerly discharges of elevated ammonia levels from the Stockton RWCF, (which releases
33 approximately 53 million gallons per day (mgd) of effluent), including large seasonal wastewater
34 loading from food canneries (Jassby and Van Nieuwenhuysse 2005).

1 **Table 8-11. Temporal Distribution of Low Dissolved Oxygen Impairment**

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1983	Excursion rate (%) ^a											
	NA NA NA NA											
1984	Excursion rate (%) ^a											
	1 7 84 91 62 2											
1985	Excursion rate (%) ^a											
	6 48 78 15											
1986	Excursion rate (%) ^a											
	29 5 21 9											
1987	Excursion rate (%) ^a											
	44 43 3 29 <1											
1988	Excursion rate (%) ^a											
	51 52 52 3 10 62											
1989	Excursion rate (%) ^a											
	65 <1 37 2 38 14											
1990	Excursion rate (%) ^a											
	1 5 3 11 <1 <1											
1991	Excursion rate (%) ^a											
	<1 8 37 34 1 5 14 55 99											
1992	Excursion rate (%) ^a											
	21 100 60 29 43 39 97 100 77 6											
1993	Excursion rate (%) ^a											
	25 8 2 29 54 87 81 23 1											
1994	Excursion rate (%) ^a											
	2 <1 61 80 63 16 46											
1995	Excursion rate (%) ^a											
	2 61 6											
1996	Excursion rate (%) ^a											
	15 NA 8 63 94 89 15 18											
1997	Excursion rate (%) ^a											
	14 74 88 83 44 2 11											
1998	Excursion rate (%) ^a											
	NA <1 48 20 43 100 93 39											
1999	Excursion rate (%) ^a											
	4 11 11 61 28 1 12											
2000	Excursion rate (%) ^a											
	4 11 11 61 28 1 12											
2001	Excursion rate (%) ^a											
	5 69 75 73 61 NA											
Average (Avg) ^c												
5 6 14 6 6 27 34 37 36 23 3 4												

Source: Central Valley Regional Water Quality Control Board 2005.

Notes: DO = dissolved oxygen.

For each month of the year in the table, the upper number presented is the percentage of hourly DO measurements below 5.0 mg/L recorded that month. If a cell is blank, there were no DO measurements below 5.0 mg/L that month. If a cell contains "NA," no data were recorded at all for that month. The lower italicized number presented for each month is the minimum DO concentration measured that month. The average rate (weighted to account for months with partial data sets) for the 19-year period is shown in the bottom row.

^a Excursion rate is the number of hourly average DO measurements from the California Department of Water Resources monitoring station below 5.0 mg/L divided by the total number of such measurements recorded that month, shown as a percentage.

^b The minimum hourly average DO measurement for the month in mg/L.

^c Average excursion rate is not the simple average of all monthly data—it is weighted to account for months that had only partial data sets.

Existing Conditions in the Study Area

All examined locations in the Delta had mean DO concentrations above 8.4 mg/L in recent years (water years 2001–2006) except the San Joaquin River at Buckley Cove (6.8 mg/L, Figure 8-21). DO minima were below 7.0 mg/L at approximately 40% of examined stations including the Sacramento River at Hood (4.8 mg/L), which was the only value at that location below 6.0 mg/L during that time period, the San Joaquin River at Vernalis (4.3 mg/L), the Sacramento River at Mallard Island (6.5 mg/L), and the San Joaquin River at Buckley Cove (3.3 mg/L), which falls under the Stockton Deep Water Ship Channel water quality criteria. Mean values for the north-of-Delta area ranged from 9.6 mg/L at the American River at WTP to 11.0 mg/L at the Sacramento River at Keswick (Table 8-12). South-of-Delta mean values were lower than north-of-Delta stations examined (8.2 to 8.9 mg/L).

Time series data indicate that DO concentrations at the examined stations generally fluctuate on an annual basis (Figure 8-22 and Figure 8-23). Higher values have tended to occur during the months of November through March, with lower values occurring during June through September. The San Joaquin River at Buckley Cove site has continued to experience low DO concentrations, primarily in the late summer to late fall period.

Table 8-12. Dissolved Oxygen Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Dissolved Oxygen (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	32	7.3	15.6	11.0	11.1
Sacramento River at Verona	15	5.4	13.0	10.0	10.0
Feather River at Oroville	29	7.4	12.5	10.1	10.2
American River at WTP	120	6.5	13.0	9.6	9.5
California Aqueduct at Check 13	68	5.7	10.9	8.9	9.0
California Aqueduct at Check 29	49	0.0	12.6	8.2	9.5

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

The 2006 Bay-Delta WQCP, Region 2 Basin Plan, and Region 5 Basin Plan all contained DO objectives applicable to water bodies in the affected environment. A DO objective for protection of fish and wildlife beneficial uses exists in the 2006 Bay-Delta WQCP for the San Joaquin River between Turner Cut and Stockton: 6.0 mg/L from September through November (State Water Resources Control Board 2006). The Region 5 Basin Plan has the same objective for the San Joaquin River, and the Region 2 Basin Plan incorporates by reference the DO objectives in the 2006 Bay-Delta WQCP (Central Valley Regional Water Quality Control Board 2009a; San Francisco Bay Regional Water Quality Control Board 2007). The Region 5 Basin Plan contains the following additional numerical DO objectives for the Delta (Central Valley Regional Water Quality Control Board 2009a).

- At least 7.0 mg/L in the Sacramento River below the I Street bridge and west of the Antioch Bridge.
- At least 5.0 mg/L at all other locations and times, unless the water body has been constructed for special purposes and fish are excluded or not important as a beneficial use.

1 In addition, the Region 5 Basin Plan requires that water bodies outside the legal boundary of the
2 Delta meet certain saturation levels and not be reduced below the following levels at any time.

- 3 • Waters designated WARM, 5.0 mg/L.
- 4 • Waters designated COLD, 7.0 mg/L.
- 5 • Waters designated SPWN, 7.0 mg/L.

6 The Region 2 Basin Plan also has minimum DO objectives for warm and coldwater habitat of
7 5.0 mg/L and 7.0 mg/L, respectively (San Francisco Bay Water Board 2007). Lastly, the Region 5
8 Basin Plan contains a DO objective for the Sacramento River from Keswick Dam to Hamilton City of
9 9.0 mg/L (or 95% saturation) from June 1 to August 31, and an objective of 8.0 mg/L for the Feather
10 River from Fish Barrier Dam at Oroville to Honcut Creek from September 1 to May 31 (Central
11 Valley Regional Water Quality Control Board 2009a). There are no DO criteria in the CTR (as it is not
12 a priority pollutant), nor is there a California drinking water MCL for DO.

13 Water bodies in the affected environment listed on the state's CWA Section 303(d) list as impaired
14 because of low DO levels include Middle River, Old River, the Stockton Deep Water Ship Channel and
15 portions of other sloughs and rivers in the southern, eastern, and western Delta (State Water
16 Resources Control Board 2011). A TMDL for the Stockton Deep Water Ship Channel was approved
17 by USEPA on February 27, 2007, and includes a Region 5 Basin Plan Amendment that contains a
18 Control Program to reduce the amount of oxygen-demanding substances and their precursors in the
19 San Joaquin River. The TMDL takes a phased approach to allow more time to gather additional
20 informational on source and linkages to the DO impairment, while at the same time moving forward
21 on improving DO conditions. TMDLs for listed water bodies are proposed for completion in 2012
22 through 2021 (State Water Resources Control Board 2011).

23 Actions that are being taken to address DO conditions in the Stockton Deep Water Ship Channel, or
24 have assisted in improving DO conditions, include the construction of water aeration devices by the
25 Port of Stockton at the confluence of the San Joaquin River and Stockton Deep Water Ship Channel
26 and by DWR with a new aeration facility at the west end of the Port of Stockton docks in the Deep
27 Water Ship Channel. DWR's aeration facility is much larger than the Port of Stockton system and
28 injects pure oxygen into the Deep Water Ship Channel through a 200-foot-long diffuser during
29 periods when DO conditions approach, or drop below, 5 mg/L. Testing of the facility during 2008–
30 2010 indicates that the aeration facility can help prevent exceedances of the DO objectives but is not
31 sufficient to prevent low DO under all possible upstream oxygen loading conditions (ICF
32 International 2010). Additionally, the Stockton RWCF constructed nitrifying bio-towers that became
33 operational in 2006, which, by converting ammonia to nitrate, reduce the historical ammonia
34 loading rate and its associated oxygen demand to the San Joaquin River by about 90%.

35 **8.1.3.7 Salinity and Electrical Conductivity**

36 **Background and Importance in the Study Area**

37 Salinity is the concentration of dissolved salts in water. Typical salts found include the major cations
38 (calcium, magnesium, sodium, and potassium) and anions (sulfate, chloride, fluoride, bromide,
39 bicarbonate, and carbonate). The relative proportion of the anions and cations are different in
40 typical freshwater and seawater, with sodium and chloride dominating seawater salinity. The
41 composition of dominant cations and anions in freshwater can vary to a much greater degree.
42 Salinity can be measured in a variety of ways, including chloride concentration, TDS concentrations,

1 and EC. While a recognized international measurement scale of salinity exists (Practical Salinity
2 Units), the term is not commonly used, and the measured parameters EC and TDS are more often
3 used interchangeably to refer to generalized effects of salinity. The beneficial uses most affected by
4 salinity concentrations are municipal, agricultural, and industrial water supply.

5 Additionally, changes in salinity, including tidally influenced interfaces between freshwater and
6 saltwater in the Delta, directly affect aquatic organisms and indirectly affect aquatic and wildlife
7 habitats (warm freshwater habitat, cold freshwater habitat, estuarine habitat). Related beneficial
8 uses such as commercial and sport fishing and shellfish harvesting also are affected.

9 EC and TDS values tend to be highly correlated because the majority of chemicals that contribute to
10 TDS are charged particles that impart conductance of water. EC often is used to measure salinity
11 because a simple electronic probe can measure salinity directly in the field and be recorded at
12 frequent intervals (e.g., every 15 minutes), making it a cost-effective measurement. Other measures
13 require field collection of water samples and laboratory analysis, which can be expensive. EC units
14 commonly used are micromhos per centimeter ($\mu\text{mhos/cm}$) and milliSiemens per centimeter
15 (mS/cm), and both are measures of the conductivity of the water.

16 Salinity can originate from natural sources such as seawater and rainfall-induced leaching of salts
17 from soils. Anthropogenic sources of salinity include drainage from irrigated agricultural lands and
18 managed wetlands, agricultural chemical soil additives, municipal and industrial wastewater
19 discharges, and urban stormwater. Salinity also increases through evaporative concentration, which
20 occurs during the dry, warm months of the year in ditches, canals, and reservoirs. Also, when excess
21 water is applied to land for crop irrigation, the excess runs off to drainage ditches where it can be
22 subject to evaporative concentration. Concern about salinity involves three main issues: drinking
23 water, crop irrigation, and biota/habitat. Elevated concentrations of salinity result in poor-tasting
24 water and also limit the ability to recycle wastewater for nonpotable uses (e.g., landscape irrigation).
25 The TDS concentration of water from Sierra Nevada streams is typically less than 100 mg/L, while
26 drinking water from the Delta typically has TDS concentrations from 150 to 300 mg/L, with
27 concentrations occasionally exceeding 500 mg/L (CALFED Bay-Delta Program 2007a). Bromide, a
28 constituent most commonly found in seawater and marine sediments, is a precursor to the
29 formation of DBPs in drinking water facilities, which can be harmful to humans and animals (see
30 Section 8.1.3.3 for a detailed discussion of bromide). In addition, industrial processes that require
31 low-salinity water can be negatively affected. Salt removal during the water purification process (for
32 either drinking or process water) is presently very expensive.

33 When salinity concentrations in irrigation water are too high, yields for salt-sensitive crops may be
34 reduced. Salinity can decrease water available to the plant and cause plant stress (CALFED Bay-
35 Delta Program 2007a). There are also fish, wildlife, and aquatic plant species that have adapted to
36 naturally occurring salinity ranges in the Bay-Delta system, with specific salinity requirements at
37 certain life stages in order to survive. There is evidence to suggest that the artificial stabilization of
38 salinity, which has been undertaken in the Delta to maximize drinking and agricultural water
39 quality, may create habitat more suitable for invasive species than for native species (Lund et al.
40 2007).

41 The primary source of salinity in the Delta is seawater intrusion from the west (CALFED Bay-Delta
42 Program 2000), which occurs at greater magnitudes when Delta outflow to San Francisco Bay is low.
43 Salinity also is elevated in the San Joaquin River inflows as a result of irrigated agricultural drainage
44 on southern San Joaquin Valley soils of marine origin that are naturally high in salts, and from salt in

1 Delta waters that are used for irrigation and returned back to the Delta. From a broad viewpoint,
 2 salinity is determined as interplay between the amount of freshwater entering the Delta from the
 3 major tributaries (e.g., Sacramento and San Joaquin Rivers) and seawater from San Francisco Bay.
 4 During the late winter and spring months of seasonally elevated runoff and flows, and in particular
 5 during wet years with high levels of runoff from interior California, the elevated freshwater flows
 6 limit the extent of seawater intrusion into the Delta from the Bay. During low-flow summer and fall
 7 months, and dry water-year types with low levels of runoff, the lower freshwater flows result in
 8 greater amounts of seawater intrusion (Figures 8-4 and 8-5). Maximum salinity intrusions into the
 9 study area from the Bay are greatest during low-precipitation years.

10 The volume of Delta channels subject to daily tidal action is an important factor affecting the extent
 11 of high-salinity seawater intrusion and also influences the behavior of saline water once in the Delta.
 12 As described above, salinity in the Suisun Marsh channels are similarly affected by tidal seawater
 13 intrusion, and the SMSCG facilities and operations were developed in the late 1980's in response to
 14 the need to better manage changing salinity conditions. Increases in channel volume associated with
 15 levee failures on Delta islands (Mierzwa and Suits 2005) can result in daily tidal exchange moving
 16 considerably farther inland compared to conditions with the island levees intact. The June 2004
 17 failure of a levee at Jones Tract, which flooded both upper and lower Jones Tract, resulted in
 18 substantial increased salinity conditions in the southern and central Delta (Mierzwa and Suits
 19 2005).

20 The description of salinity in the Delta provided above is intended as an overview; salinity in the
 21 Delta can vary greatly in time and space (CALFED Bay-Delta Program 2007a) with many
 22 contributing factors, including those following.

- 23 • Hydrology (precipitation and runoff).
- 24 • Water operations (reservoir releases, channel barrier operations, diversion pumping rates).
- 25 • Watershed sources (agriculture, managed wetlands, natural leaching, municipal and industrial
 26 discharges).
- 27 • Hydrodynamics (geometry of water bodies, meteorology, salinity gradients, freshwater inputs,
 28 tidal action).

29 **Existing Conditions in the Study Area**

30 During the water year 2001–2006 period, mean EC concentrations tended to increase from the
 31 northern Delta to the southern Delta, and from the eastern Delta to the western Delta (Figure 8-24).
 32 For example, EC mean concentrations in the northern Delta were 166 and 141 $\mu\text{mhos/cm}$ for the
 33 Sacramento River at Hood and the Mokelumne River (South Fork) at Staten Island, respectively. In
 34 the southern Delta region, EC mean concentrations were 590 and 673 $\mu\text{mhos/cm}$ for the San Joaquin
 35 River at Buckley Cove and the San Joaquin River near Vernalis, respectively. As water exits the Delta,
 36 mean EC concentrations were 3,481 and 2,366 $\mu\text{mhos/cm}$ for the Sacramento River above Point
 37 Sacramento and the San Joaquin River at Antioch Ship Channel, respectively. Mean EC
 38 concentrations increased to 4,920 $\mu\text{mhos/cm}$ at the Sacramento River at Mallard Island and were
 39 highest at Suisun Bay at Bulls Head Point near Martinez, with a value of 19,331 $\mu\text{mhos/cm}$.

40 Mean values for the north-of-Delta area were lower than in the Delta region, ranging from
 41 65 $\mu\text{mhos/cm}$ at the American River at the WTP to 120 $\mu\text{mhos/cm}$ at the Sacramento River at
 42 Verona (Table 8-13). South-of-Delta mean values were higher than those for the north-of-Delta

1 stations examined (439 to 460 $\mu\text{mhos/cm}$), and slightly higher than the mean at the Banks
2 headworks (393 $\mu\text{mhos/cm}$) (Figure 8-24).

3 **Table 8-13. Electrical Conductivity Concentrations at Selected North- and South-of-Delta Stations,**
4 **Water Years 2001–2006**

Location	Electrical Conductivity ($\mu\text{mhos/cm}$)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	32	82	127	106	108
Sacramento River at Verona	15	92	148	120	117
Feather River at Oroville	29	53	239	86	83
American River at WTP	120	6	152	65	65
California Aqueduct at Check 13	69	217	981	460	465
California Aqueduct at Check 29	74	133	680	439	456

Source: California Department of Water Resources 2009b.

Notes: $\mu\text{mhos/cm}$ = micromhos per centimeter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

5
6 Time series data indicate that EC concentrations at the examined stations generally fluctuate on an
7 annual basis (Figures 8-25a, 8-25b, and 8-26). However, peak values occurred at different times of
8 the year for the various locations. Factors influencing this variability may include hydrology, water
9 operations, watershed sources, and hydrodynamics in the Delta.

10 Because EC is not a priority pollutant, there are no criteria established for EC in the NTR or CTR. The
11 secondary MCL for EC is specified as a range: 900 microSiemens per centimeter ($\mu\text{S/cm}$) (1
12 $\mu\text{S/cm}$ =1 $\mu\text{mhos/cm}$) (recommended), 1,600 $\mu\text{S/cm}$ (upper), and 2,200 $\mu\text{S/cm}$ (short-term), and is
13 applicable to all surface waters in the affected environment, other than the Delta, that have the
14 municipal and domestic supply beneficial use designation. The Region 5 Basin Plan specifies EC
15 objectives for the Sacramento River, Feather River, and San Joaquin River; it also contains EC
16 objectives for the Delta, which have been superseded by the 2006 Bay-Delta WQCP. The Bay-Delta
17 WQCP contains EC objectives for the Delta for agricultural and fish and wildlife beneficial use
18 protection, which vary by month and water-year type (see Appendix 8A, *Water Quality Criteria and*
19 *Objectives*). The Bay-Delta WQCP EC objectives for agricultural protection are designed primarily to
20 control salinity conditions in the interior and southern Delta channels, and San Joaquin River inflow
21 to the Delta at Vernalis, which tend to have higher salinity concentrations and are influenced most
22 by Delta exports. A contract between DWR and the North Delta Water Agency specifies that DWR
23 will operate the SWP to achieve specified EC levels at certain Delta locations that, a minimum, must
24 be equal to or better than the State Water Board's Bay-Delta WQCP EC objectives (California
25 Department of Water Resources 1981).

26 Table 8-13a summarizes the record of compliance with the Delta EC objectives that are specified in
27 the Bay-Delta WQCP. The compliance record indicates that with the exception of a 35 day period at
28 the Sacramento River at Emmaton location during the severe drought of 2013, Delta water supply
29 operations have been able to maintain compliance with the agricultural EC objectives in the interior
30 and western Delta locations and all fish and wildlife EC objectives. The south Delta EC objectives
31 have been exceeded at the San Joaquin River at Brandt Bridge, Old River at Tracy Bridge, and Old
32 River at Middle River locations for various lengths of time in several years. Water quality in the

1 southern Delta downstream of Vernalis is influenced primarily by San Joaquin River inflow; tidal
 2 action; agricultural return flows; and channel capacity. The Delta water supply operations have
 3 relatively little influence on salinity levels at these locations, and the elevated salinity in south Delta
 4 channels is affected substantially by local salt contributions discharged into the San Joaquin River
 5 downstream of Vernalis as evidenced by the comparatively lower EC levels at Vernalis and the
 6 Banks and Tracy export locations.

7 **Table 8-13a. Summary of Compliance with Delta Electrical Conductivity Objectives (1995–2014)**

Location	Objective ^{a, b}		Exceedances of Objective		
	Applicable Period and narrative description	Days/ Year ^c	Years with Objective Exceeded	Maximum Days Exceeded	Median Days Exceeded ^d
Agricultural Water Supply Objectives					
Sacramento River at Emmaton	Apr 1–date end varies by WY 14-day avg EC varies by WY	137	1	35	35
San Joaquin River at Jersey Point	Jun 1–period end varies by WY 14-day avg EC varies by WY	76	0	0	0
SF Mokelumne at Terminous	Apr 1–Aug 15 14-day avg EC varies by WY	137	0	0	0
San Joaquin River at San Andreas	Apr 1–date end varies by WY 14-day avg EC varies by WY	137	0	0	0
Old River at Tracy	Apr 1–Aug 31 30-day avg EC ≤ 0.7 mS/cm Sep 1–Mar 31 30-day avg EC ≤ 1.0 mS/cm	365	9	289	88
Old River at Middle River	Apr 1–Aug 31 30-day avg EC ≤ 0.7 mS/cm Sep 1–Mar 31 30-day avg EC ≤ 1.0 mS/cm	365	2	47	41
San Joaquin River at Brandt Bridge	Apr 1–Aug 31 30-day avg EC ≤ 0.7 mS/cm Sep 1–Mar 31 30-day avg EC ≤ 1.0 mS/cm	365	3	68	28
San Joaquin River at Vernalis	Apr 1–Aug 31 30-day avg EC ≤ 0.7 mS/cm Sep 1–Mar 31 30-day avg EC ≤ 1.0 mS/cm	365	0	0	0
CCF	Oct 1–Sep 30 Monthly avg EC ≤ 1.0 mS/cm	365	0	0	0
DMC at Tracy PP	Oct 1–Sep 30 Monthly avg EC ≤ 1.0 mS/cm	365	0	0	0

Location	Objective ^{a, b} Applicable Period and narrative description	Days/ Year ^c	Exceedances of Objective		
			Years with Objective Exceeded	Maximum Days Exceeded	Median Days Exceeded ^d
Fish & Wildlife Objective					
Chippis Island and Port Chicago	Feb 1–Jun 30 “X2” objective for EC (min days/month vary by PMI)	150	0	0	0
San Joaquin River between Jersey and Prisoners Points	Apr 1–May 31 14-day avg EC ≤ 0.44 mS/cm	61	0	0	0
Eastern Suisun Marsh (Sacramento River at Collinsville)	Oct 1–May 31 Monthly avg high tides EC varies by month.	243	0	0	0
Eastern Suisun Marsh (Montezuma Slough at National Steel)	Oct 1–May 31 Monthly avg high tides EC varies by month.	243	0	0	0
Eastern Suisun Marsh (Montezuma Slough near Beldon’s Landing)	Oct 1–May 31 Monthly avg high tides EC varies by month.	243	0	0	0
Western Suisun Marsh (Chadbourne Slough)	Oct 1–May 31 Monthly avg high tides EC varies by month and deficiency period.	243	0	0	0
Western Suisun Marsh (Suisun Slough)	Oct 1–May 31 Monthly avg high tides EC varies by month and deficiency period.	243	0	0	0

Notes: Avg = average; CCF = Clifton Court Forebay; CCC = Contra Costa Canal; DMC= Delta-Mendota Canal; mS/cm = milliSiemens per centimeter; PP=Pumping Plant; PMI = previous month’s Eight River Index; SF Mokelumne = South Fork Mokelumne River; WY= water year.

^a This table also includes objectives/standards set by Water Rights Orders 95-6 and 98-6.

^b Only partial description of objective provided; refer to Bay-Delta Water Quality Control Plan for full text of objective.

^c Total number of days in year that requirement is applicable.

^d Median calculated using only years when exceedances occurred.

1

2 The Region 2 Basin Plan contains agricultural EC objectives; however, the affected environment of
3 the Delta and downstream Bay waters in Region 2 are generally saline and do not likely serve as a
4 major water source for agricultural activity. For the protection of fish and wildlife habitat, the Bay-
5 Delta WQCP regulates EC in western and interior Delta locations and Suisun Marsh.

6 The Central Valley Water Board and the State Water Board, in coordination with funding from the
7 Central Valley Salinity Coalition, are overseeing the Central Valley Salinity Alternatives for Long-
8 Term Sustainability (CV-SALTS) program, which is a science, policy, and regulatory planning process
9 that began in 2006 to address the long-term buildup of salts, including nitrates, throughout the
10 Central Valley in a comprehensive, consistent, and sustainable manner. Through a collaborative
11 multistakeholder process, the CV-SALTS program will result in development of a Central Valley Salt
12 and Nutrient Management Plan (SNMP), along with Basin Plan amendments to implement the SNMP.
13 A goal for CV-SALTS is to foster regional collaborations for more efficient and effective salinity and
14 nutrient management from regulated discharges and actions beyond the jurisdiction of the Central
15 Valley Water Board and State Water Board, such as regional salt storage or conveyance systems,

1 treatment facilities, Real-Time Management, water or salt trading, or other actions that the
 2 regulators are unable to require, but which could facilitate sustainable salinity management in the
 3 region.

4 CV-SALTS prepared an updated strategy and workplan in February 2012 that identified necessary
 5 studies to develop the SNMP. CEQA scoping meetings were held in late 2013 to solicit comments on
 6 potential components of the Central Valley SNMP. CV-SALTS has completed many studies identified
 7 in the early planning stages for CV-SALTS, including review and evaluations of applicable and
 8 potential alternative salinity and nutrient regulatory policies and water quality objectives for
 9 beneficial use protection. Many more studies, including economic and environmental review of
 10 proposed SNMP alternatives, are underway. A Strategic Salt Accumulation Land and Transport
 11 Study (SSALTS) is being prepared to identify the range of viable salt disposal methods for the
 12 Central Valley (taking into account regulatory, institutional, economic, and technological issues) and
 13 inclusion in the SNMP. The SSALTS study will evaluate existing salt disposal areas, establishment of
 14 new salt disposal areas within the Central Valley, export or transport of salt out of the Central Valley,
 15 or some combination of the above. Two parts of the study have been completed to date including a
 16 “Phase 1” report in December 2013 of potential study areas, and a “Phase 2” report in October 2014
 17 that identifies potential salt disposal options.

18 As envisioned by CV-SALTS, the major final phases to develop the SNMP by mid-2016 are as follows:

- 19 ● Initial Conceptual Model (ICM): The ICM study report was prepared in August 2013 and
 20 provides an approximate water, salt, and nitrate load balance analysis for the Central Valley
 21 floor in 22 areas of analysis referred to as Initial Analysis Zones (IAZs). The analysis uses the
 22 USGS 2009 Central Valley Hydrologic Model (CVHM) model, coupled with the Watershed
 23 Analysis Risk Management Framework model, to evaluate TDS, chloride, and nitrate mass
 24 loading and transport in the Central Valley.
- 25 ● Development of the Draft SNMP: This phase will utilize the data collected and/or organized as
 26 well as the methods and results developed as a part of the ICM. The Draft SNMP will provide
 27 refined spatial detail in some locations for the water balance, salt, and nitrate modeling of the
 28 Central Valley floor.
- 29 ● Regulatory Approval Process: During this phase, the SNMP will be finalized and the documents
 30 that are necessary for the regulatory approval process for the adoption of the SNMP will be
 31 developed and submitted as a part of the Basin Plan Amendments.
- 32 ● Development of Local SNMPS: It is anticipated that, upon completion of SNMP, focused SNMPS
 33 (Local SNMPS) may be developed and implemented by local and/or regional entities as needed.

34 Multiple water bodies in the affected environment are on the state’s CWA Section 303(d) list for
 35 impairment by elevated EC levels, as follows: (a) southern, northwestern, and western channels in
 36 the Delta; (b) Delta export area; (c) Grasslands drainage area, Mud Slough, and Salt Slough in the San
 37 Joaquin River valley; (d) San Joaquin River from Bear Creek to Delta boundary; and (e) Suisun Marsh
 38 (State Water Resources Control Board 2011). A TMDL has been prepared for the lower San Joaquin
 39 River at Vernalis, and the TMDL for segments upstream from Vernalis is under development.

8.1.3.8 Emerging Pollutants: Endocrine-Disrupting Compounds, Pharmaceutical and Personal Care Products, and Nitrosamines

Background

Emerging water quality contaminants represent a broad range of chemicals that have not traditionally been part of monitoring programs because they were not deemed important until recently or the ability to quantify them had not been possible until recent laboratory advances allowed their detection. As such, data for these parameters in the study area are relatively sparse. The beneficial uses (Table 8-1) most directly affected by emerging pollutant concentrations are aquatic organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat) and drinking water supplies (municipal and domestic supply). The focus of the following section is on three classes of emerging contaminants: EDCs, PPCPs, and nitrosamines (e.g., NDMA).

Endocrine-Disrupting Chemicals

EDCs interfere with hormone (endocrine) systems in animals. Hormones are released by body organs (e.g., thyroid, ovaries, testes) and act as chemical messengers to other organs and tissues. Hormones bind with receptor sites in a way similar to how a key fits into a lock. Upon binding, the receptor carries out the hormone's instructions by either altering the cell's existing proteins or turning on genes that will build a new protein (U.S. Environmental Protection Agency 2009b). Both of these actions create reactions throughout the body. The hormone system operates from conception through old age, affecting development, reproduction, metabolism, and other crucial body functions.

The problem with EDCs is that they can bind to hormone receptor sites in the body. The effect of this action varies but usually involves altering the function of the hormone system (U.S. Environmental Protection Agency 2009b). For example, an EDC that mimics a natural hormone can result in over- or underproduction of a chemical or response (e.g., too much growth hormone) or generation of a response at an inappropriate time (e.g., producing insulin when not needed). Other EDCs can block natural hormones from binding. Overall, the action of EDCs is typically undesirable because EDCs can disrupt normal body function.

EDCs have been studied with respect to their potential impacts on aquatic organisms (e.g., Snyder 2003, 2008). For example, studies of the impact of estrogen exposure on fish downstream of WWTPs have detected elevated levels of vitellogenin, a female-specific egg yolk protein, in male fish. In a 7-year study, investigators found that concentrations of estrogens/estrogen mimics observed in freshwater could affect the sustainability of wild fish populations by altering the male population (Kidd et al. 2007).

Examples of EDCs include natural plant and animal compounds, metals (e.g., arsenic, cadmium, lead, mercury), dioxins, polycyclic aromatic hydrocarbons (PAHs), pesticides, PPCPs, and PCBs (Snyder 2008). Sources of anthropogenic EDCs include WWTPs, private septic systems, urban stormwater runoff, industrial effluents, landfill leachates, discharges from fish hatcheries and dairy facilities, runoff from agricultural fields and livestock enclosures, and land amended with biosolids or manure.

WWTPs are not specifically designed to treat and remove EDCs, and the WWTP industry is just beginning to examine their ability to treat for EDCs, with some degree of success (e.g., Snyder 2008; Benotti et al. 2009; Contra Costa Water District 2009); however, our understanding of treatability

1 for CECs is incomplete. Related research suggests that estrogen compounds can be biodegraded in
2 the stream sediments below plant outfalls (Bradley et al. 2009).

3 **Pharmaceuticals and Personal Care Products**

4 PPCPs generally represent products used by humans for personal health (e.g., prescription and over-
5 the-counter drugs) or cosmetic (e.g., fragrances, lotions) reasons, as well as products used to
6 enhance livestock growth or health (e.g., hormones, antibiotics).

7 PPCPs in the environment have not yet been shown to adversely affect human health, but some
8 studies suggest that they contribute to ecological harm (U.S. Environmental Protection
9 Agency 2009c). PPCPs have been found in most places sampled but typically at very low
10 concentrations. Research to study the long-term exposure to very low PPCP concentrations is in its
11 infancy. Concern exists because so much is unknown about the effects of PPCPs and because the
12 number of PPCPs is growing.

13 According to the USEPA (2009c), people contribute PPCPs to the environment when medication
14 residues pass out of the body and into sewer lines, when externally applied drugs and personal care
15 products they use wash down the shower drain, and when unused or expired medications are
16 placed in the trash or flushed down a toilet.

17 Municipal WWTPs are not specifically designed to treat and remove PPCPs; however, activated
18 sludge treatment processes are known to exhibit PPCP treatment and removal effectiveness for
19 many compounds. The Water Environment Federation has sponsored research that investigated
20 factors of WWTP processes that result in PPCP removal performance (Oppenheimer and Stephenson
21 2006). The study evaluated monitoring data for 20 PPCP compounds in a variety of secondary
22 biological and filtration treatment processes, including processes with nitrification and
23 denitrification. The study determined that in general, an increase in solids residence time (SRT) was
24 an important factor resulting in enhanced removal efficiency for the majority of the monitored
25 chemicals. The SRT required to achieve consistent removal above 80% is compound-specific, with
26 many of the target compounds well removed by activated sludge processes with SRTs of 5 to 15
27 days. Half of the 20 PPCP target compounds showed frequent occurrence in secondary influent, but
28 were also efficiently removed (>80%) at SRT of less than 5 days, consisting of caffeine, ibuprofen,
29 oxybenzone, chloroxylenol, methylparaben, benzyl salicylate, 3-phenylpropionate, butylbenzyl
30 phthalate, and octylmethoxycinnamate. An SRT of more than 30 days was necessary to achieve 80%
31 removal for certain compounds. Miège et al. (2009) evaluated PPCP removal performance based on
32 monitoring data from 117 WWTPs and determined that PPCP removal efficiency was highest in
33 facilities utilizing activated sludge with nitrogen removal processes. They determined that the main
34 mechanisms involved in removal efficiency of the PPCPs were biodegradation (e.g., oxidation,
35 hydrolysis, demethylation, cleavage of glucuronide conjugates), sorption on sludge or particulate
36 matter (by hydrophobic or electrostatic interactions), and filtration.

37 Given the hundreds of EDCs and PPCPs that exist, determining which compounds to monitor
38 presents a challenge (e.g., Hoenicke et al. 2007; de Voogt et al. 2009; Southern California Coastal
39 Water Research Project 2009). National reconnaissance studies have keyed in on several dozen
40 chemicals that are known to have or may have the potential to affect humans and wildlife.

41 The first nationwide study took place in 1999 and 2000 and examined 95 chemicals in 139 streams
42 across 30 states (Kolpin et al. 2002). According to the study, the most frequently detected
43 compounds were coprostanol (fecal steroid); cholesterol (plant and animal steroid); N,N-

1 diethyltoluamide (insect repellent); caffeine (stimulant); triclosan (antimicrobial disinfectant); tri(2-
2 chloroethyl) phosphate (fire retardant); and 4-nonylphenol (nonionic detergent metabolite). In a
3 follow-up study, the most frequently detected chemicals targeted in surface water were cholesterol,
4 metolachlor (herbicide), cotinine (nicotine metabolite), and β -sitosterol (natural plant sterol).

5 **Nitrosamines**

6 Nitrosamines are a family of semi-volatile organic chemicals containing a nitroso and an amine
7 functional group. N-Nitrosodimethylamine (NDMA) is the best-known nitrosamine, although there
8 are several others of importance, including N-Nitrosodiethylamine (NDEA) and N-Nitrosodi-n-
9 propylamine (NDPA). Chlorination or chloramination of water containing organic-nitrogen, such as
10 occurs during water and wastewater treatment, can lead to the production of NDMA and other
11 nitrosamines. NDMA and other nitrosamines also can form or be leached during treatment of water
12 by anion exchange resins. NDMA and other nitrosamines are not easily removed during treatment,
13 as they do not readily biodegrade, adsorb, or volatilize (Najm and Trussell 2001).

14 NDMA has been used in the production of liquid rocket fuel, and in a variety of other industrial uses.
15 It has been found in foods, beverages, drugs, and tobacco smoke (National Toxicology Program
16 2011). NDMA and other nitrosamines can cause cancer in laboratory animals. The USEPA classifies a
17 number of them as probable human carcinogens. In 2006, the Office of Environmental Health and
18 Hazard Assessment established a public health goal of 3 nanograms per liter (ng/L) for NDMA. The
19 DPH also has a 10 ng/L notification level for several nitrosamines, including NDMA.
20 (<http://www.cdph.ca.gov/certlic/drinkingwater/pages/NDMA.aspx> accessed 4-23-12)

21 **Importance in the Study Area**

22 Studies of EDCs and PPCPs in California waters are, like the national studies, typically less than 10
23 years old. A few of these studies are highlighted in the following sections.

24 In 2001 and 2002, a survey of raw and treated drinking water from four water filtration plants in
25 San Diego County showed the occurrence of several PPCPs including phthalate esters, sunscreens,
26 clofibrate, clofibric acid, ibuprofen, triclosan, and DEET (Loraine and Pettigrove 2006). This is
27 important because on average, roughly a third of the water in San Diego County originates from the
28 Delta via conveyances of the SWP. According to the study, occurrence and concentrations of these
29 compounds were highly seasonally dependent, and reached maximums when the flow of the San
30 Joaquin River was low and the quantity of imported water was high. The maximum concentrations
31 of the PPCPs measured in the raw water were correlated with low-flow conditions in the Delta that
32 feed the SWP.

33 Sampling in the Bay-Delta system in 2002 and 2003 resulted in detection of several EDCs and PPCPs
34 (Hoenicke et al. 2007). In this study, the authors reported flame-retardant compounds, pesticides
35 and insecticide synergists, insect repellents, PPCPs, plasticizers, non-ionic surfactants, and other
36 manufacturing ingredients in water, sediment, and biological tissue samples. Several of these
37 compounds, especially polybrominated diphenyl ether flame retardants, exhibited concentrations of
38 environmental concern. The highest tissue concentrations of total polybrominated diphenyl ethers
39 in bivalves (oysters, mussels, and clams) were detected in samples near the outlets of the
40 Sacramento and San Joaquin Rivers. Another study evaluated the occurrence and fate and transport
41 of 33 target analytes representing EDCs, PPCPs, and other organic chemicals in wastewater from
42 quarterly samples (April 2008–2009) collected at 11 locations in the Sacramento River, Delta, and
43 California Aqueduct, along with similar watershed sample locations from the Santa Ana River and

1 imported Colorado River water distribution systems in southern California (Guo et al. 2010). With
2 the exception of the American River sample, all of the Sacramento River/Delta/Aqueduct sample
3 locations had one or more target analytes detected. The median concentration of individual analytes
4 was <30 ng/L, except for diuron (81 ng/L), an agricultural pre-emergent herbicide that is used
5 extensively in the region. Maximum concentrations for some analytes exceeded 100 ng/L. The study
6 determined that analyte concentrations were generally lower in locations upstream of domestic
7 WWTPs, indicating that wastewater effluent discharges are the likely dominant sources of most
8 PPCPs detected.

9 A preliminary screening study of surface waters along the northern California coast and the Central
10 Valley took place between 2003 and 2005 to determine whether chemicals associated with
11 agricultural and urban land uses could be potential sources of EDCs (de Vlaming et al. 2006). The
12 authors concluded that there was no strong estrogenic activity equivalent to assay positive control.

13 In 2006, CCWD participated in a study to examine the toxicological relevance of EDCs and PPCPs in
14 both raw source and treated water (Contra Costa Water District 2009). Of the 62 compounds
15 analyzed, only five were detected in the treated water: sulfamethoxazole (pharmaceutical),
16 meprobamate (pharmaceutical), atrazine (herbicide—endocrine disruptor), triclosan
17 (pharmaceutical), and dioctyl phthalate (used to make plastics—endocrine disruptor). The study
18 concluded that detection occurred at low concentrations and should not pose any health threats.

19 Regarding nitrosamines, while several studies have examined NDMA and other nitrosamine
20 formation in water and WWTPs, few studies have examined NDMA or other nitrosamines in the
21 study area. A study conducted in the Delta concluded that locations downstream of WWTPs had the
22 highest levels of NDMA precursors, as measured by NDMA formation potential, although actual
23 NDMA concentrations were low. Formation potential as a result of diuron in the samples was low
24 (DiGiorgio 2009).

25 Existing Conditions in the Study Area

26 Data for most EDCs, PPCPs, and nitrosamines in the Delta and the north- and south-of-Delta
27 locations are very sparse because most compounds are not typically part of water quality sampling
28 programs. The aforementioned studies represent the most current information on the monitoring of
29 these compounds in the Delta. This reality lead EPA to recently conclude in its Advanced Notice of
30 Proposed Rule Making regarding water quality challenges in the Delta, “Although there is not
31 sufficient data in the published literature to adequately assess the ecological implications of these
32 compounds in the Bay Delta Estuary, there is ample evidence to warrant additional attention” (U.S.
33 Environmental Protection Agency 2011:48). As such, EPA included emerging contaminants on its list
34 of likely stressors affecting aquatic resources in the Delta (U.S. Environmental Protection Agency
35 2011:20, 48; 2012a:3).

36 Regulatory criteria with respect to emerging pollutants are as follows. Numerical water quality
37 objectives for the CTR, Central Valley Water Board Basin Plan, San Francisco Bay Water Board Basin
38 Plan, or California drinking water MCLs for pollutants that act as EDCs are discussed in previous
39 constituent subsections: mercury, other trace metals, dioxins, PAHs, PCBs, and pesticides. Listings
40 for emerging pollutants on the Section 303(d) list are limited to these aforementioned subsections
41 as well. With regard to Basin Plan narrative objectives, emerging pollutants might fall under the
42 *population and community ecology* or *toxic* categories. Finally, in addition to the aforementioned
43 DPH public health goal (3 ng/L for NDMA) and notification levels for some nitrosamines, three

1 nitrosamines (NDMA, NDPA, and N-Nitrosodiphenylamine) are listed in the CTR (0.00069, 0.005, 5.0
2 µg/L, respectively, for consumption of water and organisms).

3 **8.1.3.9 Mercury**

4 **Background**

5 Mercury and its more biologically available methylated form is an element of statewide concern.
6 Mercury present in the Delta, its tributaries, Suisun Marsh, and San Francisco Bay today is derived
7 both from current processes and as a result of historical deposition. The majority of the mercury
8 present (and hence the impacts on beneficial uses) is the result of historical mining of mercury ore
9 in the Coast Ranges (via Putah and Cache Creeks to the Yolo Bypass) and the extensive use of
10 elemental mercury to aid gold extraction processes in the Sierra Nevada (via Sacramento, San
11 Joaquin, Cosumnes, and Mokelumne Rivers) (Alpers et al. 2008:6; Wiener et al. 2003). Residual
12 mercury in soils affected by historical mining continues to contribute to mercury concentrations in
13 water and sediments of the Delta and its tributaries. The mercury supplied from historical gold
14 mining processes appears to be the most bioavailable of the two primary sources because that
15 mercury was purified prior to use rather than left as more refractory ore and tailings (Central Valley
16 Regional Water Quality Control Board 2008a).

17 The bioavailability and toxicity of elemental mercury (from whatever primary source) are greatly
18 enhanced through the natural, bacterial conversion of mercury to methylmercury in marshlands or
19 wetlands. These environments tend to be more stagnant, with reduced oxygen concentrations, and
20 promote chemical reduction processes that make methylation possible.

21 Areas of enhanced bioavailability and toxicity of mercury (created through the mercury methylation
22 process) exist in the Delta, and elevated methylmercury concentrations in fish tissue produce
23 subsequent exposure and risk to humans and wildlife. Consequently, the beneficial uses (Table 8-1)
24 most directly affected by mercury are shellfish harvesting and commercial and sport fishing
25 activities that pose a human health concern, and wildlife habitat and rare, threatened, and
26 endangered species resources that can be exposed to bioaccumulation of mercury. Because of these
27 concerns, mercury was the first TMDL approved for San Francisco Bay in 2007 (San Francisco Bay
28 Water Board 2006). The Delta methylmercury TMDL was approved by the Central Valley Water
29 Board in 2010 and was approved as final on October 20, 2011 (Central Valley Regional Water
30 Quality Control Board 2011b). The Delta, several direct tributaries to the Delta (i.e., Sacramento
31 River, San Joaquin River, Mokelumne River, Putah Creek, and Calaveras River), and areas
32 downstream (i.e., Suisun Bay and Suisun Marsh) also are listed as impaired water bodies on the
33 Section 303(d) lists for mercury in fish tissue (State Water Resources Control Board 2011).

34 **Importance in the Study Area**

35 Limiting characterization to the routine monitoring of total mercury waterborne concentrations is
36 inadequate to determine mercury bioavailability. A conceptual model is needed to determine the
37 importance of sediment, fish tissue, and methylated mercury as measures of exposure and risk in
38 the system. A description of this model follows, and then concentrations in sediment and fish tissues
39 are detailed.

1 **Conceptual Model of Mercury and Methylmercury Transport and Fate in the Delta**

2 Several conceptual models have been created for the Delta to describe important linkages among
 3 waterborne loading, waterborne concentrations, and water, sediment, and biotic processing of
 4 mercury and methylmercury (Ecosystem Restoration Program Delta Regional Ecosystem
 5 Restoration Implementation Plan [ERP DRERIP]). Figure 8-27 shows the important linkages,
 6 pathways, and relative importance of each in determining bioavailability; the important links
 7 between sediment processes and biotic uptake are emphasized. Mercury is strongly particle-
 8 associated and tends to settle and accumulate in sediment deposition areas, where, if conditions are
 9 favorable, can facilitate mercury methylation by sulfur-reducing bacteria. From that point in the
 10 cycle, diet (rather than waterborne concentration) is the primary route for methylmercury exposure
 11 to fish, wildlife, and humans. Refer also to Chapter 25 (Public Health) for discussion of the effects of
 12 mercury to human health.

13 The goal of mercury conceptual models (such as Alpers et al.2008:ii) and plans created for
 14 integrated mercury investigations as part of Delta restoration efforts (such as Wiener et al. 2003)
 15 has been to identify linkages that can be used to guide restoration efforts toward the least harmful
 16 alternatives (the alternative with the least potential to exacerbate mercury-related effects). Aside
 17 from controlling upstream sources of mercury and methylmercury loading to the Delta, it may be
 18 important to limit the conversion of mercury to the more bioaccumulative and toxic methylmercury
 19 in Delta environments. For that reason, the Central Valley Water Board has focused on controlling
 20 methylmercury to protect beneficial uses in the Delta (Central Valley Regional Water Quality Control
 21 Board 2008b). As shown in Figure 8-27, a series of drivers related to water quality and sediment
 22 determines methylmercury production and uptake in biota and subsequent health effects on
 23 humans or wildlife. At every step of the process, opportunities exist to modify final outcomes and
 24 minimize impacts from mercury toxicity.

25 As suggested in Figure 8-27 and summarized from the local and general literature (as discussed and
 26 cited in Alpers et al. 2008), the following environmental characteristics are most important for
 27 determining risks to fish, wildlife, and humans from waterborne mercury contamination in the
 28 Delta.

- 29 • Source of mercury (atmospheric and gold mining operations are most bioavailable).
- 30 • Nutrient enrichment (high nutrient supply, algal growth, and eutrophication favor mercury
 31 uptake, bioaccumulation, and methylation).
- 32 • Water column DO (oxygen depletion in water or surface sediments favors methylation).
- 33 • Sediment organic content and grain size (small size fractions and more organic characteristics
 34 favor methylation).
- 35 • Water residence time and sediment accumulation (high residence time and sediment deposition
 36 areas favor methylation).
- 37 • Periodic drying and wetting (seasonal or annual flooding enhances methylmercury production
 38 and food chain bioaccumulation in certain areas of the Delta) (Slotton et al. 2007).
- 39 • Fish species and age structure (top predators and older, larger fish accumulate higher tissue
 40 concentrations of methylmercury).

1 Although sulfate could affect rates of mercury methylation (due to the dependence on sulfate-
2 reducing bacteria for methylation), such a relationship is highly variable and site-specific and not a
3 good predictor of methylation potential. The environmental factors governing rates of methylation
4 are complicated and site-specific modeling is required (Moore et al. 2003). Although sulfate can be
5 important to the rate of mercury methylation (Gilmour et al. 1992), intermediate levels may be more
6 stimulatory than low or high concentrations (Shao et al. 2012). Furthermore, experiments have
7 revealed that sulfate supply does not always directly relate to rates of methylation (Johnson and
8 Beck 2012). In contrast, the importance of low DO and availability of organic carbon is well known
9 (Alpers et al. 2008; Gorski et al. 2007), as well as the necessary supply of inorganic mercury (Shao et
10 al. 2012). In addition, the availability of dissolved mercury may be determined by the availability of
11 solid FeS (Han et al. 2007). For these reasons, waterborne sulfate, by itself, is not considered a
12 reliable predictor of mercury methylation potential or correlated to methylmercury concentrations.

13 **Existing Conditions in the Study Area**

14 **Water Concentrations**

15 Water quality data from the Delta and Suisun Marsh include records of mercury and methylmercury
16 waterborne concentrations as total or filtered water fractions. Water quality summary information
17 since 1999 is shown in Table 8-14. The general pattern of mercury waterborne loading to the Delta
18 shows the dominance of mercury mining sources via Cache Creek and the Yolo Bypass (Central
19 Valley Regional Water Quality Control Board 2008b); however, the waterborne average
20 concentrations do not reflect the same pattern as loads (Table 8-15). Instead, the eastside
21 tributaries and San Joaquin River show higher mercury and methylmercury concentrations than the
22 Sacramento River inputs. In general, waterborne concentrations of total mercury fall below
23 regulatory guidelines while most of the mean methylmercury concentrations throughout the Delta
24 exceed the Regional Board TMDL concentration guidelines of 0.06 ng/L (Table 8-14).

25 **Sediment Concentrations**

26 It has been estimated that the flux of methylmercury from Delta sediments contributes up to 36% of
27 the waterborne methylmercury load in the Delta (Central Valley Regional Water Quality Control
28 Board 2008a). Therefore, the spatial variability of mercury and methylmercury in sediments is an
29 important characteristic of the Delta's current condition for mercury exposure and could be
30 important for determining future mercury risk. Table 8-15 shows the pattern of surface sediment
31 mercury throughout the Delta and Suisun Bay. The data is presented to show the pattern of mercury
32 deposition and to aid future planning, but sediment data (in contrast to water and fish) is not
33 modeled as part of this evaluation of future conditions for project alternatives.

34 The CALFED sediment mercury study reported that total mercury in sediments varied spatially but
35 not seasonally (Heim et al. 2007). Total mercury concentrations (the sum of elemental and
36 methylmercury) in sediment were most elevated in the influent tributary streams and Suisun Bay
37 compared to the central and southern Delta.

38 In contrast, methylmercury showed both spatial and seasonal variations in concentration. The
39 biologically mediated nature of mercury methylation was apparently important in creating a
40 seasonal summer maximum in sediment methylmercury concentrations. Methylmercury
41 concentrations were highest in the mid-Delta interior marshes (compared to peripheral rivers) and
42 varied on a small scale, with the highest concentrations in mid-marsh.

1 The pattern of mercury transport and fate in the Delta is one of waterborne loading from historical
2 source waters (and runoff from historically affected soils) to the interior Delta, followed by the
3 accumulation of fine sediments in the marsh and subsequent methylation of elemental mercury in
4 those locations (Heim et al. 2007).

5 **Fish Tissue Concentrations**

6 Resident Delta fish accumulate mercury primarily through dietary exposure; larger, piscivorous
7 (fish-eating) fish show the greatest levels of tissue mercury. In contrast to anadromous fish
8 (migratory species), the resident fish experience constant exposure to local mercury sources.
9 Resident species include larger fish with human health exposure (such as largemouth bass) and
10 smaller, forage fish (such as inland silversides). Fish tissues are the ultimate route of exposure to
11 mercury for aquatic-dependent birds and mammals, and for humans who consume locally caught
12 fish.

13 The mercury conceptual model illustrates these principles. Human health and wildlife health effects
14 resulting from mercury exposure and uptake are the final outcomes of the mercury conceptual
15 model (Figure 8-27). Available data show substantial levels of mercury contamination in fish
16 throughout the Delta. For example, the tissue concentrations of mercury in largemouth bass are
17 shown as a spatial distribution throughout the Delta in Figure 8-28 (1999–2000 data). Note that the
18 Mokelumne River, Cosumnes River, Sacramento River, and San Joaquin River inflows exhibit the
19 highest fish tissue bioaccumulation, whereas these larger sport fish had uniformly lower tissue
20 concentrations in the central Delta.

21 Larger, piscivorous resident fish, in general, provide a good record of fish tissue mercury as a
22 baseline condition for the Delta. Largemouth bass were chosen because they are popular sport fish,
23 top predators, live for several years, and tend to stay in the same area (exhibit high site fidelity).
24 Consequently, they are excellent indicators of long-term average mercury exposure, risk, and spatial
25 pattern for ecological and human health. Results from a study of mercury in sport fish from the Delta
26 region found the median largemouth bass tissue mercury concentration to be 0.53 mg mercury per
27 kilogram (Hg/kg) wet weight (Davis et al. 2008). Recent summaries from tributary inputs to the
28 Delta reveal average bass concentrations similar to or higher than this Delta-wide average (Table 8-
29 16).

30 Current fish tissue concentrations thus exceed both adopted regulatory standards and guidance
31 from the USEPA. In the draft Delta TMDL for methylmercury, the Central Valley Water Board has
32 recommended fish tissue goals (fillet concentrations, wet weight mercury) of 0.24 mg Hg/kg wet
33 weight in trophic level 4 fish (adult, top predatory sport fish, such as largemouth bass) (Central
34 Valley Regional Water Quality Control Board 2008b). These values are slightly lower than USEPA's
35 national recommended water quality criterion for fish tissue of 0.3 mg Hg/kg wet weight for
36 protection of human health and wildlife (U.S. Environmental Protection Agency 2001). Therefore,
37 the Delta average for largemouth bass fillet concentrations in the study by Davis et al. exceeds both
38 recommended safe consumption guidelines.

1 **Table 8-14. Mercury and Methylmercury Surface Water Concentrations at Tributary Inputs and the Delta’s Major Outputs**

Site	Mercury Concentration (ng/L)						Methylmercury Concentration (ng/L)					
	No. of Samples	Min.	Max.	Mean	Year Collected	Source	No. of Samples	Min.	Max.	Mean	Year Collected	Source
Mercury Concentrations for Tributary Inputs												
Sacramento River at Keswick	26	0.2	2.7	0.5	2006–2007	DWR 2010	–	–	–	–	–	–
Sacramento River at Keswick ^a	–	–	–	–	–	–	–	–	–	–	–	–
Feather River at Oroville	5	0.2	0.7	0.4	2006–2007	DWR 2010	–	–	–	–	–	–
Feather River at Oroville ^a	–	–	–	–	–	–	–	–	–	–	–	–
Sacramento River at Verona	5	0.8	2.6	1.6	2006–2007	DWR 2010	–	–	–	–	–	–
Sacramento River at Verona ^a	–	–	–	–	–	–	–	–	–	–	–	–
Sacramento River at Freeport	45	1.2	30.6	4.1	1999–2002	Central Valley Water Board 2008a	36	0.05	0.24	0.10	2000–2003	Central Valley Water Board 2008a
Sacramento River at Freeport ^a	0	–	–	–	–	–	1	0.03	0.03	0.03	2000	Central Valley Water Board 2008a
San Joaquin River at Vernalis	49	3.1	21.7	7.6	2000–2004	BDAT 2010; Central Valley Water Board 2008a	49	0.09	0.26	0.15	2000–2001, 2003–2004	BDAT 2010; Central Valley Water Board 2008a
San Joaquin River at Vernalis ^a	19	0.3	3.0	0.8	2000–2002	BDAT 2010; USGS 2010	25	0.01	0.08	0.03	2000–2002	BDAT 2010; Central Valley Water Board 2008a; USGS 2010
Mokelumne River at Interstate 5	21	0.3	12.0	4.5	2000, 2001, 2003	Central Valley Water Board 2008a	23	0.02	0.32	0.12	2000, 2001, 2003	Central Valley Water Board 2008a
Mokelumne River at Interstate 5 ^a	0	–	–	–	–	–	8	0.02	0.17	0.06	2000	Central Valley Water Board 2008a
Cosumnes River at Michigan Bar ^a	1	1.4	1.4	1.4	2002	USGS 2010	1	0.41	0.41	0.41	2002	USGS 2010
Calaveras River at Rail Road upstream of West Lane	4	13	26	20	2003–2004	Central Valley Water Board 2008a	4	0.11	1.9	0.14	2003–2004	Central Valley Water Board 2008a

Site	Mercury Concentration (ng/L)						Methylmercury Concentration (ng/L)					
	No. of Samples	Min.	Max.	Mean	Year Collected	Source	No. of Samples	Min.	Max.	Mean	Year Collected	Source
Mercury Concentrations for Delta's Major Outputs												
Delta-Mendota Canal at Byron Highway	23	1.9	6	3.3	2000, 2001, 2003	Central Valley Water Board 2008a	21	0.01	0.17	0.05	2000, 2001, 2003	Central Valley Water Board 2008a
Delta-Mendota Canal at Byron Highway ^a	0	-	-	-	-	-	8	0.02	0.09	0.03	2000	Central Valley Water Board 2008a
SWP	20	1.2	7.2	2.5	2000, 2001, 2003	Central Valley Water Board 2008a	20	0.01	0.14	0.04	2000, 2001, 2003	Central Valley Water Board 2008a
SWP ^a	0	-	-	-	-	-	8	0.02	0.08	0.03	2000	Central Valley Water Board 2008a
X2	20	4	49	15	2000, 2001, 2003	Central Valley Water Board 2008a	22	0.007	0.24	0.05	2000, 2001, 2003	Central Valley Water Board 2008a
X2 ^a	0	-	-	-	-	-	8	0.02	0.06	0.03	2000	Central Valley Water Board 2008a
Suisun Bay	34	2.52	35.24	9.43	2000-2008	SFEI 2010	36	8E-05	0.18	0.03	2000-2008	SFEI 2010
Suisun Bay ^a	35	0.16	4.80	0.84	2000-2008	SFEI 2010	32	8E-05	0.10	0.01	2000, 2002-2008	SFEI 2010
California Aqueduct Check 13	-	-	-	-	-	-	-	-	-	-	-	-
California Aqueduct Check 13 ^a	36	0.2 ^b	0.2 ^b	0.2 ^b	2000-2005	DWR 2010	-	-	-	-	-	-
California Aqueduct Check 29	-	-	-	-	-	-	-	-	-	-	-	-
California Aqueduct Check 29 ^a	152	0.2 ^b	0.2 ^b	0.2 ^b	2000-2010	DWR 2010	-	-	-	-	-	-

Sources: Bay Delta and Tributaries Project (BDAT) 2010; Central Valley Regional Water Quality Control Board 2008a; California Department of Water Resources (DWR) 2010; San Francisco Estuary Institute (SFEI) 2010; U.S. Geological Survey (USGS) 2010.

Notes: Max. = maximum; Min. = minimum; ng/L = nanograms per liter.

^a Dissolved concentration of analyte.

^b It is assumed that the units were reported incorrectly for the site.

1 **Table 8-15. Mercury and Methylmercury Sediment Concentrations for Tributary Inputs, the Delta, and Suisun Bay**

Site	Sample Type	Total Mercury (ng/g Dry Weight)					Methylmercury (ng/g Dry Weight)				
		Samples	Min.	Max.	Mean	Year	Samples	Min.	Max.	Mean	Year
Concentrations at Tributary Inputs											
Sacramento River, Freeport ^a	Colloid	4	140	290	208	1996–1997	–	–	–	–	–
Sacramento River, Freeport ^a	Bed Sediment	1	267	267	267	1996–1997	–	–	–	–	–
Concentrations in Delta and Suisun Bay											
North Delta ^b	Surficial Sediment	11	104	320	170	1999	11	0.12	0.64	0.35	1999
East Delta ^b	Surficial Sediment	12	10.5	340	110	1999	9	0.02	0.68	0.3	1999
Central and West Delta ^b	Surficial Sediment	15	10.5	370	77	1999	12	0.019	1.1	0.36	1999
Central and West Delta ^c	Surficial Sediment	18	16.5	417	106	2000–2008	18	0.02	0.7	0.11	2000–2008
Suisun Bay ^b	Surficial Sediment	21	66	580	270	1999	20	0.019	9.3	0.45	1999
Suisun Bay ^c	Surficial Sediment	69	0.03	413	114	2002–2007	69	0.004	0.82	0.13	2000–2008

Sources: Heim et al. 2007; San Francisco Estuary Institute 2010; U.S. Geological Survey 2009.

Notes: Max. = maximum; Min. = minimum; ng/g = nanograms per gram.

^a Source: U.S. Geological Survey 2009.

^b Source: Heim et al. 2007.

^c Source: San Francisco Estuary Institute 2010.

2

1 **Table 8-16. Mercury Concentrations in Largemouth Bass Fillets for Tributary Inputs**

Site	Fish	Length (mm)			Concentration (mg Hg/kg Wet Weight)			Year
		Min.	Max.	Mean	Min.	Max.	Mean	
San Joaquin River at and downstream of Vernalis	40	226	530	325	0.21	1.4	0.56	1998–2000
Mokelumne River downstream of Cosumnes River	22	210	425	331	0.31	1.6	0.83	1999–2000
Cosumnes River	19	201	485	329	0.34	2.1	0.87	1999–2000

Source: Central Valley Regional Water Quality Control Board 2008a.

Notes: Max = maximum; mg Hg/kg = milligrams mercury per kilogram; Min = minimum; mm = millimeters.

2

3 Surprisingly, spatial patterns of mercury bioaccumulation in larger piscivorous sport fish do not
 4 show a clear link to zones of active sediment methylation in the Delta. In the study by Davis et al., the
 5 highest levels of fish tissue concentrations were found in the north Delta, Cosumnes River, and San
 6 Joaquin River, and lower fish tissue concentrations were found in the central, marsh-like Delta
 7 locations (Davis et al. 2008). The pattern reflects the dominance of source waters carrying
 8 methylmercury as a driver of increased fish tissue concentrations relative to the contribution from
 9 areas of secondary methylation in marshy locations or wetlands. In fact, in a related comprehensive
 10 study of Delta sport fish (including largemouth bass), mercury concentrations in fish tissues were
 11 found not to directly relate to the presence of wetlands. The authors found that the data
 12 “contradicted the prevailing notion that wetlands generally increase methylmercury accumulation
 13 in the food web” (Melwani et al. 2007). Nevertheless, the authors acknowledged the complexity of
 14 developing such relationships on a watershed scale; small-scale local factors may be the most
 15 important determinants of mercury bioaccumulation. In a subsequent study, the same authors
 16 suggest that in the case of the Delta, waterborne methylmercury may be a more important
 17 determinant of fish bioaccumulation than sediment mercury and the associated sites where
 18 methylation occurs (Melwani et al. 2009). Furthermore, laboratory studies of mercury uptake in
 19 Delta species indicate that much higher assimilation and uptake were observed in waters of lower
 20 DOC (as might be expected from the tributaries versus the interior Delta) (Pickhardt et al. 2006).
 21 This finding may help explain the dissimilar spatial pattern between sediment and fish
 22 methylmercury concentrations in the areas studied; waterborne methylmercury loading may be
 23 more important than sediment methylation in explaining the patterns of fish mercury
 24 bioaccumulation in the Delta.

25 In addition to human exposure as estimated from large-fish monitoring, the monitoring of whole-
 26 body fish tissues from various smaller species provides slightly different information. Monitoring of
 27 these so-called *biosentinel species*, such as inland silversides, prickly sculpin, and juvenile
 28 largemouth bass, demonstrates the variation in mercury bioaccumulation over small spatial scales
 29 and seasonal time frames (Slotton et al. 2007). The fish were juveniles of predatory fish or were
 30 various short-lived, smaller species and exhibited high site fidelity; thus, they were good monitors of
 31 spatial patterns and short time exposure. These fish were also good indicators of short-term

1 seasonal or interannual exposure patterns. Biosentinel monitoring has been implemented at various
 2 locations within the watershed, a subset of which was incorporated into a Fish Mercury Project
 3 Ecosystem Restoration Program grant. However, funding to support such a program over the long
 4 term is not currently in place. To date, the ongoing biosentinel monitoring program (Slotton et al.
 5 2007) has made these key findings.

- 6 • Episodic, aperiodic, and nonroutine flooding (such as seasonal high flows, extremely high tides,
 7 and managed marsh flooding) of formerly dry sediments leads to enhanced methylmercury
 8 exposure in some areas.
- 9 • The general pattern of bioaccumulation was higher fish tissue mercury concentrations in Suisun
 10 Marsh, Cosumnes River, and Yolo Bypass but lower tissue concentrations in the central Delta
 11 (similar to sport fish results).
- 12 • Large differences occurred in fish tissue concentrations from year to year in Suisun Marsh,
 13 associated with large variations in the extent of annual flooding.

14 The current pattern of mercury bioaccumulation in fish in the Delta and Suisun Marsh demonstrates
 15 the response to enhanced sources of mercury and methylmercury from water, sediment, and dietary
 16 pathways. Larger, piscivorous fish almost uniformly exhibit greater tissue mercury concentrations
 17 than human diet consumption guidelines and are linked to sources of influent loading (Central
 18 Valley Regional Water Quality Control Board 2008b). Smaller, short-lived fish demonstrate clear
 19 spatial patterns of bioaccumulation and the effects of enhanced mercury exposure following the
 20 flooding of usually dry areas (Slotton et al. 2007).

21 Regulatory criteria with respect to mercury are as follows. Applicable water quality criteria for
 22 judging the degree of contamination and effects of future changes in concentrations include those
 23 following.

- 24 • The CTR contains criteria for human health protection of 50 ng/L for freshwater and 51 ng/L for
 25 saltwater, which are expressed in the total recoverable form of the metal.
- 26 • The national recommended water quality criterion for total mercury is 770 ng/L to protect
 27 freshwater aquatic life from chronic exposure and 940 ng/L to protect marine life (U.S.
 28 Environmental Protection Agency 2012b).
- 29 • The Delta methylmercury TMDL limit of methylmercury in water, protective of fish
 30 bioaccumulation, is 0.06 ng/L (Central Valley Regional Water Quality Control Board 2008b).
- 31 • The San Francisco Bay mercury TMDL limit of total mercury in water is 25 ng/L (4-day average).

32 A comparison to Table 8-14 shows that the total mercury criterion (25 ng/L) has been exceeded in
 33 the Sacramento River at Freeport, the Calaveras River, and Suisun Bay, but mean concentrations
 34 have been below this criterion. In contrast, many of the mean and maximum methylmercury
 35 concentrations in water exceed the suggested guidelines for aquatic life (0.06 ng/L) and human
 36 health (through fish consumption).

37 Sediment concentrations can be judged against the Section 303(d) list screening as used by the
 38 Central Valley Water Board, based on the consensus screening value of 1.06 mg Hg/kg dry weight
 39 (1,060 ng/g) (MacDonald et al. 2000). Note that all total mercury values in Table 8-16 are below this
 40 screening value. However, this does not account for the complicated exposure pathways and
 41 methylation, which drive uptake and bioaccumulation into the food chain (Figure 8-27) more than
 42 does the total mercury concentrations in bulk sediment. Instead, sediment concentrations of

1 mercury and methylmercury can serve as weights of evidence for differences among areas in
2 mercury exposure potential from in-place or resuspended sediments.

3 The Delta TMDL limit for small, whole-fish mercury content for protection of fish and wildlife is 0.03
4 mg Hg/kg wet weight (Central Valley Regional Water Quality Control Board 2008b). This is in
5 comparison to 2005–2006 Mississippi silversides whole-body mercury concentrations of 0.03 to
6 0.06 mg Hg/kg wet weight in the central Delta, 0.17 mg Hg/kg wet weight in the Yolo Bypass, and up
7 to 0.20 mg Hg/kg wet weight at the Cosumnes River site (Slotton et al. 2007). Most of these small
8 fish from the Delta and Suisun Marsh exceeded the recommended Delta TMDL small-fish guideline
9 concentrations for mercury.

10 USEPA (2012a) has initiated a series of special, focused studies concerned with the control of
11 mercury methylation in marsh and wetland habitats of the Delta, with special emphasis on the
12 mitigation for enhanced methylation as may occur in new restoration wetland environments. As
13 part of their list of water quality challenges and action plan for the Delta, USEPA (2012a) lists the
14 need to “Restore aquatic habitats while managing methylmercury”. The plan cites specific ongoing
15 studies by USGS, the Central Valley Water Board, and the California Coastal Conservancy, in
16 conjunction with USEPA, to study treatment technologies that may be used to sequester
17 methylmercury.

18 Additionally, the Central Valley Basin Plan requires all entities subject to controlling methylmercury
19 in the Delta and Yolo Bypass, including DWR and USBR, to participate in a program to reduce human
20 exposure to mercury through eating fish. Individually or collectively, these entities will submit a
21 mercury exposure reduction program strategy in 2013.

22 **8.1.3.10 Nitrate/Nitrite and Phosphorus**

23 **Background and Importance in the Study Area**

24 Nutrients, primarily nitrogen (N) and phosphorus (P), play a complex role in water quality
25 (ammonia-N is discussed in a previous section) and the health of aquatic ecosystems. Phosphorus is
26 generally considered a limiting nutrient in freshwater systems, while nitrogen is generally
27 considered a limiting nutrient in marine systems. A limiting nutrient is one that is in shorter supply
28 for organisms that depend on nutrients for growth relative to the other nutrients, and thus increases
29 or decreases in the limiting nutrient affect primary productivity. In freshwater rivers, phosphorus is
30 usually bound to particles, complexing with elements such as iron. When this freshwater enters
31 estuaries and becomes more saline, the P-iron complex disassociates and the phosphorus is released
32 in a form that can be readily absorbed by algae. Hence there is, in many instances, adequate
33 phosphorus available for algal growth in estuary conditions.

34 The beneficial uses (Table 8-1) most directly affected by nutrient concentrations include those
35 relevant to aquatic organisms (cold freshwater habitat, warm freshwater habitat, and estuarine
36 habitat), drinking water supplies (municipal and domestic supply), and recreational activities
37 (water contact recreation, noncontact water recreation), which can be indirectly affected by the
38 nuisance eutrophication effects of nutrients. Aquatic life depends on the availability of nutrients;
39 however, elevated concentrations of nutrients can cause eutrophication, as discussed in the
40 previous sections (DO, ammonia, and turbidity and total suspended solids [TSS]).

41 There are presently no applicable water quality standards for P. Drinking water standards have
42 been set for nitrate (10 mg/L) and nitrite (1 mg/L) because nitrate and nitrite can compete with

1 oxygen for receptor sites on hemoglobin in the bloodstream, thereby interfering with normal
2 respiration and causing effects in humans such as blue-baby syndrome. The USEPA in 1998
3 published the *National Strategy for the Development of Regional Nutrient Criteria* where it identified
4 that, due to the highly variable relationships of nutrient levels to biostimulatory responses across
5 the county, it would not develop national recommended nutrient criteria. Instead, USEPA expects
6 states and tribes to develop water quality standards for nutrients, or nutrient numeric endpoints
7 (NNEs), in their geographic regions. The primary goal of NNEs is to establish nutrient levels that
8 support the health of aquatic systems and also limit excessive growth of macrophytes or
9 phytoplankton, public health threats, and general degradation of aquatic resources. The NNE
10 framework has two components: a) response indicators and regulatory endpoints that specify how
11 to assess water body condition, and b) nutrient-response models that can be used to link response
12 indicators to nutrients and other management controls (e.g., hydrology) on a water body-specific
13 basis.

14 The State Water Board and USEPA Region 9 office are working to develop NNEs to regulate nutrient
15 levels for inland surface waters in California, excluding inland bays and estuaries. The San Francisco
16 Bay Water Board is working with Southern California Coastal Water Research Project and SFEI staff
17 to develop NNEs for the San Francisco Bay. The Delta Stewardship Council's 2013 Delta Plan
18 recommended that the San Francisco and Central Valley Water Boards prepare study plans for the
19 development of NNEs for the Delta and Suisun Bay. The Delta Plan states that the water boards
20 should adopt and begin implementation of nutrient objectives, either narrative or numeric, where
21 appropriate, by January 1, 2018. The Central Valley Water Board has embarked on a Nutrient Study
22 Plan, which will be closely coordinated with the San Francisco Bay study effort, to determine
23 whether separate nutrient criteria for the Delta are necessary. The Nutrient Study Plan is considered
24 a necessary prerequisite for any decisions about creating NNEs for the Delta and determining how
25 they would be implemented. The Nutrient Study Plan consists of four topical study areas (i.e.,
26 macrophyte, cyanobacteria, nutrient concentrations-forms-ratios, and modeling tools) to assess the
27 fundamental question of whether there is evidence that nutrients contribute to Delta problems
28 associated with macrophytes and algae.

29 Nutrients in the Delta are derived from a variety of point sources, including municipal discharges,
30 and nonpoint sources, including agricultural and urban runoff. As discussed previously (see the
31 Ammonia section), nutrient concentrations in the Delta are high enough that they are probably not a
32 true limiting factor for algal growth. However, excessively high nutrient concentrations also can be
33 associated with algal blooms and decreased water quality, and it is unclear whether nutrient
34 concentrations are adversely affecting primary productivity, which may be a contributing factor to
35 pelagic organism decline (POD) (see the Ammonia section for more information on POD). Excessive
36 algae growth also can be a concern for municipal beneficial uses as a result of the elevated organic
37 carbon associated with organic biomass. Cyanobacteria are of concern due to toxin formation
38 potential of some species.

39 Aquatic life depends on the availability of nutrients; however, elevated concentrations of nutrients
40 such as nitrate can cause eutrophication, in which high algal and bacterial growth and subsequent
41 microbial respiration deplete oxygen, producing anoxic waters and sediments. Waters of the Delta
42 are not considered nutrient-limited; that is, algal growth rates are limited by availability of light, and
43 thus increases or decreases in nutrient levels are, in general, expected to have little effect on
44 productivity (Jassby et al. 2002). However, when waters of the Delta are exported into conveyance
45 canals, algae may no longer be light-limited, and thus increases in nutrient levels in Delta export
46 waters may increase phytoplankton growth in the canals. Algal blooms are problematic in that they

1 create biomass that can obstruct water conveyance facilities and clog filters, and they may also lead
2 to taste and odor problems for municipal supplies (State Water Project Contractors Authority
3 2007:3-69).

4 However, regarding the potential for taste and odor concerns, Jones-Lee (2008) summarized a
5 presentation by P. Hutton (Metropolitan Water District), given at the March 25, 2008, California
6 Water and Environmental Modeling Forum (CWEMF) Delta Nutrient Water Quality Modeling
7 Workshop, that stated:

8 “there is limited ability to relate nutrient loads or in-channel concentrations to domestic water
9 supply water quality. While there is some ability to model the relationship between the nutrient load
10 to a waterbody and the planktonic algal biomass that develops in the waterbody, it is not possible to
11 adequately model the relationship between nutrient load to a waterbody and the development of
12 benthic and attached algae in that waterbody (Jones-Lee 2008:6).”

13 This is important in that benthic and attached algae are potentially more important for taste and
14 odor concerns than is planktonic biomass generally (Juttner and Watson 2007:1-2, Taylor et al.
15 2006).

16 In addition, changes in ratios of nutrients may affect aquatic life by causing changes in the
17 proportions of algal species, macrophytes and higher species (Glibert et al. 2011). While the impact
18 of nutrient ratios on the proportions of algal species, macrophytes and higher species is unsettled
19 within the scientific community, some analyses demonstrate that the ratio of one nutrient to
20 another, nutrient stoichiometry, may influence primary productivity and community composition.
21 Glibert et al. (2011) analyzed over 30 years of Delta water quality data and conclude that numerous
22 aquatic organism population shifts (i.e., increases in flagellates, cyanobacteria, piscivorous fish, and
23 invasive vegetation and bivalves; and declines in the zooplankton *Eurytomea* sp., delta smelt, and
24 diatoms) were correlated with changes in the quality and quantity of nutrients.

25 This relationship between nutrient ratios and organism population shifts is not unique to the Delta.
26 Studies in Hong Kong, Tunisia, Germany, Florida, Spain, Korea, Japan and Washington D.C.
27 (Chesapeake Bay), to name a few, have all concluded that nutrient stoichiometry influences
28 phytoplankton community composition (Ruhl and Rybicki 2010; Ibanez et al. 2008; Hodgkiss and
29 Ho 1997; and Glibert et al. 2004). Furthermore, studies by Glibert et al. (2004; 2006), Lomas and
30 Glibert (1999), and Dortch (1990) concluded that diatoms have a preference for nitrate while
31 dinoflagellates and cyanobacteria generally prefer more reduced forms of nitrogen. Hessen (1997)
32 found that a shift from calanoid copepods to *Daphnia* tracked N:P changes in Norwegian lakes.
33 Sterner and Elser (2002) found that zooplankton size, composition and growth rates changed as the
34 N:P ratio changed. Similar changes have been observed in the Delta, though these researchers did
35 not differentiate the form of N between nitrate and ammonium. Glibert et al. (2011) found
36 significant correlations between nutrient ratios and the dominant zooplankton in the Delta over the
37 last 30 years.

38 The beneficial uses most directly affected by nitrogen and phosphorus concentrations are aquatic
39 organisms (cold freshwater habitat, warm freshwater habitat, and estuarine habitat), drinking water
40 supplies (municipal and domestic supply), and recreational activities (water contact recreation,
41 non-contact water recreation), which can be indirectly affected by the nuisance eutrophication
42 effects of nutrients.

1 Existing Conditions in the Study Area

2 A conceptual model developed for the Central Valley Drinking Water Policy Workgroup (Tetra Tech
3 2006a) estimated nutrient concentrations across the Central Valley by averaging time series data at
4 many sampling locations. Results indicate that total nitrogen (TN) and total phosphorus (TP)
5 concentrations were typically higher in the San Joaquin River (approximately 1.6 mg/L and 0.16
6 mg/L, respectively) compared to the Sacramento River (approximately 0.4 mg/L and 0.08 mg/L,
7 respectively). TN was typically in the form of nitrate-N. TP composition varied from high to low
8 concentrations of particulate-phosphorus. TP concentrations showed little inter-seasonal variation
9 for these two rivers, but higher TN concentrations were seen in the Sacramento River during wet
10 months and in the San Joaquin River during dry months (Tetra Tech 2006a).

11 Overall, TN and TP concentrations in the San Joaquin River and the Delta are relatively high and are
12 at concentrations that would be classified as eutrophic waters. Given the abundance of nutrients,
13 primary productivity in the Delta is fairly low (Jassby et al. 2002), suggesting that factors other than
14 nutrients are limiting, specifically light limitation caused by turbidity levels. The San Joaquin River
15 exhibits symptoms of eutrophic conditions, notably low DO concentrations that impair migration of
16 cold and warm freshwater species (Jassby 2005). However, when waters from the Delta are pumped
17 out in aqueducts for transport, or stored in reservoirs along the way, other limiting factors may
18 disappear and high levels of algal growth may result (Tetra Tech 2006a).

19 Although effects on water quality usually are related to concentrations of constituents, load
20 estimates may facilitate identification of important sources. Tributary loads were found to vary
21 substantially between wet and dry years, with loads from the Sacramento River exceeding the San
22 Joaquin River loads by nearly a factor of two or greater, especially in dry years (Tetra Tech 2006a).
23 Forest/rangeland loads may dominate the overall nitrogen loads for the Sacramento basin, and
24 agricultural loads may dominate in the overall nitrogen loads to the San Joaquin basin, particularly
25 for wet years. Point source loads from wastewater discharges may contribute nearly half or more of
26 the overall nitrogen and phosphorus loads during dry years in both basins, and possibly during wet
27 years for phosphorus in the San Joaquin basin. Current estimates for in-Delta contribution of
28 nutrients from agriculture on the Delta islands are small compared to tributary sources (Tetra Tech
29 2006a).

30 TN and TP are often subdivided into different chemical species. Filtered water samples consist of
31 dissolved organic nitrogen, nitrate-N ($\text{NO}_3\text{-N}$), nitrite-N ($\text{NO}_2\text{-N}$), ammonia ($\text{NH}_3\text{-N}$), dissolved
32 organic phosphorus, and ortho-phosphorus (ortho-P). Due in part to their immediate biological
33 availability to algae, chemical species typically analyzed by water quality monitoring programs
34 include $\text{NH}_3\text{-N}$ (see previous section), the combined $\text{NO}_3/\text{NO}_2\text{-N}$ fraction (because of ease of
35 analysis; in oxygenated waters the sample typically is dominated by $\text{NO}_3\text{-N}$), and ortho-P.

36 In the aquatic environment, nitrogen and phosphorus compounds may rapidly cycle between water,
37 organisms, and sediments. Nitrate also is formed in the process of nitrification from ammonia. It is
38 estimated that 75% of the ammonia present in the Sacramento River at Hood is converted to nitrate
39 by the time the water reaches Chipps Island (Central Valley Regional Water Quality Control Board
40 2010a:4).

1 Dissolved ortho-phosphate is the form of phosphorus that generally is considered to be available for
 2 algal and plant uptake. Total phosphorus may be a better determinant of lake and reservoir
 3 productivity because most phosphorus is tied up in plankton and organic particles during periods of
 4 high productivity. Therefore, dissolved ortho-phosphate concentrations may be very low in highly
 5 productive lakes and reservoirs (Tetra Tech 2006a:2-4). The dynamics and speciation of
 6 phosphorus in flowing water bodies such as the Sacramento and San Joaquin Rivers is not as
 7 straightforward because they continually receive phosphorus from upstream, groundwater, and
 8 runoff. Because of this, the form in which phosphorus is delivered plays a role in determining which
 9 form of phosphorus is a better predictor of productivity downstream (Tetra Tech 2006a:2-5). An
 10 analysis of source waters to the Delta found that ortho-phosphate may make up from very little to
 11 almost all of the TP at a location at any given time (Tetra Tech 2006a:3-25 to 3-26).

12 Nitrate/Nitrite

13 Most examined locations in the northern half of the Plan Area, as well as the export area of the Delta,
 14 have had low concentrations of NO₃/NO₂-N in recent years (water years 2001–2006), with mean
 15 values typically ranging from 0.28 to 0.40 mg/L (Figure 8-29). Concentrations in the southern half of
 16 the Delta, however, were typically higher. For example, the CCWD pumping plant #1 had a mean
 17 value of 0.46 mg/L, and the Banks pumping plant had a mean value of 0.56 mg/L. The highest mean
 18 values were seen at the San Joaquin River near Vernalis (1.34 mg/L) and San Joaquin River at
 19 Buckley Cove (1.63 mg/L).

20 Mean values for the north-of-Delta area ranged from 0.6 mg/L at the Feather River at Oroville to
 21 0.12 mg/L at the Sacramento River at Verona (Table 8-17). South-of-Delta mean values were higher
 22 than north-of-Delta stations examined (0.62 to 0.64 mg/L), comparable to the mean at the Banks
 23 headworks (0.56 mg/L) (Figure 8-29).

24 **Table 8-17. Nitrate/Nitrite Concentrations at Selected North- and South-of-Delta Stations, Water**
 25 **Years 2001–2006^a**

Location	Nitrate/Nitrite (mg/L as N)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	44	0.03	0.99	0.10	0.08
Sacramento River at Verona	19	0.02	0.34	0.12	0.09
Feather River at Oroville	40	0.01	0.20	0.06	0.04
American River at WTP	39	0.01	0.36	0.07	0.05
California Aqueduct at Check 13	27	0.18	1.50	0.62	0.59
California Aqueduct at Check 29	29	0.19	1.70	0.64	0.50

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

26

27 Time series data indicate that NO₃/NO₂-N concentrations at the examined stations generally
 28 fluctuate on an annual basis (Figures 8-30a, 8-30b, and 8-31). Higher values have tended to occur
 29 during the months of November through March.

1 Ortho-Phosphorus

2 Most examined locations have had low concentrations of ortho-P in recent years (water years 2001–
3 2006), with mean values typically ranging from 0.04 to 0.08 mg/L (Figure 8-32). Exceptions include
4 the Barker Slough pumps (mean 0.10 mg/L), the San Joaquin River near Vernalis (mean 0.11 mg/L),
5 and San Joaquin River at Buckley Cove (0.16 mg/L).

6 Mean values for the north-of-Delta area were all 0.02 mg/L (Table 8-18). South-of-Delta mean
7 values were higher than north-of-Delta and Plan Area stations examined, with mean values of 0.08
8 to 0.10 mg/L (Banks headworks: 0.07 mg/L) (Figure 8-32).

9 **Table 8-18. Ortho-Phosphorus Concentrations at Selected North- and South-of-Delta Stations,**
10 **Water Years 2001–2006^a**

Location	Ortho-Phosphorus (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	41	0.01	0.03	0.02	0.02
Sacramento River at Verona	18	0.01	0.05	0.02	0.02
Feather River at Oroville	7	0.01	0.05	0.02	0.01
American River at WTP	8	0.01	0.05	0.02	0.01
California Aqueduct at Check 13	27	0.05	0.15	0.08	0.07
California Aqueduct at Check 29	2	0.04	0.15	0.10	0.10

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

11
12 Time series data indicate that ortho-P concentrations at the examined stations generally fluctuate on
13 an annual basis (Figures 8-33a, 8-33b, and 8-34). However, some stations have seen higher values
14 during the summer and fall months, while other stations have seen higher values during the winter
15 and spring months.

16 Total Phosphorus

17 Most examined Delta locations have had low concentrations of TP in recent years (water
18 years 2001–2006), with mean values typically ranging from 0.08 to 0.11 mg/L (Figure 8-35). As
19 seen with ortho-P, exceptions include the Barker Slough pumps (mean 0.20 mg/L), the San Joaquin
20 River near Vernalis (mean 0.19 mg/L), and San Joaquin River at Buckley Cove (0.25 mg/L).

21 Mean values for the north-of-Delta area were between 0.06 and 0.08 mg/L, with the exception of a
22 lower value of 0.02 mg/L at the American River at WTP (Table 8-19). South-of-Delta mean values
23 were higher than north-of-Delta and Plan Area stations examined, with mean values (0.10 mg/L)
24 near those seen in the Plan Area.

Table 8-19. Total Phosphorus Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Total Phosphorus (mg/L)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	44	0.01	0.89	0.06	0.02
Sacramento River at Verona	19	0.02	0.20	0.06	0.04
Feather River at Oroville	36	0.01	1.80	0.08	0.02
American River at WTP	37	0.01	0.10	0.02	0.02
California Aqueduct at Check 13	27	0.06	0.21	0.10	0.10
California Aqueduct at Check 29	29	0.06	0.22	0.10	0.09

Source: California Department of Water Resources 2009b.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

Time series data indicate that TP concentrations at the examined stations generally did not fluctuate in a consistent manner on an annual basis (Figures 8-36 and 8-37).

Regulatory criteria with respect to nitrogen and phosphorus are as follows. Regarding Basin Plan narrative objectives, nitrogen and/or phosphorus could be considered biostimulatory substances because they are plant nutrients. There are no numerical water quality criteria for nutrients in the CTR or the Central Valley Water Board Basin Plan. The San Francisco Bay Water Board Basin Plan has objectives of 30 mg/L NO₃ plus NH₄ as nitrogen for agricultural supply—irrigation, and 100 mg/L NO₃/NO₂-N for agricultural supply—livestock watering. The California drinking water MCL is 1 mg/L for NO₂-N and 10 mg/L for NO₃-N because it can compete with oxygen for receptor sites on hemoglobin in the bloodstream, thereby interfering with normal oxygen transport by the blood and causing effects in humans, particularly infants. Another threshold for nitrate-N is for irrigation water as recommended by Ayers and Westcot (1994), who recommend a value of 5 mg/L NO₃-N for sensitive crops (e.g., sugar beets, grapes, apricot, citrus, avocado, grains).

8.1.3.11 Organic Carbon

Background and Importance in the Study Area

In an aquatic system, organic carbon encompasses a broad range of compounds, all of which fundamentally contain carbon in their structure. Organic carbon may be contributed to the aquatic environment by degraded plant and animal materials, and from anthropogenic sources such as domestic wastewater, urban runoff, and agricultural discharge. TOC represents the summation of both particulate organic carbon (POC) and DOC.

Organic carbon is a critical part of the foodweb and sustains aquatic life in the Delta and Bay. However, organic carbon and bromide, a naturally occurring salt found throughout the Delta, are precursors that contribute to DBP formation risk at drinking water treatment plants that use disinfection processes to treat Delta surface water sources. DBPs in municipal water supplies can be harmful to humans when consumed at low levels over a lifetime, and thus organic carbon concentrations are of primary concern for the municipal water supply beneficial use. Environmental concerns regarding DBPs are related primarily to the consumers (humans, animals) of drinking water containing the DBPs HAAs (monochloroacetic acid, dichloroacetic acid, trichloroacetic acid, monobromoacetic acid, and dibromoacetic acid) and THMs (chloroform, bromodichloromethane,

1 dibromochloromethane, and bromoform). THMs and HAAs are known to cause liver, kidney, and
2 central nervous system problems and an increased risk of cancer (U.S. Environmental Protection
3 Agency 2008c). The risk of DBP formation at drinking water treatment plants that use Delta surface
4 water sources has been, and will continue to be, a central focus of water quality regulations for the
5 Delta and the SWP/CVP Export Service Areas.

6 **DBP-Formation Potential**

7 The primary disinfectants currently used at municipal drinking water treatment plants to remove
8 microbial contaminants consist of chlorine, chloramines, ozone, and ultraviolet (UV) light.
9 Numerous DBPs can be formed by disinfectants reacting with various constituents in the source
10 water, particularly DOC, bromide, and nitrogenous compounds. Chlorine-based disinfectants are a
11 cause in the formation of many DBPs, including the THMs and HAAs. Modern disinfection methods
12 used instead of chlorine to reduce DBP formation include chloramines and chlorine dioxide, ozone,
13 and UV light. Ozone can substantially reduce THM formation, and UV light does not form DBPs;
14 however, ozone can cause formation of bromate if bromide is present in the water (see the *Bromide*
15 section for a detailed discussion of its effects on water quality). UV light disinfection system design
16 must account for potential reduced efficiency associated with elevated turbidity and suspended
17 solids (which can shield bacteria/viruses from radiation) and biological fouling of lamps. Ozone and
18 UV light disinfection processes leave no residual disinfectant in the treated water, so a chlorine
19 disinfectant generally must be added to finished water to provide a residual level of disinfection
20 effect from the drinking water treatment plant through the distribution system to a user's tap. The
21 potential for DBPs to form during drinking water disinfection is a function of source water quality,
22 influenced primarily by DOC concentration and bromide, and a function of treatment operational
23 factors such as disinfectant dose and reaction time, pH, and temperature (Sadiq and Rodriquez
24 2004). The potential formation of THMs, HAAs, and bromate has been extensively studied, and
25 models are able to predict their formation with reasonable accuracy (Sohn et al. 2004).

26 **Methods to Reduce DBP Formation Risk**

27 Identifying and developing dynamic strategies and options to reduce DBP formation requires
28 analysis of technical feasibility and economic considerations and is one element of the Equivalent
29 Level of Public Health Protection (ELPH) concept of a multibarrier approach to providing drinking
30 water and public health protection. Because organic/inorganic substances act as precursors for
31 DBPs, their removal prior to disinfection is effective in reducing DBP formation potential. Organic
32 matter can be partially removed using conventional coagulation, flocculation, sedimentation, and
33 filtration methods or with more advanced methods (e.g., enhanced coagulation, granular activated
34 carbon [GAC] filtration, and membrane filtration). The control of water treatment operational
35 factors such as pH or disinfection contact time may reduce the formation of DBPs. Ozonation and UV
36 light are the primary existing and alternative disinfection processes to reduce DBP formation that
37 have been considered or implemented by water purveyors that use Delta source waters (Chen et al.
38 2010). pH reduction can control bromate formation during ozonation; however, the process
39 requires increased ozone dosage and large amounts of acid to lower the pH and base addition to
40 raise pH after ozonation to prevent corrosion in the distribution system (Tetra Tech 2006a).

41 Our understanding of organic carbon dynamics in the Delta has advanced greatly in recent years,
42 due in part to intensive sampling efforts and research conducted by various institutions (e.g., Chow
43 et al. 2007; Deverel et al. 2007; Drexler et al. 2009a, 2009b; Eckard et al. 2007; Kratzer et al. 2004;
44 Kraus et al. 2008; Municipal Water Quality Investigations 2009; Saleh et al. 2007; Sickman et al.

1 2007; Spencer et al. 2007; Stepanauskas et al. 2005; U.S. Geological Survey 2003). Sources of organic
2 carbon in the study area include peat soils, upland, agricultural and urban runoff, wetlands, algae
3 production, and municipal wastewater discharges. DOC is present in all the streams and rivers
4 flowing into the Delta, and it is these upstream sources that supply the majority of the organic
5 carbon load to the Delta. It has been estimated that between 50 and 90% of the DOC load entering
6 the Delta arrives from upstream sources (CALFED Bay-Delta Program 2008a:6). There are also
7 sources internal to the Delta, such as agricultural drains and wetlands that, on an annual average
8 basis, provide nearly 25% of the DOC load. These upstream and internal loads, and their related
9 sources, vary by season. Related to particular in-Delta sources, loading of DOC from agricultural
10 drains is typically greatest in the winter, while loading from wetlands is greatest in the spring and
11 summer (Fleck et al. 2007:1, 21; Deverel et al. 2007:18).

12 In the Delta, THM formation has been found to be strongly correlated to TOC concentrations, but
13 relationships to DOC depend on specific structural characteristics of the organic matter, and
14 research has focused on the sources of DOC as being a critical factor for THM formation potential
15 (Tetra Tech 2006a). A study assessing organic carbon, bromide, and THM formation potential in the
16 California Aqueduct found that TOC concentration was a good predictor of THM formation potential
17 at the Banks pumping plant, the Delta-Mendota Canal (which feeds the Jones pumping plant), and
18 several locations along the California Aqueduct (California Department of Water Resources 2005).
19 The study did not measure DOC. Data collected from August 1998 at various Delta locations
20 (Municipal Water Quality Investigations 2003a:62, Table 4-3) indicated a strong positive
21 relationship between DOC and HAA formation potential ($r^2 = 0.996$). In Delta waters, DOC typically
22 represents 85–90% of TOC (CALFED Bay-Delta Program 2007b:5–22).

23 The measurement of specific UV light absorbance at a wavelength of 254 nanometers (nm) (SUVA)
24 is a commonly used measure of the potential conversion of DOC compounds into compounds such as
25 THMs; however, SUVA has been found to be a generally poor predictor of THM formation potential
26 in Delta waters (Tetra Tech 2006a). THMs generally are anticipated to be the most abundant DBP
27 formed in treated Delta source water, with HAA formation generally expected to be less than 50% of
28 the DBP production.

29 Table 8-20 provides a summary of TOC concentrations at several Delta intakes and major
30 tributaries. In general, the highest average concentrations of organic carbon occur in the San Joaquin
31 River and in the Delta, while the lowest average concentrations occur in the Sacramento River.

32 Concentrations are important to municipal drinking water purveyors because of regulations that
33 require advanced treatment depending on TOC concentrations. Drinking water treatment plants
34 using North Bay Aqueduct water repeatedly have shut down, switched to blending operations with
35 better quality water, or alternative water sources to avoid seasonal precipitation-induced spikes in
36 DOC (Municipal Water Quality Investigations 2003b). DOC in the Delta typically peaks in the winter
37 months, when seasonal river and Delta agricultural drain DOC loading are their greatest (Fleck et al.
38 2007:1, 21; Deverel et al. 2007:18).

1 **Table 8-20. Total Organic Carbon Concentrations at Delta Intakes and Major Tributaries**

Intake	Form	Period	Number of Samples (n)	Median TOC (mg/L)	Maximum TOC (mg/L)
Harvey O. Banks	TOC	1986–2006	252	3.20	16.3
C. W. Jones (Tracy)	TOC	1986–1999	29	3.30	5.0
CCWD Old River	TOC	1994–2006	176	3.00	14.0
CCC (Rock Slough)	TOC	1991–2006	169	3.60	40.0
North Bay Aqueduct (Barker Slough)	TOC	1988–2006	289	4.70	38.0
Sacramento River	TOC	1998–2006	595	1.75	8.6 (19.9) ^a
San Joaquin River at Vernalis	TOC	1986–2006	418	3.30	10.5

Source: CALFED Bay-Delta Program 2007b.

Notes: CCC = Contra Costa Canal; CCWD = Contra Costa Water District; NBA = North Bay Aqueduct; mg/L = milligrams per liter; TOC = total organic carbon.

^a Maximum reported value is 19.9 mg/L, second highest is 8.6 mg/L; site: Hood/Greene's Landing.

2

3 **Existing Conditions in the Study Area**

4 The lowest observed mean concentrations of DOC in the Delta during the waters years 2001–2006
5 ranged from 1.9 to 2.2 mg/L, with the lowest concentrations occurring in the Sacramento River at
6 Hood (Figure 8-38). Higher mean concentrations of DOC occurred in the southern Delta, ranging
7 from 3.3 mg/L at the Banks headworks location to 3.8 mg/L at the San Joaquin River near Vernalis.
8 The highest observed mean DOC concentration occurred at the North Bay Aqueduct pumping plant
9 on Barker Slough (5.7 mg/L). The quality of water in Barker Slough is substantially influenced by
10 local sources located in its immediate upland watershed. These local sources contribute a significant
11 organic carbon load to Barker Slough, particularly during winter months when concentrations of
12 DOC often exceed 10 mg/L (State Water Project Contractors Authority 2007: 3-19, 3-26).

13 DOC measured in the Sacramento River shows a trend of gradually increasing DOC with distance
14 from Shasta Dam, where median concentrations of about 1 to 1.5 mg/L increase to about 1.5 mg/L
15 to 2 mg/L at Hood (CALFED Bay-Delta Program 2007b:5–58). Major tributaries such as the Feather
16 and American Rivers contain relatively low DOC as well, with median measured concentrations of
17 1.5 mg/L–2 mg/L. DOC on the lower San Joaquin River is comparatively greater but generally
18 decreases with downstream distance, where median concentrations at Stevinson are nearly 6 mg/L
19 and median concentrations at Vernalis are about 3 mg/L (CALFED Bay-Delta Program 2007b:5–49).
20 This decrease in DOC can be attributed to inputs from tributaries such as the Merced, Tuolumne, and
21 Stanislaus Rivers, with median DOC concentrations of 2 mg/L. Mean values for the north-of-Delta
22 area during water years 2001–2006 ranged from 1.5 mg/L at the Feather River at Oroville to
23 2.0 mg/L at the Sacramento River at Veterans Bridge (Table 8-21). South-of-Delta mean values were
24 higher than north-of-Delta stations examined (3.2 to 3.4 mg/L), and comparable to the mean at the
25 Banks headworks (3.3 mg/L, Figure 8-38).

26 Time series data indicate that DOC concentrations at the examined stations generally fluctuate on an
27 annual basis (Figure 8-39 and Figure 8-40). Higher values have tended to occur during the months
28 of December through March at most locations, particularly the Sacramento River and in-Delta
29 locations, whereas the San Joaquin River concentrations tend to be higher in the summer months as
30 a result of irrigated agricultural drainage (Tetra Tech 2006b).

Table 8-21. Dissolved Organic Carbon Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Dissolved Organic Carbon (mg/L as C)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	10	0.9	2.5	1.6	1.5
Sacramento River at Veterans Bridge	18	1.2	4.3	2.0	1.6
Feather River at Oroville	28	1.0	2.2	1.5	1.5
American River at WTP	156	1.1	3.7	1.6	1.5
California Aqueduct at Check 13	115	2.1	8.0	3.4	3.1
California Aqueduct at Check 29	86	1.8	7.4	3.2	3.0

Sources: California Department of Water Resources 2009b; Sacramento Regional County Sanitation District 2004, 2005, 2006, 2007, 2008, 2009.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

The lowest observed mean concentrations of TOC in the Delta during the water years 2001–2006 ranged from 2.7 to 3.0 mg/L, occurring at the Sacramento River at Hood and Mallard Island, respectively (Figure 8-41). Higher mean concentrations of TOC occurred in the southern Delta region, ranging from 3.8 mg/L at CCWD pumping plant #1 to 5.1 mg/L at the San Joaquin River near Vernalis. The highest observed mean TOC concentration occurred at the Barker Slough pump (7.8 mg/L).

Mean values for the north-of-Delta area ranged from 1.5 mg/L at the Sacramento River at Keswick to 2.1 mg/L at the Sacramento River at Veterans Bridge (Table 8-22). South-of-Delta mean values were higher than north-of-Delta stations examined (3.9 to 4.2 mg/L) and slightly lower than the mean at the Banks headworks (4.3 mg/L, Figure 8-41).

Time series data indicate that TOC concentrations at the examined stations generally fluctuate on an annual basis (Figure 8-42 and Figure 8-43). Higher values have tended to occur during the months of December through March.

Table 8-22. Total Organic Carbon Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006^a

Location	Total Organic Carbon (mg/L as C)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	15	1.0	2.6	1.5	1.4
Sacramento River at Veterans Bridge	18	1.2	5.9	2.1	1.6
Feather River at Oroville	28	1.4	3.6	2.0	1.9
American River at WTP	162	1.2	4.8	1.8	1.6
California Aqueduct at Check 13	203	2.1	12.6	4.2	3.5
California Aqueduct at Check 29	158	1.9	14.5	3.9	3.5

Sources: California Department of Water Resources 2009b; Sacramento Regional County Sanitation District 2004, 2005, 2006, 2007, 2008, 2009.

Notes: mg/L = milligrams per liter; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

1 Organic carbon is not a priority pollutant; thus, the CTR has no criteria. There are no state or federal
2 regulatory numerical water quality objectives/criteria for organic carbon or any USEPA-
3 recommended criteria. As a consequence, none of the water bodies in the affected environment are
4 listed as impaired on the state's CWA Section 303(d) list because of elevated organic carbon.
5 However, the Central Valley Water Board recently (July 2013) amended the Drinking Water Policy in
6 the Basin Plan to include new directives to ensure that risks to drinking water quality associated
7 with organic carbon from Delta waters and upstream tributaries do not increase over current levels.
8 The Basin Plan narrative chemical objective (i.e., "Waters shall not contain chemical constituents in
9 concentrations that adversely affect beneficial uses.") was amended to include a new footnote
10 stating, "This includes drinking water chemical constituents of concern, such as organic carbon." The
11 revised policy requires the Central Valley Water Board to consider the necessity for inclusion of
12 monitoring of organic carbon, salinity, and nutrients when renewing waste discharge requirements
13 (WDRs) based on the discharge loading, proximity to drinking water intakes, and trends in ambient
14 conditions for these constituents.

15 Under USEPA's Disinfectants and Disinfection Byproducts Rule (63 FR 69390), municipal drinking
16 water treatment facilities are required to remove specific percentages of TOC in their source water
17 through enhanced treatment methods, unless the drinking water treatment system can meet
18 alternative criteria. USEPA's action thresholds begin at 2-4 mg/L TOC and, depending on source
19 water alkalinity, may require a drinking water utility to employ treatment to achieve as much as a
20 35% reduction in TOC. Where source water TOC is between 4 and 8 mg/L TOC, drinking water
21 utilities may be required to achieve a 45% reduction in TOC. Existing Delta water quality regularly
22 exceeds 2 mg/L TOC, and existing treatment plants already are obligated to remove some amount of
23 TOC. Nevertheless, changes in source water quality at municipal intakes may trigger additional
24 enhanced TOC removal, and associated increased treatment costs.

25 The CALFED Program established a goal to in addition to USEPA's Disinfectants and Disinfection
26 Byproducts Rule, to achieve TOC of 3 mg/L as a long-term average as applied to municipal drinking
27 water intakes drawing water from the Delta (CALFED Bay-Delta Program 2000). The goal was
28 established based on a study prepared by California Urban Water Agencies (CUWA) recommending
29 Delta source water quality targets sufficient to achieving DBP criteria in treated drinking water and
30 sufficient to allow continued flexibility in treatment technology. Specifically, the goal of the CALFED
31 Drinking Water Program is to:

32 achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central
33 Delta drinking water intakes of 50 µg/L bromide and 3.0 mg/L total organic carbon, or (b) an
34 equivalent level of public health protection using a cost-effective combination of alternative source
35 waters, source control, and treatment technologies. (CALFED Bay-Delta Program 2000)

36 The USEPA promulgated the Stage 1 Disinfectants and Disinfection Byproducts (D/DBP) Rule in
37 1998 and the Stage 2 D/DBP Rule in 2006 under the Safe Drinking Water Act (SDWA) which
38 collectively establish the treatment standards for DBPs, tightened compliance monitoring
39 requirements for DBPs, and strengthened public health protection related to DBP exposure in
40 municipal water distribution systems. The Long Term 2 Enhanced Surface Water Treatment Rule
41 focuses on reducing illness from cryptosporidium and other disease-causing microorganisms in
42 drinking water distribution systems and requires water utilities to balance long-term and short-
43 term health concerns posed by DBPs and pathogens, respectively. The compliance challenge for
44 WWTP operators is to provide adequate disinfection to protect against pathogens without forming
45 DBPs. Development of the Delta Drinking Water Policy by the Central Valley Water Board was
46 identified as a future need during the 1998 and 2001 triennial reviews of the Basin Plan, and by the

1 CALFED process, with a goal of completing the policy and associated Basin Plan amendments in
2 2013.

3 **8.1.3.12 Pathogens**

4 **Background and Importance in the Study Area**

5 The term *pathogens* refers to viruses, bacteria, and protozoa that pose human health risks.
6 Pathogens of concern include bacteria, such as *Escherichia coli* and *Campylobacter*; viruses such as
7 hepatitis and rotavirus; and protozoans such as *Giardia* and *Cryptosporidium*. Most data that exist
8 regarding pathogens are for coliform bacteria, which are indicators of potential fecal contamination
9 by humans or other warm-blooded animals because of their relative abundance and ease of
10 measuring in water samples.

11 Sources of pathogens include wild and domestic animals, aquatic species, urban stormwater runoff,
12 discharge from WWTPs, and agricultural point and nonpoint sources such as confined feeding lots
13 and runoff. Pathogens that have animal hosts can be transported from the watershed to source
14 waters from natural lands or grazed lands and cattle operations; aquatic species such as waterfowl
15 also contribute pathogens directly to water bodies. Stormwater runoff from urban or rural areas can
16 contain pathogens carried in waste from domestic pets, birds, or rodents as well as sewage spills.
17 Once in the ambient environment, pathogens often die, although in some instances they can survive
18 and even reproduce in sediments.

19 The beneficial uses of surface waters in the affected environment that are affected by pathogens are
20 municipal and domestic supply, water contact recreation, shellfish harvesting, and commercial and
21 sport fishing. Of these beneficial uses, municipal and domestic supply and water contact recreation
22 are the receptors most affected by pathogens because direct contact or ingestion affects human
23 health. Infections in humans may arise from pathogens that break through into treated drinking
24 water or from external sources such as food ingestion and ingestion of untreated water during
25 recreation.

26 Water treatment processes that are focused on the removal of particulates, such as filtration and
27 membranes, are generally effective at removing pathogens. Disinfection of bacteria pathogens can
28 be achieved effectively either through chemical oxidation using chlorine or ozone, or through
29 exposure to UV light. Viruses also can be effectively removed by filtration. The treatment of
30 protozoans is more challenging, as cysts and oocysts of protozoans cannot be fully removed by sand
31 filtration and are resistant to chemical disinfection; however, disinfection using UV light has been
32 found to be effective (Tetra Tech 2007).

33 **Escherichia Coli**

34 *Escherichia coli* is an anaerobic bacterium that lives in the gastrointestinal tract of warm-blooded
35 animals. The presence of *E. coli* normally is beneficial to the host through the synthesis of vitamins
36 and the suppression of harmful bacteria. However, some strains of *E. coli* are pathogenic. Pathogenic
37 *E. coli* affect humans by generating toxins that can result in diarrhea, inflammation, fever, and
38 bacillary dysentery (U.S. Environmental Protection Agency 2009d). Certain strains of *E. coli* can be
39 severely toxic to some patients, particularly children, causing hemolytic uremic syndrome and
40 leading to destruction of red blood cells and occasional kidney failure (Tetra Tech 2007). The
41 presence of *E. coli* is an indicator of fecal contamination, either by human waste, wastewater, or
42 animal wastes.

1 **Campylobacter**

2 *Campylobacter* is a bacterium that can be found in natural waters throughout the year.
3 *Campylobacter jejuni* is commonly present in the gastrointestinal tract of cattle, pigs, and poultry
4 and is a leading cause of bacterial gastroenteritis in the United States. *Campylobacter* infection in
5 some rare cases may be followed by Guillain-Barré syndrome, a form of neuromuscular paralysis.
6 Strains of *Campylobacter* have developed resistance to antibiotics, resulting in the difficulties with
7 clinical treatment.

8 **Hepatitis**

9 Hepatitis is a virus that causes liver inflammation and sometimes leads to jaundice. Hepatitis Types
10 A and E are infectious and are transmitted through the fecal-oral route. Hepatitis A is a well-
11 documented waterborne disease and is widespread throughout the world.

12 **Rotavirus**

13 Rotaviruses are the most prevalent viruses that cause diarrhea worldwide. Rotavirus was estimated
14 to contribute to 30 to 50% of severe diarrhea disease in humans (Tetra Tech 2007). The virus can be
15 transmitted through fecal-oral route and through contaminated food and water.

16 **Giardia**

17 *Giardia* is a parasite found in the intestinal linings of a wide range of animals and their feces, and in
18 contaminated water. *Giardia* can survive a wide range of temperature—from ambient temperature of
19 fresh water to internal temperatures of animals. Among the many species of *Giardia*, *Giardia lamblia*
20 infects humans and causes diarrhea and abdominal pain. *Giardia lamblia* has been found in
21 wastewater and has been related to several outbreaks of waterborne disease around the world
22 (Tetra Tech 2007).

23 **Cryptosporidium**

24 *Cryptosporidia* are single-celled, intestinal parasites that infect humans and a variety of animals.
25 These parasites can infect epithelial cells of the intestinal wall and are excreted in feces as oocysts.
26 *Cryptosporidium* has a wide range of hosts, including domestic and wild animals. Symptoms of
27 cryptosporidiosis, a disease caused by ingestion of *Cryptosporidium*, include diarrhea, stomach
28 cramps, upset stomach, and slight fever; more serious symptoms can result in weakened immune
29 systems (U.S. Environmental Protection Agency 1999b). Cryptosporidiosis is a major cause of
30 gastrointestinal illness around the world, especially to individuals with compromised immune
31 systems. For these people, the symptoms can be more severe or life-threatening.

32 **Existing Conditions in the Study Area**

33 A conceptual model of pathogens and pathogen indicators was developed for the Central Valley
34 Drinking Water Policy Workgroup (Tetra Tech 2007). The pathogen and indicator data compiled for
35 the model consisted primarily of measurements of total and fecal coliforms and *E. coli*, some limited
36 data on other species of coliforms, and even more limited data on pathogens such as
37 *Cryptosporidium* and *Giardia*. Fecal indicator concentrations are highly variable both temporally
38 and spatially and can vary by orders of magnitude (Tetra Tech 2007). The variable nature of
39 pathogen and indicator concentrations in surface waters, and the rapid die-off of many of these
40 organisms in the ambient environment, makes it very difficult to quantify the importance of

1 different sources on a scale as large as the Central Valley, especially for coliforms that are widely
 2 present in water. A single source close to the sampling location can dominate the coliform
 3 concentrations observed at a location downstream of several thousand square miles of watershed.

4 Of the known sources of coliform discharges into the waters of the Central Valley, it was found that
 5 wastewater total coliform concentrations for most plants were fairly low (<1,000 most probable
 6 number per 100 milliliters [MPN/100 ml]), whereas the highest total coliform concentrations in
 7 water (>10,000 MPN/100 ml) were observed near samples influenced by urban areas (Tetra Tech
 8 2007). In fact, the regional water boards limit publicly owned treatment works discharges to
 9 <23 MPN/100 ml in NPDES permits, with most plants limited to <2.2 MPN/100 ml. In the San
 10 Joaquin River valley, comparably high concentrations of *E. coli* were observed for waters affected by
 11 urban environments and intensive agriculture in the San Joaquin Valley (Tetra Tech 2007). Fecal
 12 indicator data showed minimal relationships with flow rates, although most of the high
 13 concentrations were observed during the wet months of the years, possibly indicating the
 14 contribution of stormwater runoff (Tetra Tech 2007).

15 Regulatory criteria with respect to pathogens are as follows. The Central Valley Water Board Basin
 16 Plan specifies numerical water contact recreation criteria for fecal coliform bacteria not to exceed a
 17 geometric mean of 200 organisms/100 ml in any 30-day period (based on a minimum of five
 18 samples), nor more than 10% of the total number of samples taken during any 30-day period to
 19 exceed 400 organisms/100 ml. The Central Valley Water Board Basin Plan numerical water quality
 20 objectives for pathogens are detailed in Appendix 8A, *Water Quality Criteria and Objectives*. The
 21 Central Valley Water Board in July 2013 amended the Drinking Water Policy in the Basin Plan to
 22 include new directives to ensure that risks to drinking water quality associated with pathogens from
 23 Delta source water does not increase over current levels. A new narrative objective was added
 24 stating, "Waters shall not contain *Cryptosporidium* and *Giardia* in concentrations that adversely
 25 affect the public water system component of the MUN beneficial use." The new objective applies to
 26 the Delta and tributaries below the first major dams, and allows utilities to request assistance from
 27 the state to conduct source evaluations and implement potential control actions if the drinking
 28 water utility monitoring at intakes indicates increased risks to treatment from these constituents.
 29 The Stockton Deep Water Ship Channel and various sloughs and creeks in the western and eastern
 30 Delta are on the state's CWA Section 303(d) list as impaired because of pathogens, with sources
 31 identified as recreational and tourism activities [nonboating] and urban runoff/storm sewers (State
 32 Water Resources Control Board 2011). A TMDL for the Stockton Urban Waterbodies was approved
 33 by EPA on 13 May 2008. TMDLs for other listed water bodies in the affected environment are
 34 proposed for completion in 2021 (State Water Resources Control Board 2011).

35 USEPA's surface water treatment rules require that systems using surface water, or groundwater
 36 under the direct influence of surface water, to: (1) disinfect water to destroy pathogens and (2) filter
 37 water or meet criteria for avoiding filtration to remove pathogens, so that the following
 38 contaminants are controlled at the following levels (U.S. Environmental Protection Agency 2009d).

- 39 ● Viruses: 99.99% removal/inactivation.
- 40 ● *Giardia lamblia*: 99.9% removal/inactivation.
- 41 ● *Cryptosporidium*: 99% removal.

42 Further, USEPA has established an MCL for total coliform requiring no more than 5% positive
 43 samples in a month (for water systems that collect fewer than 40 routine samples per month, no
 44 more than one sample can be positive per month). Every sample that has total coliform must be

1 analyzed for either fecal coliforms or *E. coli*. If two consecutive total coliform positive samples occur,
2 and one is also positive for *E. coli*/fecal coliforms, the system is deemed as having an acute MCL
3 violation (U.S. Environmental Protection Agency 2009d).

4 **8.1.3.13 Pesticides and Herbicides**

5 **Background and Importance in the Study Area**

6 A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling,
7 or mitigating any pest. Pesticides typically occur in the form of chemicals or biological agents (e.g.,
8 virus or bacterium) and are often formulated for specific pests such as weeds (herbicides), insects
9 (insecticides), and fungi (fungicides), among others. Pesticides may be described in two general
10 categories: current use pesticides and legacy pesticides.

11 Current use pesticides include carbamates (e.g., carbofuran), organophosphates (e.g., chlorpyrifos,
12 diazinon, methyl parathion, malathion), thiocarbamates (e.g., molinate, thiobencarb), and more
13 recently pyrethroids (e.g., permethrin, cypermethrin), a class of synthetic insecticides applied in
14 urban and agricultural areas. USEPA has begun to phase out certain uses of organophosphates
15 because of their potential toxicity in humans, which has led to the gradual replacement of
16 organophosphates by pyrethroids (Werner et al. 2008).

17 Legacy pesticides include primarily organochlorine pesticides like dichlorodiphenyltrichloroethane
18 (DDT) and Group A Pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide,
19 hexachlorocyclohexane [including lindane], endosulfan, and toxaphene). These chemicals are highly
20 persistent in the environment and were banned in the 1970s because of their health and
21 environmental effects. Organochlorines are prone to accumulation in sediments.

22 Pesticides, including pyrethroids, organophosphates, carbamate insecticides, herbicides, and
23 fungicides are used extensively throughout the Central Valley. The critical pathways for pesticides
24 entering the rivers, streams, and the Delta include agricultural and urban stormwater runoff,
25 irrigation return water, drift from aerial or ground-based spraying, and periodic release of
26 agricultural return flows from rice production (Werner and Oram 2008). Agricultural inputs are
27 dominant, but urban inputs are also substantial in areas of high population density (CALFED Bay-
28 Delta Program 2008a) and appear to be a primary source of pyrethroid insecticides entering urban
29 creeks. For example, Weston and Lydy (2010) demonstrated that urban runoff produced pyrethroid
30 concentrations exceeding acutely toxic thresholds. The authors also found that the pyrethroids
31 passed through secondary treatment systems at wastewater treatment facilities, suggesting possible
32 sewer disposal of pyrethroids (e.g., household pesticides).

33 The timing of pesticide input to Delta waters is related to application rates, when pesticides are
34 applied to farmed land, runoff events, and other transport processes (Kuivila and Jennings 2007). In
35 agricultural applications, for example, diazinon and chlorpyrifos are applied during the dormant
36 season (December through February) and the irrigation season (March through November).
37 Dormant orchards (nuts and fruits) are sprayed to limit pest damage. Application totals for diazinon
38 (1999–2003 average) were 52% dormant season and 48% irrigation season (47,652 pounds total);
39 application totals for chlorpyrifos (1999–2003 average) were 3% dormant season and 97%
40 irrigation season (114,101 pounds total).

41 Concern about pesticides is primarily associated with nontarget-organism toxic effects; because
42 many pesticides have been developed to target insect pests (e.g., neurotoxins), these pesticides also

1 have the potential to harm other organisms. Pesticides have toxic effects on the nervous systems of
2 terrestrial and aquatic life, and some are toxic to the human nervous system (U.S. Environmental
3 Protection Agency 2008d). Consequently, the beneficial uses (Table 8-1) most directly affected by
4 pesticide concentrations are aquatic organisms (cold freshwater habitat, warm freshwater habitat,
5 and estuarine habitat); rare, threatened, and endangered species; harvesting activities (shellfish
6 harvesting and commercial and sport fishing); and drinking water supplies (municipal and domestic
7 supply).

8 Toxicity of pesticides, like all toxins, is related to the dose an organism receives. For example, a
9 pesticide applied to a rice field in the Sacramento Valley may be diluted many times before it
10 reaches irrigation return canals and the Sacramento River. Aquatic herbicides are applied to control
11 invasive aquatic plants in irrigation canals and in the Delta (CALFED Bay-Delta Program 2008b). A
12 recent assessment of heavily used aquatic herbicides suggests that there is limited short-term and
13 no long-term toxicity directly attributable to their use (Siemering et al. 2008). However, acute
14 toxicity to algae (*Selenastrum capricornutum*) has been found in numerous studies and attributed to
15 the widely used agricultural herbicide diuron (de Vlaming et al. 2005). Ecological effects of pesticide
16 contamination (e.g., fish toxicity) reflect the cumulative influence of pesticides currently in use,
17 those used historically, and the constantly changing new pesticides introduced for agricultural
18 practices (CALFED Bay-Delta Program 2008b).

19 The Department of Pesticide Regulation, an agency within the California Environmental Protection
20 Agency (Cal/EPA), is charged with administering California's statewide pesticide regulatory
21 program, the largest of its kind in the nation. It administers the CCR Title 6 (Food and Agriculture),
22 which restricts the use of pesticides near water bodies and establishes Pesticide Management Zones
23 and reporting requirements for pesticide use. The Department of Pesticide Regulation also conducts
24 pesticide-monitoring activities. It and other agencies responsible for water quality, such as the State
25 Water Board, promote use of Best Management Practices (BMPs) and other preventive measures to
26 reduce pesticide contamination of water bodies. For example, rice growers are required to hold
27 water on their fields following application of rice pesticides to allow pesticides to degrade, reducing
28 concentrations contained in rice field runoff that enters waterways adjacent to treated fields
29 (Newhart 2002).

30 The fate and effects of pesticide mixtures in the Delta and the implications of pesticide mixtures for
31 populations of native species are not well understood (Werner and Oram 2008). Monitoring data for
32 pyrethroids in water and sediment are scarce or do not exist, confounding attempts to estimate
33 loads of pyrethroids transported to the Delta from the Central Valley (Werner and Oram 2008; TDC
34 Environmental 2010). Implementation of TMDLs has reduced concentrations of some pesticides in
35 the Delta (e.g., chlorpyrifos, diazinon); incidences of toxicity attributable to organophosphate
36 pesticides have declined substantially compared to observations in the early 1990s (CALFED Bay-
37 Delta Program 2008b). Organophosphates have been shown to be present at elevated
38 concentrations in tributaries and the Delta, and pyrethroids at toxic concentrations have been
39 detected in water bodies draining agricultural areas in the Central Valley, as well as urban creeks in
40 the Delta region (Werner et al. 2008; Weston and Lydy 2010).

41 **Existing Conditions in the Study Area**

42 Limited data and studies are available for characterizing the existing conditions of pesticide
43 concentrations in the study area. These are summarized below.

1 Monitoring efforts at the north-of-Delta stations since 2001 have resulted in no pesticide detections,
 2 while monitoring at the south-of-Delta stations resulted in various detections. The California
 3 Aqueduct at Check 13 had detections of chlorpyrifos (3/15/05, 0.02 µg/L), diazinon (3/20/01, 0.01
 4 µg/L), and metolachlor (6/14/05, 0.1 µg/L) and of diuron (eight detections between 3/15/00 and
 5 9/15/09, ranging from 0.27 to 3.2 µg/L) and simazine (13 detections between 3/15/00 and
 6 9/15/09, ranging from 0.02 to 0.14 µg/L). The California Aqueduct at Check 29 had detections of
 7 chlorpyrifos (9/20/05, 0.01 µg/L) and dacthal (9/19/07, 0.12 µg/L) and numerous detections of
 8 diazinon (four detections between 3/20/01 and 6/22/06, ranging from 0.01 to 0.03 µg/L), diuron
 9 (seven detections between 3/14/00 and 9/15/09, ranging from 0.29 to 1.2 µg/L) and metolachlor
 10 (detections on 6/15/04 and 6/21/05, 0.01 and 0.01 µg/L).

11 Monitoring for diazinon suggests that higher concentrations occur in Delta back sloughs and small
 12 upland drainages, with lower concentrations occurring in Delta island drains, main rivers, and
 13 tributaries (Table 8-23). Monitoring for chlorpyrifos suggests that higher concentrations occur in
 14 Delta back sloughs, Delta island drains, and small upland drainages, with lower concentrations
 15 occurring in main rivers and tributaries (Table 8-24).

16 **Table 8-23. Diazinon Concentrations, by Water Body Category**

Water Body Type	Number of Samples	Median Concentration (ng/L)	90 th Percentile Concentration (ng/L)	Maximum Concentration (ng/L)	Samples >160 ng/L ^a
Delta Back Sloughs	352	13	300	1,400	56 (16%)
Delta Island Drains	57	0	17	82	0 (0%)
Delta Rivers and Main Delta Waterways	774	0	97	797	31 (4%)
Major Delta Tributaries	2,056	0	80	1,700	106 (5%)
Small Upland Drainages	146	16	150	2,790	13 (9%)

Source: Central Valley Regional Water Quality Control Board 2006.

Note: ng/L = nanograms per liter.

^a Acute toxicity water quality objective for diazinon to protect invertebrates.

17

18 **Table 8-24. Chlorpyrifos Concentrations, by Water Body Category**

Water Body Type	Number of Samples	Median Concentration (ng/L)	90 th Percentile Concentration (ng/L)	Maximum Concentration (ng/L)	Samples >25 ng/L ^a
Delta Back Sloughs	373	0	68	677	62 (17%)
Delta Island Drains	57	5	46	360	11 (19%)
Delta Rivers and Main Delta Waterways	722	0	0	76	7 (1%)
Major Delta Tributaries	1,887	0	7	700	32 (2%)
Small Upland Drainages	148	0	87	180	35 (24%)

Source: Central Valley Regional Water Quality Control Board 2006.

Note: ng/L = nanograms per liter.

^a Acute toxicity water quality objective for chlorpyrifos to protect invertebrates.

19

1 Pesticide data available for the Banks and Barker Slough pumping plants include the Group A
 2 Pesticides (aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, lindane, endosulfan,
 3 and toxaphene), DDT products (p,p'-DDD, p,p'-DDE, and p,p'-DDT), atrazine, chlorpyrifos, diazinon,
 4 glyphosate, malathion, molinate, methyl parathion, permethrin, simazine, and thiobencarb. The
 5 monitoring program sampled for these analytes approximately 16 times during the water years
 6 2001–2006 for each location. Detections were limited to those presented in Table 8-25. These
 7 detections generally occurred during the wet season during wet years. The exception is for molinate,
 8 which was detected during the early summer of a dry year (2004).

9 **Table 8-25. Pesticide Concentrations at the Banks and Barker Slough Pumping Plants, Water Years**
 10 **2001–2006**

Pesticide	Harvey O. Banks	Barker Slough
Chlorpyrifos	0.03 µg/L (3/16/05)	–
Diazinon	0.01 µg/L (3/21/01)	0.01 µg/L (3/21/01)
Molinate	0.04 µg/L (6/16/04)	0.04 µg/L (6/15/04)
Simazine	0.12 µg/L (3/21/01)	0.02 µg/L (3/21/01)
	0.02 µg/L (3/20/02)	0.24 µg/L (3/16/05)
	0.11 µg/L (3/16/05)	0.02 µg/L (6/15/05)
	0.05 µg/L (3/15/06)	0.46 µg/L (3/15/06)

Source: Bay Delta and Tributaries Project 2009.

Notes: Data represent water quality samples having values at or greater than the reporting limit.
 µg/L = micrograms per liter.

11
 12 SFEI data for the Sacramento River above Point Sacramento and the San Joaquin River at Antioch,
 13 which has very low detection limits, have enabled the detection of many pesticides (Table 8-26). The
 14 samples were taken annually between late July and late August, which does not allow examination of
 15 wet versus dry season effects. The results suggest that many of the legacy pesticides are still present
 16 in the Sacramento River and San Joaquin River outflows during summer conditions, albeit at low
 17 concentrations. Chlorpyrifos, diazinon, and DDT median concentrations were higher than the other
 18 pesticides; median concentrations for nearly all pesticides were higher in the Sacramento River than
 19 in the San Joaquin River.

20 The Central Valley Water Board and San Francisco Bay Water Board Basin Plans contain narrative
 21 objectives for pesticides and toxicity. There are several pesticides with water quality criteria listed
 22 under the CTR, the Central Valley Water Board Basin Plan, the San Francisco Bay Water Board Basin
 23 Plan, and the California drinking water MCLs (Appendix 8A, *Water Quality Criteria and Objectives*).

1 **Table 8-26. Pesticide Concentrations at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006**

Pesticide	Fraction	Sacramento River above Point Sacramento (pg/L)					San Joaquin River at Antioch Ship Channel (pg/L)				
		Samples	Min.	Max.	Mean	Median	Samples	Min.	Max.	Mean	Median
Aldrin	Dissolved	4	1	3	2	2	2	<1	2	1	1
Aldrin	Total	1	4	4	4	4	1	3	3	3	3
Chlorpyrifos	Dissolved	4	300	1,070	719	753	4	76	789	486	541
Chlorpyrifos	Total	4	332	1,070	727	753	4	90	789	490	541
Diazinon	Dissolved	3	511	765	599	520	4	229	1,079	515	375
Diazinon	Total	3	511	765	599	520	4	229	1,079	605	557
Dieldrin	Dissolved	7	56	110	85	82	5	49	81	68	73
Dieldrin	Total	7	60	117	89	84	6	52	87	74	77
Endosulfan I	Dissolved	5	11	57	32	31	2	13	13	13	13
Endosulfan I	Total	2	31	43	37	37	3	13	35	20	13
Endosulfan II	Dissolved	1	34	34	34	34	1	3	3	3	3
Endosulfan II	Total	0					1	3	3	3	3
Endrin	Dissolved	4	2	2	2	2	3	2	2	2	2
Endrin	Total	2	2	2	2	2	2	2	2	2	2
Heptachlor	Dissolved	4	<1	2	1	1	1	1	1	1	1
Heptachlor	Total	2	2	3	2	2	1	1	1	1	1
Heptachlor Epoxide	Dissolved	7	2	24	7	4	5	4	15	6	4
Heptachlor Epoxide	Total	6	2	24	7	4	4	3	15	6	4
Sum of Chlordanes	Dissolved	6	25	106	48	40	5	20	55	37	30
Sum of Chlordanes	Total	5	20	143	66	51	4	27	68	46	45
Sum of DDTs	Dissolved	7	153	227	188	194	5	93	144	124	131
Sum of DDTs	Total	7	266	546	368	366	6	175	257	214	210

Source: San Francisco Estuary Institute 2010.

Notes: Sample size represents water quality samples having values at or greater than the reporting limit. Values for “dissolved” may exceed “total” because of rejected laboratory samples.

DDT = dichlorodiphenyltrichloroethane; Max. = maximum; Min. = minimum; pg/L = picograms per liter.

2

1 Regions on the CWA Section 303(d) list for pesticides include the Central Valley Region (chlordane,
 2 chlorpyrifos, DDT, diazinon, dieldrin, and Group A pesticides) and the San Francisco Bay Region
 3 (chlordane, DDT, dieldrin). The Section 303(d) list of impaired water bodies identifies the entire
 4 Delta as impaired by one or more legacy pesticides (State Water Resources Control Board 2011).
 5 Chlorpyrifos and diazinon TMDL studies have been completed for Sacramento County urban creeks,
 6 the Feather River, the Sacramento River, the San Joaquin River, and the Delta; ongoing TMDL studies
 7 are occurring for organochlorine and other pesticides. There are many water bodies served by SWP
 8 South-of-Delta exports listed for pesticide impairment (State Water Resources Control Board 2011)
 9 including those listed by the Central Coast Water Board, the Los Angeles Water Board, the Santa Ana
 10 Water Board, and the San Diego Water Board.

11 A target list of pesticides has been developed by the Central Valley Water Board (2009d) to assess
 12 risk in the study area. The list was based on work by Urban Pollution Prevention Projects for the San
 13 Francisco Estuary Project (TDC Environmental 2008). Eight of the 38 pesticides considered highly
 14 toxic to aquatic organisms are pyrethroids, and the process has begun to establish water quality
 15 criteria for bifenthrin, lambda-cyhalothrin, and cyfluthrin (Central Valley Regional Water Quality
 16 Control Board 2010c).

17 **8.1.3.14 Polycyclic Aromatic Hydrocarbons**

18 **Background**

19 PAHs are toxic compounds formed primarily as products of incomplete combustion (burning) of
 20 substances such as gasoline, coal, oil, wood, garbage, grilled meat, and tobacco (Agency for Toxic
 21 Substances and Disease Registry 1995). Some PAHs are manufactured for specific uses such as
 22 asphalt, creosote, roofing tar, medicines, dyes, pesticides, and plastics. Mahler et al. (2005) suggest
 23 that parking lot sealcoat can be a major source of PAHs to urban water bodies. PAHs in oil products
 24 also may exist in a watershed from spills and leaking vehicle fluids, which can then enter the aquatic
 25 environment from pavement runoff. PAHs in the environment tend to be found together as complex
 26 mixtures rather than single compounds (Oros et al. 2007).

27 PAHs can lead to red blood cell damage, leading to anemia, suppressed immune system,
 28 developmental and reproductive effects, and possibly cancer over a lifetime of exposure (U.S.
 29 Environmental Protection Agency 2009e). Wildlife effects (e.g., mammals, birds, invertebrates,
 30 plants, amphibians, fish) also have been observed (Eisler 1987). The typical means of exposure to
 31 PAHs occurs through inhalation. Other exposure pathways are skin contact of PAH-containing
 32 products and ingestion of foods and liquids containing PAH compounds. Consequently, the beneficial
 33 uses (Table 8-1) most directly affected by PAHs are aquatic organisms (cold freshwater habitat,
 34 warm freshwater habitat, and estuarine habitat); rare, threatened and endangered species, if the
 35 community population level were to be reduced by exposure through the aquatic environment;
 36 harvesting activities that depend on aquatic life (shellfish harvesting and commercial and sport
 37 fishing); and drinking water supplies (municipal and domestic supply).

38 PAHs enter the environment mostly as releases to air from volcanoes, forest fires, residential wood-
 39 burning, and exhaust from automobiles and trucks (Agency for Toxic Substances and Disease
 40 Registry 1995). They also can enter surface water through discharges from industrial plants and
 41 WWTPs and can be released to soils at hazardous waste sites if they escape from storage containers.

1 PAHs are present in air as vapors or adhere to the surfaces of small solid particles. They can travel
 2 long distances before they return to earth through rainfall or particle-settling. Some PAHs evaporate
 3 into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms
 4 of rivers or lakes. The solubility of PAHs in water is often very low. PAHs stay adsorbed to soil
 5 particles, although some tend to evaporate or contaminate groundwater.

6 PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in
 7 the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks
 8 to months and is caused primarily by the actions of microorganisms.

9 Benzo[a]pyrene is an example of an environmental PAH that can behave as described above (U.S.
 10 Environmental Protection Agency 2009e). Benzo[a]pyrene is expected to bioconcentrate in aquatic
 11 organisms that cannot metabolize it. Reported bioconcentration factors include: oysters 3,000;
 12 rainbow trout 920; bluegills 2,657; and zooplankton 1,000 to 13,000. The presence of humic acid in
 13 solution has been shown to decrease bioconcentration. Organisms that lack a metabolic
 14 detoxification enzyme system tend to accumulate these compounds. For example, bioconcentration
 15 factors have been found to be very low (<1) for mudsuckers, sculpins, and sand dabs.

16 There are two major sources of PAHs in drinking water: contamination of raw water (untreated)
 17 supplies from natural and human-made sources, and leachate from coal tar and asphalt linings in
 18 water storage tanks and distribution lines. PAHs in raw water will tend to adsorb to any particulate
 19 matter and be removed by filtration before reaching the drinking water supply. Background levels of
 20 PAHs in drinking water range from 4 to 24 ng/L (U.S. Environmental Protection Agency 2009e).

21 The MCL for benzo[a]pyrene is 0.0002 mg/L. Potential health effects from exposure above the MCL
 22 include reproductive difficulties and increased risk of cancer. The public health MCL goal (MCLG) is
 23 a concentration of zero (U.S. Environmental Protection Agency 2009e).

24 **Importance in the Study Area**

25 Assessment of how human atmospheric emission sources of PAHs in the study area directly affect
 26 the area would be difficult, given the complexity of area meteorology. Such sources would need to be
 27 identified and undergo air transport modeling to determine deposition rates onto land and water in
 28 the study area. Human activities related to PAH land and water emissions may be more easily
 29 quantified. Land applications of PAHs in the study area may include unintended releases from
 30 hazardous waste containers, while water sources may include industrial wastewaters, municipal
 31 sewage, and stormwater runoff.

32 The Regional Monitoring Program for Water Quality in the San Francisco Estuary has monitored
 33 PAHs and other pollutants in San Francisco Bay water, sediments, and bivalves since 1993 at several
 34 locations, including the mouths of the Sacramento and San Joaquin Rivers near Antioch.

35 In an analysis of 1993–2001 data, Ross and Oros (2004) found the distribution of median total PAH
 36 concentration by estuary segment was as follows.

- 37 ● Extreme South Bay (120 ng/L).
- 38 ● South Bay (49 ng/L).
- 39 ● North Estuary (29 ng/L).

- 1 • Central Bay (12 ng/L).
- 2 • Delta (7 ng/L).

3 These results suggest that the Delta is not a major contributor of PAHs to San Francisco Bay. Using
4 PAH isomer pair ratio analysis, Ross and Oros (2004) showed that PAHs in estuary waters were
5 derived primarily from combustion of fossil fuels/petroleum (possible PAH source contributors
6 include coal, gasoline, kerosene, diesel, No. 2 fuel oil, and crude oil) and biomass (possible
7 contributors include wood and grasses), with lesser amounts of PAH contributed from direct
8 petroleum input.

9 A modeling exercise of PAHs in San Francisco Bay ranked PAH loading pathways as stormwater
10 runoff (51%), tributary inflow (28%), WWTP effluent (10%), atmospheric deposition (8%), and
11 dredged material disposal (2%) (Greenfield and Davis 2005; Oros et al. 2007). A study of PAH inputs
12 and sources along an urban tributary to the Sacramento River took place in 2004 and 2005 (Kim and
13 Young 2009).

14 Surface water concentrations varied from 192 to 3,784 ng/L for total PAHs and 18 to 48 ng/L for
15 dissolved PAHs. Precipitation concentrations varied from 77 to 236 ng/L for total PAHs and 15 to
16 66 ng/L for dissolved PAHs. The authors suggest that indirect deposition (i.e., wash off of
17 atmospheric particles previously deposited to land) of PAHs into surface water is a more likely
18 substantial input pathway for total PAHs than direct dry or wet deposition during the wet season.
19 They also assert that particulate matter carried by stormwater runoff was the major source of PAHs
20 in surface water in the early rainy season.

21 **Existing Conditions in the Study Area**

22 Recent monitoring efforts to assess PAHs are very limited with respect to locations selected. For
23 example, naphthalene had been sampled at three pumping plants (Banks, Barker Slough, CCWD #1)
24 and the San Joaquin River at Vernalis since the late 1990s with no laboratory detections.

25 The Sacramento River above Point Sacramento and the San Joaquin River at Antioch Ship Channel
26 were sampled for 24 different PAH compounds on an annual basis by SFEI as part of its monitoring
27 program (denoted as stations BG20 and BG30, respectively). The SFEI laboratory reporting limits
28 are on the order of pg/L, which are orders of magnitude more sensitive than the laboratory
29 reporting limits for the Banks and Barker Slough pumping plants. These very low detection limits
30 have enabled the detection of many PAHs examined in the current study, which are presented as the
31 sum of all PAHs in Table 8-27.

32 The samples were taken between late July and late August, which does not allow examination of wet
33 versus dry season effects. The results indicate that PAHs are present in the Sacramento and San
34 Joaquin River outflows during summer conditions, albeit at low concentrations. Values for PAHs
35 were comparable between the two locations. No detections were reported in the data examined for
36 the north- and south-of-Delta sampling locations.

Table 8-27. Sum of All Polycyclic Aromatic Hydrocarbons at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006

Sum of all PAHs	Samples	Minimum (pg/L)	Maximum (pg/L)	Mean (pg/L)	Median (pg/L)
Sacramento River above Point Sacramento					
Dissolved	7	2,240	17,444	8,962	9,359
Total	6	9,090	29,205	16,510	15,415
San Joaquin River at Antioch Ship Channel					
Dissolved	5	1,380	16,637	9,881	9,331
Total	6	6,472	21,972	14,117	15,017

Source: San Francisco Estuary Institute 2010.

Notes: All concentrations in picograms per liter (pg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

PAH = polycyclic aromatic hydrocarbon.

Regulatory criteria with respect to PAHs are as follows. There are no listings for PAHs on the Section 303(d) list in the Delta. With regard to Basin Plan narrative objectives, PAHs might be considered toxic at high concentrations. There are no numerical water quality objectives for the Central Valley Water Board or San Francisco Bay Water Board Basin Plans. The CTR criteria for benzo[a]pyrene is 0.0044 µg/L (Human Health: Water and Organisms) and 0.049 µg/L (Human Health: Organisms Only). The California drinking water standard MCL for benzo[a]pyrene is 0.0002 mg/L. Data are inadequate to assess whether the sites examined in this study exceeded the CTR or drinking water standard MCL.

8.1.3.15 Selenium

Background

Selenium is a constituent of concern in the lower San Joaquin River, the Delta, and San Francisco Bay for potential effects on water quality, aquatic and terrestrial resources, and (indirectly) human health. Because of the known effects of selenium bioaccumulation from aquatic organisms to higher trophic levels in the foodchain, the wildlife habitat and rare, threatened, or endangered species beneficial uses are the most sensitive receptors to selenium exposure. Examples of those effects include reduced hatchability of fertile eggs and the development of severe, often lethal, embryo deformities in fish and birds (Department of the Interior 1998; Ohlendorf 2003). Selenium also affects other aquatic life beneficial uses, including warm freshwater habitat; cold freshwater habitat; migration of aquatic organisms; spawning, reproduction, and/or early development; and estuarine habitat. Additional nonhabitat beneficial uses that may be affected include freshwater replenishment, municipal and domestic supply, and agricultural supply.

The State Water Board lists the western Delta as having impaired water quality for selenium (under Section 303[d]) (State Water Resources Control Board 2011). The Central Valley Water Board completed a TMDL for selenium in the lower San Joaquin River (downstream of the Merced River) in 2001 and Salt Slough in 1997/1999, and USEPA approved this in 2002 (Central Valley Regional Water Quality Control Board 2001, 2009c).

1 The Central Valley Water Board adopted amendments to the Basin Plan for the Sacramento River
2 and San Joaquin River basins to address selenium control in the San Joaquin River basin in
3 May 2010 (Central Valley Regional Water Quality Control Board 2010d), and the State Water Board
4 approved the amendments in October (State Water Resources Control Board 2010b, 2010c). The
5 intent is to modify the compliance time schedule for discharges regulated under WDRs to meet the
6 selenium objective or comply with a prohibition of discharge of agricultural subsurface drainage to
7 Mud Slough (north), a tributary to the San Joaquin River, in Merced County. The proposed
8 amendments and supporting staff report include environmental documentation required under
9 California Public Resources Code 21080.5 and 23 CCR 3775–3782. The environmental
10 documentation is informed by the environmental analysis conducted by Reclamation and the San
11 Luis and Delta Mendota Water Authority, dated December 21, 2009 (Bureau of Reclamation 2009c),
12 which was prepared in compliance with the same legal provisions with regard to the use of the
13 federally owned San Luis Drain. The environmental analysis concluded that, with the agreed-upon
14 mitigation measures, the amendments would have no significant effects on the environment. The
15 Basin Plan amendments are administrative in nature and will not alter any water quality objective,
16 program goal, policy, or other scientific underpinning of the selenium control program for the San
17 Joaquin River.

18 The San Francisco Bay Water Board is conducting a TMDL project to address selenium toxicity in the
19 North San Francisco Bay (North Bay), defined to include a portion of the Delta, Suisun Bay,
20 Carquinez Strait, San Pablo Bay, and the Central Bay (State Water Resources Control Board 2011).
21 The North Bay selenium TMDL will identify and characterize selenium sources to the North Bay and
22 the processes that control the uptake of selenium by wildlife. The TMDL will quantify selenium
23 loads, develop and assign waste load and load allocations among sources, and include an
24 implementation plan designed to achieve the TMDL and protect beneficial uses.

25 **Importance in the Study Area**

26 Selenium is an essential trace element for human and other animal nutrition that occurs naturally in
27 the environment. In the Delta watershed, selenium is most enriched in marine sedimentary rocks of
28 the Coast Ranges on the western side of the San Joaquin Valley (Presser and Piper 1998). Because of
29 erosion of the selenium-enriched sedimentary rock and irrigation practices used in the Central
30 Valley, selenium concentrations in this watershed are high. It is also highly bioaccumulative and is of
31 greatest concern because it can cause chronic toxicity (especially impaired reproduction) in fish and
32 aquatic birds (Ohlendorf 2003; State Water Resources Control Board 2011). Bioaccumulation of
33 selenium in diving ducks has led to health advisories for local hunters. Monitoring of selenium in
34 ducks, fish, and invertebrates in the northern part of San Francisco Bay has revealed concentrations
35 that could cause health risks to people and wildlife. Although the entire Bay is listed as impaired by
36 selenium, separate TMDLs for selenium will be developed for the North Bay and South Bay, because
37 the primary selenium loading to the North Bay and the Suisun Bay area is from the Delta and oil
38 refineries in the vicinity of Carquinez Strait while the South Bay is affected by local and watershed
39 sources not associated with the Delta or refineries (Lucas and Stewart 2007; Stewart et al. 2013).

40 Selenium concentrations in whole-body fish or fish eggs are most useful for evaluating risks to fish,
41 and concentrations in bird eggs are most useful for evaluating risks to birds (Skorupa and Ohlendorf
42 1991; Department of the Interior 1998; Ohlendorf 2003). Analyses of dietary items (such as benthic
43 [sediment-associated] or water-column invertebrates) also can be used for evaluating risks through
44 dietary exposure, although with less certainty than when using concentrations measured in fish or
45 birds. When data are not available for the target receptors (fish and birds) or for their diets,

1 concentrations can be estimated from selenium in water and suspended particulates. However, such
2 modeling further increases the uncertainties in predictions of risk.

3 For evaluation of risks to human health, analyses of fish fillets are most common, although the fish
4 should be analyzed in the form that people may eat (for example, for some species or ethnic groups,
5 whole-body analyses may be appropriate) (California Office of Environmental Health Hazard
6 Assessment 2008; see also Chapter 25, *Public Health*).

7 **Existing Conditions in the Study Area**

8 **Water Concentrations**

9 Selenium has been monitored most consistently at the mouth of the San Joaquin River at Vernalis
10 (Table 8-28) mainly because agricultural drainage in the San Joaquin Valley is the primary source of
11 selenium to the Delta (Cutter and Cutter 2004; Presser and Luoma 2006; Bureau of Reclamation
12 2006; Entrix 2008; Tetra Tech 2008).

13 Selenium also has been monitored frequently at selected locations north and south of the Delta and
14 occasionally at a few locations in the Delta. In addition, a CALFED study (Lucas and Stewart 2007)
15 provided results of several cruises in the study area during 2003–2004, focused primarily on the
16 waterways between Stockton, Rio Vista, and Benicia (Table 8-29 and Figure 8-44).

17 Total selenium concentrations measured on a weekly basis by the Central Valley Water Board's
18 Surface Water Ambient Monitoring Program at Vernalis (Airport Way monitoring station) show the
19 variation in concentrations by season and year (Figure 8-45).

20 Before implementation of the Grassland Bypass Project in September 1996, selenium concentrations
21 at Vernalis were commonly twice as high as those shown in Figure 8-45. Implementation of the
22 Grassland Bypass Project has led to a 60% decrease in selenium loads from the Grassland Drainage
23 Area in comparison to preproject conditions (Tetra Tech 2008). Cutter and Cutter (2004) reported a
24 decreased mean concentration of 0.68 µg/L at Vernalis from 1997 to 2000 in comparison to values
25 shown in Table 8-28 and data from a previous study from 1984 to 1988 (1.25 µg/L). More recent
26 data show a mean of 0.54 µg/L (geometric mean of 0.45 µg/L) for the San Joaquin River at Vernalis
27 in 2007–2014 (U.S. Geological Survey 2014). It is likely that the selenium concentration at Vernalis
28 will continue to decrease with continued operation of the Grassland Bypass Project and
29 achievement of Basin Plan objectives in the amendment described above (Central Valley Regional
30 Water Quality Control Board 2010b; State Water Resources Control Board 2010b, 2010c).

31 Much less sampling has been conducted for selenium analysis in the Sacramento River. The most
32 recent available data for locations in or near the Delta are from Freeport (Table 8-28). A mean
33 concentration of 0.072 µg/L was reported for Freeport in 1984 to 1988 and 1997 to 2000 (years
34 combined, with no apparent difference between the two periods) (Cutter and Cutter 2004), but the
35 detailed data (e.g., min-max values and sample numbers) are not available for comparison to the
36 USGS data shown in the table. Because of the limited data from Freeport, additional values are
37 provided from the Sacramento River at Verona and below Knights Landing (upstream from
38 Sacramento but reflecting quality of water that may enter the Yolo Bypass during flooding). The
39 maximum selenium concentration at those locations was 0.39 µg/L, and the mean concentrations
40 were all less than 0.25 µg/L. Only limited selenium data are available for other major tributaries to
41 the eastern Delta.

1 **Table 8-28. Selenium Concentrations in Surface Water in the Study Area**

Site	No. of Samples	Selenium Concentration (µg/L)			Years	Source
		Min.	Max.	Mean		
Selenium Concentrations North of the Delta						
Sacramento River at Keswick	86	0.061	0.40	0.21	2003–2008	DWR 2010
Sacramento River at Keswick ^a	80	0.090	0.40	0.19	2004–2008	DWR 2010
Feather River at Oroville	31	0.033	0.37	0.19	2003–2008	DWR 2010
Feather River at Oroville ^a	30	0.052	0.28	0.16	2003–2008	DWR 2010
Selenium Concentrations for Inflows to the Delta						
Sacramento River at Verona	24	0.061	0.39	0.21	2003–2009	DWR 2010
Sacramento River at Verona ^a	21	0.15	0.29	0.20	2004–2009	DWR 2010
Sacramento River below Knights Landing	5	0.19	0.30	0.23	2004, 2007, 2008	DWR 2009
Sacramento River at Freeport ^a	88	0.044	0.23	0.09	11/2007–07/2014	USGS 2014
San Joaquin River at Vernalis (Airport Way) ^b	105 ^c	0.20	2.3	0.83	1999–2007	Bureau of Reclamation 2009d
San Joaquin River at Vernalis (Airport Way)	201	0.40	2.8	0.98	1999–2002	BDAT 2009
San Joaquin River at Vernalis (Airport Way) ^b	453	0.40	2.8	0.84	1999–2007	SWAMP 2009
San Joaquin River at Vernalis	93	0.070	1.5	0.45	11/2007–08/2014	USGS 2014
Selenium Concentrations within/near the Delta						
North: Cache Slough near Ryer Island Ferry	7	0.05	0.24	0.12	1999–2000	BDAT 2009
South: Old River at Tracy Boulevard	1	0.61	0.61	0.61	2002	BDAT 2009
South: Old/Middle River	6	1.0	1.0	1.0	1999	DWR 2009
South: Old/Middle River ^a	6	1.0	2.0	1.6	1999	DWR 2009
Central-West: Sacramento River near Mallard Island (BG20)	11	0.06	0.45	0.11	2000–2008	SFEI 2010
Central-West: Sacramento River near Mallard Island (BG20) ^a	12	0.03	0.44	0.09	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	11	0.03	0.40	0.11	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30) ^a	11	0.03	0.45	0.09	2000–2008	SFEI 2010
Suisun Bay	38	0.02	0.21	0.12	2000–2008	SFEI 2010
Suisun Bay ^a	38	0.02	0.44	0.10	2000–2008	SFEI 2010
Selenium Concentrations for the Delta's Major Outputs						
Banks Pumping Plant ^a	71	1.0	2.0	1.0	2001–2007	MWQI 2003, 2005, 2006, 2008
Sources: Bay Delta and Tributaries Project (BDAT)2009; Department of Water Resources 2009b; Municipal Water Quality Investigations (MWQI) 2003a, 2005, 2006, 2008; Bureau of Reclamation 2009d; San Francisco Estuary Institute 2010; Surface Water Ambient Monitoring Program (SWAMP) 2009; U.S. Geological Survey (USGS) 2014.						
Notes: Data include detected concentrations and reporting limits for undetected concentrations. Means are geometric means. Max. = maximum; µg/L = micrograms per liter; Min. = minimum.						
^a Dissolved selenium concentration.						
^b Not specified whether total or dissolved selenium.						
^c Represents the number of months with an average concentration of selenium, not total samples collected.						

1 **Table 8-29. Selenium Concentrations in Surface Water Reported by CALFED Bay-Delta Program**

Site	Number of Samples	Dissolved Selenium (µg/L)			Particulate Selenium (µg/L)			Total Selenium (µg/L)		
		Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
San Joaquin River at Stockton	5 ^a	0.52	1.01	0.73	0.005	0.04	0.02	0.55	1.03	0.76
Calaveras River	2 ^a	0.55	0.72	0.63	0.005	0.03	0.01	0.56	0.75	0.65
Fourteen Mile Slough	6 ^a	0.35	0.94	0.59	0.01	0.03	0.01	0.36	0.95	0.61
McDonald-Empire	5 ^a	0.09	0.91	0.17	0.005	0.03	0.01	0.10	0.94	0.18
Mildred Island South	1 ^a	0.12	0.12	0.12	0.02	0.02	0.02	0.14	0.14	0.14
Mildred Island Center	1 ^a	0.11	0.11	0.11	0.01	0.01	0.01	0.13	0.13	0.13
Mildred Island North	1 ^a	0.09	0.09	0.09	0.01	0.01	0.01	0.10	0.10	0.10
Venice	1 ^a	0.12	0.12	0.12	0.01	0.01	0.01	0.12	0.12	0.12
Franks Tract South	1	0.10	0.10	0.10	0.00	0.00	0.00	0.10	0.10	0.10
Franks Tract East	1	0.10	0.10	0.10	0.002	0.002	0.002	0.10	0.10	0.10
Franks Tract West	1 ^a	0.12	0.12	0.12	0.01	0.01	0.01	0.14	0.14	0.14
Mokelumne River	6 ^a	0.09	0.22	0.13	0.01	0.01	0.01	0.10	0.23	0.14
Three Mile Slough	6 ^a	0.09	0.13	0.11	0.01	0.02	0.01	0.10	0.15	0.13
Sacramento River at Rio Vista	4	0.10	0.14	0.12	0.01	0.01	0.01	0.11	0.15	0.13
Antioch	5	0.08	0.17	0.12	0.01	0.03	0.02	0.10	0.19	0.14
Pittsburg East	2	0.07	0.15	0.10	0.01	0.01	0.01	0.08	0.16	0.11
Pittsburg West	2	0.11	0.12	0.11	0.02	0.03	0.02	0.13	0.14	0.14
Suisun East	2	0.10	0.14	0.12	0.01	0.01	0.01	0.11	0.15	0.13
Suisun Center	2	0.12	0.14	0.13	0.02	0.02	0.02	0.14	0.15	0.15
Suisun West	3	0.13	0.19	0.15	0.01	0.05	0.02	0.15	0.23	0.17
Grizzly Bay East	1	0.12	0.12	0.12	0.02	0.02	0.02	0.14	0.14	0.14
Grizzly Bay Center	3	0.10	0.17	0.13	0.010	0.017	0.013	0.11	0.18	0.14
Grizzly Bay West	1	0.16	0.16	0.16	0.011	0.011	0.011	0.17	0.17	0.17
Benicia	4	0.11	0.16	0.14	0.01	0.02	0.02	0.13	0.18	0.16

Source: Lucas and Stewart 2007.

Notes: Data collected within 1 mile of sample stations were compiled in the same data location. Means are geometric means.

Max. = maximum; µg/L = micrograms per liter; Min. = minimum.

^a One sample each station was collected during July 2000; all other data are from January 2003 to January 2004.

2

1 Sporadic sampling has been conducted at a few locations in the Delta (Tables 8-28 and 8-29). The
2 only two locations at which sampling was conducted over several recent years are in the
3 Sacramento and San Joaquin Rivers just upstream of Mallard Island (near the western limit of the
4 Delta). Observed total selenium concentrations at these stations are considered more representative
5 of generalized Delta concentrations than of the individual rivers (Tetra Tech 2008). Total and dissolved
6 selenium concentrations were somewhat lower at those locations during low flow in a dry year
7 (<0.1 µg/L in August 2001) than during high flow (>0.1 µg/L in February 2001) (Tetra Tech 2008).
8 Cutter and Cutter (2004) reported similar flow-related patterns for those locations. The maximum
9 selenium concentration found in the Delta was 2 µg/L at an Old/Middle River location in the south
10 subarea of the Delta. Except for that location, the available data show mean concentrations well
11 below 1 µg/L.

12 As noted in Table 8-28, inflow originating from the San Joaquin River has selenium concentrations
13 several times higher than those from the Sacramento River, but flows in the San Joaquin River at
14 Vernalis are usually only about 10–15% of the inflow from the Sacramento River at Freeport (Tetra
15 Tech 2008). Therefore, on an annual basis, selenium loads from both rivers to the Delta are large,
16 but selenium processes in the Delta are not well characterized. Besides the processes of settling and
17 mixing, a large portion of the water in the Delta is exported for agricultural and urban uses in other
18 parts of California. The relative contribution of the Sacramento and San Joaquin Rivers to the overall
19 outflow from the Delta to the North Bay changes with tidal cycles and season, as well as operations
20 of SWP/CVP reservoir release and related Delta water supply operations. The contribution from the
21 San Joaquin River potentially can increase during the drier months of September through
22 November (Presser and Luoma 2006; Tetra Tech 2008).

23 Regulatory criteria with respect to selenium are as follows. A TMDL for selenium in the San Joaquin
24 River was completed by the Central Valley Water Board and approved by USEPA in March 2002. The
25 TMDL is implemented through 1) prohibitions of discharge of agricultural subsurface drainage
26 water adopted in a Basin Plan Amendment for the Control of Subsurface Drainage Discharges (State
27 Water Resources Control Board Resolution 96-078), with an effective date of January, 10 1997; and
28 2) load allocations in WDRs (Central Valley Regional Water Quality Control Board 2009c). As
29 mentioned above, the Central Valley Water Board adopted a Basin Plan amendment in May 2010 to
30 modify the compliance time schedule for regulated discharges to Mud Slough (north), which is a
31 tributary to the San Joaquin River.

32 The water quality objective for the lower San Joaquin River at Vernalis is 5 µg/L as a 4-day average
33 for above-normal and wet water-year types, and 5 µg/L as a monthly mean for dry and below
34 normal water-year types (Central Valley Regional Water Quality Control Board 2001, 2007).
35 Selenium criteria were promulgated for all San Francisco Bay and Delta waters in the NTR (San
36 Francisco Bay Regional Water Quality Control Board 2007). The NTR criteria specifically apply to
37 San Francisco Bay upstream to and including Suisun Bay and the Delta. The NTR values are 5.0 µg/L
38 (4-day average) and 20 µg/L (1-hour average). By comparison, the available data show that the
39 maximum concentration at Vernalis has not exceeded 3 µg/L since implementation of the Grassland
40 Bypass Project, and the mean is less than 1 µg/L for the period from 1999 through 2014. The CTR
41 criteria for aquatic life protection in saltwater are substantially higher than the freshwater criteria
42 (i.e., chronic = 71 µg/L; acute = 290 µg/L).

43 Selenium concentrations in water exported from the Delta via Banks pumping plant ranged from 1
44 to 2 µg/L, with a mean of 1.02 µg/L for 2003–2007. Drinking water standards for selenium are

1 average concentrations of 50 µg/L, both as the MCL—the enforceable standard that defines the
 2 highest concentration of a contaminant allowed in drinking water—and the MCLG—a
 3 nonenforceable health goal set at a level at which no known or anticipated adverse effect on human
 4 health would result, while allowing an adequate margin of safety (U.S. Environmental Protection
 5 Agency 2009f). On April 2, 2010, the California Office of Environmental Health Hazard Assessment
 6 (OEHHA) proposed establishing a public health goal of 30 µg/L in drinking water, based on data
 7 from adverse effects of selenium in a human population, with a 45-day comment period (California
 8 Office of Environmental Health Hazard Assessment 2010). Public health goals are developed for use
 9 by DPH in establishing primary drinking water standards (state MCLs). All concentrations that have
 10 been measured in the Delta, or in tributary streams immediately upgradient of the Delta, as well as
 11 those at Banks pumping plant and in the California Aqueduct, are less than 10% of the MCL and the
 12 MCLG (Table 8-28 and Table 8-29).

13 **Sediment and Fish Tissue Concentrations**

14 Very little information is available for selenium concentrations in sediment or biota from in the
 15 Delta (Table 8-30, Table 8-31, and Table 8-32) that would be useful for evaluating risks for fish,
 16 wildlife, or the people consuming them. Selenium concentrations in sediment usually are not closely
 17 related to effects on fish or wildlife resources, although screening-level values such as those
 18 provided by the U.S. Department of the Interior (DOI) are sometimes used for comparison to
 19 background or potential effect levels (U.S. Department of the Interior 1998). Background selenium
 20 concentrations in freshwater sediments are typically <1 mg/kg dry weight. Consequently, the
 21 concentrations reported for the Sacramento and San Joaquin Rivers near Mallard Island and in
 22 Suisun Bay (Table 8-30) are consistent with background levels. They are well below the
 23 concentrations associated with effects on fish and bird populations (2.5 mg/kg). Selenium analyses
 24 of clams from the Mallard Island locations (Table 8-31) are consistent with other bivalves in the
 25 Bay-Delta (Linville et al. 2002; Stewart et al. 2004). Whole-body fish from the San Joaquin River near
 26 Manteca had selenium concentrations within the range of background (<1–4 mg/kg, typically
 27 <2 mg/kg), although the mean was slightly higher than typical background (Table 8-32). Selenium
 28 concentrations in delta smelt from Chipps Island also were consistent with background.

29 **Table 8-30. Selenium Concentrations in Delta and Suisun Bay Sediment**

Site	Number of Samples	Selenium Concentration (mg/kg)			Year Collected	Source
		Min.	Max.	Mean		
Central-West: Sacramento River near Mallard Island (BG20)	9	0.031	0.24	0.083	2000–2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	9	0.087	0.34	0.21	2000–2008	SFEI 2010
Suisun Bay	69	0.016	0.58	0.17	2000–2008	SFEI 2010

Source: San Francisco Estuary Institute (SFEI) 2010.

Notes: Data include detected concentrations and reporting limits for nondetected concentrations.
 Means are geometric means.

Max. = maximum; mg/kg = milligrams per kilogram, dry weight concentration; Min. = minimum.

30

1 **Table 8-31. Selenium Concentrations in Biota in or near the Delta**

Site	Number of Samples	Selenium Concentration (mg/kg)			Common Name	Year Collected	Source
		Min.	Max.	Mean			
Central-West: Sacramento River near Mallard Island (BG20)	5	4.0	19	8.1	Clam	1999–2001, 2008	SFEI 2010
Central-West: San Joaquin River near Mallard Island (BG30)	5	4.1	26	9.1	Clam	1999–2001, 2008	SFEI 2010
Chippis Island ^a	41	0.70	2.3	1.5	Delta Smelt	1993, 1994	Bennett et al. 2001
San Joaquin River, Dos Reis State Park and Mossdale Sites ^b	13	1.6	3.4	2.6	Silversides	May–July 1995	Bennett et al. 2001

Sources: Bennett et al. 2001; San Francisco Estuary Institute (SFEI) 2010.

Notes: Means are geometric means.

Max. = maximum; mg/kg = milligrams per kilogram, dry weight concentration; Min. = minimum.

^a Most of the fish were collected at Chippis Island but included some fish (fewer than 5) from Garcia Bend (near Sacramento).

^b Near Manteca.

2

3 **Table 8-32. Selenium Concentrations in Largemouth Bass**

Site	Number of Samples	Selenium Concentrations in Fish Fillets (mg/kg, wet weight)			Selenium Concentrations in Whole-Body Fish (mg/kg, dry weight)			Years
		Min.	Max.	Mean	Min.	Max.	Mean	
Sacramento River at Veterans Bridge	3	0.40	0.81	0.56	1.7	2.9	2.2	2005
Sacramento River at River Mile 44 ^a	9	0.27	0.72	0.46	1.2	2.7	1.9	2000, 2005, 2007
Sacramento River near Rio Vista	9	0.30	0.80	0.44	1.3	3.2	1.9	2000, 2005, 2007
San Joaquin River at Vernalis	8	0.15	0.63	0.40	0.77	2.5	1.7	2000, 2005, 2007
Old River near Tracy	3	0.45	0.69	0.55	2.0	2.9	2.4	2005
San Joaquin River at Potato Slough	9	0.22	0.89	0.38	1.1	3.5	1.6	2000, 2005, 2007
Middle River at Bullfrog	6	0.37	0.58	0.47	1.6	2.3	2.0	2005, 2007
Franks Tract	8	0.15	0.70	0.37	0.79	3.0	1.7	2000, 2005, 2007
Big Break	9	0.15	0.82	0.38	0.81	3.1	1.6	2000, 2005, 2007
Discovery Bay	3	0.32	0.41	0.37	1.5	1.7	1.6	2005
Whiskey Slough	2	0.35	0.47	0.41	1.6	1.9	1.7	2005

Source: Foe 2010.

Notes: Means are geometric means.

Max. = maximum; mg/kg = milligrams per kilogram; Min. = minimum.

^a Near Clarksburg.

1 A large number of fish tissue samples were collected from the Sacramento and San Joaquin River
2 watersheds and the Delta between 2000 and 2007 for mercury analysis. As part of the Strategic
3 Workplan for Activities in the San Francisco Bay/Sacramento–San Joaquin Delta Estuary (State
4 Water Resources Control Board 2008), archived largemouth bass samples were analyzed for
5 selenium to determine the primary source of the selenium being bioaccumulated in bass in the Delta
6 and whether selenium concentrations in bass were above recommended criteria for the protection
7 of human and wildlife health (Foe 2010). Results of this study are the most relevant biota data from
8 the Delta, and they are summarized in Table 8-32.

9 There were no differences in selenium concentrations in largemouth bass caught in the Sacramento
10 River between Veterans Bridge and Rio Vista in 2005, and there was no difference in selenium
11 concentration on the San Joaquin River between Fremont Ford (not shown in Table 8-32) and
12 Vernalis (Foe 2010). Also, there was no difference in bass selenium concentrations in the
13 Sacramento River at Rio Vista and in the San Joaquin River at Vernalis in 2000, 2005, and 2007. The
14 lack of a difference in bioavailable selenium between the two river systems was unexpected because
15 the San Joaquin River is considered a significant source of selenium to the Delta. Selenium
16 concentrations were unexpectedly higher in both river systems in 2007 than in other years; reasons
17 for this difference are related to increased bioaccumulation during low-flow conditions, as discussed
18 in Appendix 8M, *Selenium*.

19 The Central Valley appeared to be the dominant source of bioavailable selenium to bass in the Delta
20 because tissue concentrations generally decreased seaward (Foe 2010). Selenium concentrations in
21 bass were highest in a dry water-year type (2007), consistent with predictions of the Presser and
22 Luoma (2006) bioaccumulation model.

23 Selenium concentrations in the bass were compared to criteria recommended for the protection of
24 human health (based on fillets; 2.5 mg/kg, wet weight) and wildlife health (based on whole-body
25 fish; concern thresholds of 4 or 9 mg/kg, dry weight) (Foe 2010). Average concentrations were
26 always less than 4 mg/kg; only 1 of the 69 bass (4.24 mg/kg in a fish from San Joaquin River at
27 Potato Slough in 2007) marginally exceeded that lowest threshold.

28 Selenium concentrations in the livers of 2 of 86 Sacramento splittail collected from Big Break, Nurse
29 Slough, and Sherman Island exceeded the concentration (>27 mg/kg) (Teh et al. 2004) at which
30 growth, survival, and histopathology effects were observed in long-term laboratory studies of
31 juvenile splittail (Greenfield et al. 2008). Mean selenium concentrations ranged from 11.8 to
32 16.3 mg/kg in 2001 and from 8.36 to 8.84 mg/kg in 2002, with the highest mean concentrations
33 occurring in fish from Nurse Slough (in Suisun Marsh). Other field and laboratory studies have been
34 conducted with splittail (Deng et al. 2007, 2008) and with white sturgeon (Tashjian and Hung 2006;
35 Tashjian et al. 2006, 2007) and other fish (Linville et al. 2002; Stewart et al. 2004), but no other
36 analytical data for field-collected fish from in the Delta were found.

37 Species to be considered for linkage of waterborne or foodweb selenium to fish and birds will
38 include those identified by the U.S. Fish and Wildlife Service (USFWS) as being at risk from selenium
39 exposure in the San Francisco estuary, insofar as possible (U.S. Fish and Wildlife Service 2008a).
40 However, species-specific and Delta-specific bioaccumulation and trophic transfer factors for those
41 species are not available, so assessments focus on largemouth bass, which have been sampled at
42 various locations in the Delta.

43 Current ambient water quality criteria are based on waterborne selenium concentrations, but in
44 2014 USEPA released draft water quality criteria for the protection of freshwater aquatic life from

1 toxic effects of selenium in 2014, which consist of two fish tissue-based elements and two water
 2 column-based elements, as shown in Table 8-32a (U.S. Environmental Protection Agency 2014). The
 3 draft criteria emphasize the importance of tissue-based concentrations most closely associated with
 4 reproductive effects (in fish eggs or ovaries), but also address the concentrations in whole-body fish
 5 or muscle if egg/ovary data are not available and, concentrations in water. Water-column criteria
 6 differ for lotic (flowing) and lentic (still-water) aquatic systems.

7 **Table 8-32a. Draft Water Quality Criteria for Selenium**

Media Type	Fish Tissue		Water Column ^c	
Criterion Element	Egg/Ovary ^a	Fish Whole-Body or Muscle ^b	Monthly Average Exposure	Intermittent Exposure ^d
Magnitude	15.2 mg/kg	8.1 mg/kg whole body or 11.8 mg/kg muscle (skinless, boneless filet)	1.3 µg/l in lentic aquatic systems 4.8 µg/l in lotic aquatic systems	$WQC_{int} = \frac{WQC_{30-day} - C_{bkgrnd}(1 - f_{int})}{f_{int}}$
Duration	Instantaneous measurement ^e	Instantaneous measurement ^e	30 days	Number of days/month with an elevated concentration

Source: U.S. Environmental Protection Agency 2014

Notes: mg/kg = milligrams per kilogram; µg/l = micrograms per liter.

^a Overrides any whole-body, muscle, or water column elements when fish egg/ovary concentrations are measured.

^b Overrides any water column element when both fish tissue and water concentrations are measured,

^c Water column values are based on dissolved total selenium in water.

^d Where WQC_{30-day} is the water column monthly element, for either a lentic or lotic system, as appropriate. C_{bkgrnd} is the average background selenium concentration, and f_{int} is the fraction of any 30-day period during which elevated selenium concentrations occur, with f_{int} assigned a value ≥ 0.033 (corresponding to 1 day).

^e Instantaneous measurement. Fish tissue data provide point measurements that reflect integrative accumulation of selenium over time and space in the fish at a given site. Selenium concentrations in fish tissue are expected to change only gradually over time in response to environmental fluctuations.

8
 9 USEPA's Action Plan for Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin
 10 Estuary (U.S. Environmental Protection Agency 2012a) identifies selenium as one of seven priority
 11 items for action. The plan indicates that USEPA will draft new site-specific numeric selenium criteria
 12 by December 2012 to protect aquatic and terrestrial species dependent on the aquatic habitats of
 13 the Bay Delta Estuary. This planned action continues a long-term effort responding to scientific
 14 evidence that the current selenium water quality standards do not adequately protect sensitive
 15 species. USFWS and NMFS drafted a Biological Opinion in 2000 that found jeopardy under ESA for
 16 the selenium criteria that USEPA proposed in the California Toxics Rule. To avoid a final jeopardy
 17 opinion, USEPA agreed to develop site-specific water quality criteria for selenium, beginning in the
 18 Bay Delta Estuary. USEPA is using an ecosystem-based model created by the USGS with advice from
 19 the USFWS and NMFS. The model reflects the food web in the Bay Delta Estuary, the diet of sensitive
 20 species and their use of habitats, and hydrological conditions. (Note: this same modeling approach is
 21 used in estimating selenium bioaccumulation in this EIR/EIS.) More stringent selenium water
 22 quality criteria may require actions that decrease allowable concentrations of selenium in surface

1 waters of the Bay Delta Estuary and may set allowable levels of selenium in the tissue of fish and
 2 wildlife. The new criteria would reduce the chronic (long-term) exposure of sensitive species to
 3 selenium.

4 Following the development of the Bay Delta selenium criteria, USEPA plans to develop site-specific
 5 criteria for other parts of California, including the San Joaquin Valley watershed (U.S. Environmental
 6 Protection Agency 2012a). USEPA also is engaged in other efforts to minimize selenium discharges
 7 to the San Joaquin River and the Bay Delta Estuary, including the Grasslands Bypass Project and the
 8 North San Francisco Bay TMDL.

9 **8.1.3.16 Other Trace Metals**

10 **Background and Importance in the Study Area**

11 Trace metals such as aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel,
 12 silver, and zinc occur naturally in the environment. Sources of these metals include natural crustal
 13 material such as soils, and enriched ore deposits. Because of their industrial and commercial utility,
 14 trace metals also can be found in urban and agricultural stormwater runoff, landfill and mine
 15 leachate, and industrial and municipal wastewater discharges.

16 Many trace metals are necessary for healthy biological function, where deficiencies in certain trace
 17 metals can result in disease and ailment. At elevated levels, trace metals can be toxic to humans and
 18 aquatic life, where the concentration of concern in surface waters is specific to each metal and each
 19 receptor (human or aquatic life). Thus, the beneficial uses (Table 8-1) of Delta waters most affected
 20 by trace metal concentrations are aquatic life uses (cold freshwater habitat, warm freshwater
 21 habitat, and estuarine habitat), harvesting activities that depend on aquatic life (shellfish harvesting,
 22 commercial and sport fishing), and drinking water supplies (municipal and domestic supply).

23 Trace metal contamination demonstrates the magnitude of effect that human activities have had on
 24 the Delta. Sediment transport to the Bay increased by nearly an order of magnitude during the mid-
 25 1800s to early 1900s as a result of hydraulic gold mining operations; these sediments carried high
 26 concentrations of metal contaminants, which persist today (Van Geen and Luoma 1999b). The effect
 27 of these residual metals in the water column is exacerbated by the decreased river inflows into the
 28 Delta in recent years, as well as the continued discharge of contaminants from stormwater runoff
 29 and other urban activities.

30 Hayward et al. (1996), in an evaluation of metals concentrations in the San Joaquin River, found that
 31 concentrations of trace metals were uniformly low, with a few isolated exceptions related to specific
 32 point sources (e.g., elevated zinc near boat docks in the Stockton Harbor). However, relatively low
 33 concentrations in water can have effects on aquatic life. A 2006 study of sediment toxicity in the San
 34 Francisco estuary identified toxic hotspots where metals were found to cause sediment toxicity in
 35 bivalve embryos (Anderson et al. 2007).

36 Alpers et al. (2000:2) evaluated metals concentrations in the Sacramento River (Shasta Dam to Delta
 37 region) from July 1996 to June 1997, encompassing both low-flow and flood conditions. Their study
 38 showed that cadmium, copper, and zinc were transported primarily in dissolved form upstream of
 39 major agricultural activities but primarily in colloidal form downstream. Iron and lead were
 40 transported primarily in colloidal form at all mainstem Sacramento River sites.

1 Additional background for aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese,
2 nickel, silver, and zinc is provided below.

3 **Aluminum, Iron, and Manganese**

4 Aluminum, iron, and manganese are common elements in mineral soils. The concentrations of these
5 metals can be substantially elevated above background levels during watershed runoff events that
6 transport high-suspended sediment loads. However, in general, a large majority of the metals are
7 stable within the mineral matrices of the suspended particles and not available to interact
8 chemically with other compounds or otherwise cause adverse water quality effects. When these
9 constituents are in ionic and dissolved forms, they are more readily available to react chemically in
10 the water, and their presence may result in adverse effects to certain water uses. The pH of water is
11 a generally important regulator of the ionic activity of these metals, with lower pH generally
12 resulting in dissociation and creation of ionic forms of the metals with resulting higher
13 dissolved/reactive concentrations in the water. These metals are readily removed via conventional
14 water treatment processes that remove suspended sediment and through chemical ion exchange
15 and adsorption (i.e., chemical coagulation and filtration systems), and surface waters in the affected
16 environment require a minimum of coagulation and filtration to conform to federal SDWA
17 regulations.

18 Aluminum, iron, and manganese are identified as “non-priority” pollutants by U.S. EPA. Aluminum
19 can cause aquatic toxicity effects to some aquatic biota, and USEPA adopted ambient water quality
20 criteria for dissolved aluminum. There also is a primary MCL for aluminum applicable to drinking
21 water delivered at the tap. All three metals are regulated by secondary MCLs for their potential
22 nuisance effects in domestic potable water supplies (e.g., staining, and taste and odor concerns). The
23 secondary MCLs apply to the total metal concentration in treated potable water. Therefore, ambient
24 concentrations in the total form above the secondary MCLs should not be interpreted as having a
25 direct impact on potable supplies; rather, increased concentrations may indicate the potential for
26 greater levels of treatment required to achieve the same treated concentrations.

27 **Arsenic**

28 Arsenic is a semi-metal element that is tasteless and odorless and highly toxic to humans. Long-
29 term, chronic exposure to arsenic has been linked to cancer of the bladder, lungs, skin, kidneys,
30 nasal passages, liver, and prostate (U.S. Environmental Protection Agency 2009h). Short-term
31 exposure to high doses of arsenic can cause acute symptoms such as skin damage, circulatory
32 system dysfunction, stomach pain, nausea and vomiting, diarrhea, numbness in hands and feet,
33 partial paralysis, and blindness (U.S. Environmental Protection Agency 2009h).

34 Sources of arsenic contamination in water supplies include erosion of natural deposits, agricultural
35 runoff, and runoff or wastewater from industrial point sources. Arsenic commonly is found in
36 volcanic rocks and metal oxides, and is commonly associated with sulfide minerals and organic
37 carbon (Saracino-Kirby 2000). Arsenic also is found in certain pesticides, fertilizers, and feed
38 additives used in commercial agricultural operations (Saracino-Kirby 2000; U.S. Environmental
39 Protection Agency 2009h). Approximately 90% of the industrial arsenic used in the United States is
40 used as wood preservative; industry practices such as copper smelting, mining, and coal burning
41 also contribute arsenic to the environment (U.S. Environmental Protection Agency 2009h).

1 **Cadmium**

2 Cadmium can be toxic to humans. Long-term, chronic exposure to cadmium has been linked to blood
3 damage and several forms of cancers; short-term exposure to high concentrations of cadmium may
4 cause nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury,
5 convulsions, shock, and renal failure (U.S. Environmental Protection Agency 2009i). Some aquatic
6 species (e.g., Chinook salmon, Sacramento sucker, threespine stickleback) tend to bioaccumulate
7 cadmium, while others do not (U.S. Environmental Protection Agency 2009i; Saiki et al. 1995). The
8 toxicity of cadmium to aquatic life varies with the total hardness of the water, exhibiting generally
9 lower toxicity as hardness increases.

10 Cadmium occurs naturally in zinc, lead, copper, and other ores, which may erode and release
11 cadmium into water bodies, especially in soft, acidic waters (U.S. Environmental Protection
12 Agency 2009i). Cadmium is used in a variety of industrial activities and applications, including metal
13 plating and coating operations, machinery and baking enamels, photography, and nickel-cadmium
14 and solar batteries (U.S. Environmental Protection Agency 2009i). Cadmium can enter water bodies
15 through urban or industrial wastewater, leaching from landfills, and from corrosion of some
16 galvanized plumbing and water mains (Van Geen and Luoma 1999a; U.S. Environmental Protection
17 Agency 2009i).

18 Regulation of industrial and urban wastewater has led to a steady reduction in metal discharges to
19 water bodies over the past two decades; however, these contaminants persist in sediments. A study
20 of cadmium concentrations in San Francisco Bay revealed that coastal upwelling of cadmium-rich
21 sediment contributes to seasonal peaks in those levels in the Bay. Surface samples collected
22 throughout the Bay confirmed an internal cadmium source unrelated to river discharge. The results
23 of the study suggested that concentrations of cadmium and other metals in the Delta and Bay water
24 column are sensitive to river inflow and may have increased in response to reduced inflows in
25 recent years. (Van Geen and Luoma 1999a.)

26 **Copper**

27 Copper is found primarily in the form of ores with other elements. Copper occurs in both organic
28 and inorganic forms; organic copper is an essential micronutrient for animals, while exposure to
29 high concentrations of inorganic copper can be toxic (Buck et al. 2006; U.S. Environmental
30 Protection Agency 2009j). In humans, short-term exposure to copper can cause nausea and
31 vomiting; long-term exposure can cause liver or kidney damage (U.S. Environmental Protection
32 Agency 2009j).

33 Sources of copper contamination include natural deposits, industrial and urban wastewater, and
34 urban stormwater runoff (Buck et al. 2006; U.S. Environmental Protection Agency 2009j). Historical
35 copper contamination from industrial development and mining operations persists in sediments in
36 the Delta and Bay (Buck et al. 2006). Dissolved copper tends to bind with organic matter, resulting
37 in a strong correlation between concentrations of dissolved copper and organic carbon (Buck et al.
38 2006). This binding of copper with organic carbon has reduced concentrations of the toxic form of
39 copper in San Francisco Bay to concentrations that do not pose a threat to aquatic life; without the
40 copper-binding organic matter, it is likely that copper concentrations in the Bay would be toxic to
41 most aquatic microorganisms (Buck et al. 2006).

42 The most common source of copper contamination in drinking water is corrosion of household
43 copper plumbing materials. This contamination cannot be directly detected or removed with

1 conventional drinking water treatment methods; thus, USEPA requires drinking water suppliers to
2 control the corrosiveness of their water to minimize copper contamination at the tap. (U.S.
3 Environmental Protection Agency 2009j.)

4 **Lead**

5 Lead is a metal found in natural deposits as ores with other elements. Short-term exposure to lead
6 can cause a variety of health effects, including problems with blood chemistry, mental and physical
7 development in babies and young children, and increases in blood pressure in some adults. Long-
8 term exposure to lead has the potential to cause stroke, kidney disease, and cancer. (U.S.
9 Environmental Protection Agency 2009k.)

10 Sources of lead contamination include natural deposits, mining, and smelting operations (U.S.
11 Environmental Protection Agency 2009k). Lead is sometimes used in household plumbing materials
12 or in water distribution systems. Lead is regulated in drinking water systems via the USEPA's Lead
13 and Copper rule.

14 **Nickel**

15 Recent work has shown that the most substantial sources of nickel are in the South Bay; the next
16 largest source is in the Delta (Yee et al. 2007). Nickel sources in the region originate from natural
17 and human sources such as natural rock erosion, urban runoff, and WWTPs (Yee et al. 2007). Total
18 nickel concentrations from samples in the Delta averaged 3.5 µg/L in the dry season, and 5.1 µg/L in
19 the wet season. Davis et al. (2000) estimated nickel loads were 975,000 kg/year from San Francisco
20 Bay bottom sediments, 410,000 kg/year from the Delta, 49,000 kg/year from Bay tributaries, 4,800
21 kg/year from effluent, and 580 kg/year from atmospheric deposition.

22 **Silver**

23 Silver is present in San Francisco Bay sediments, which can have toxic effects on biota (Flegal et
24 al. 2007). Most fluxes of silver in the Bay are from past industrial activities and wastewater
25 treatment sources. Delta waters entering the Bay have some of the lowest river silver
26 concentrations reported.

27 **Zinc**

28 Zinc potentially can have toxic effects on biota, although it is an essential element in the diet of these
29 plants and animals. Zinc is used to make tires, so it is generally found at higher concentrations near
30 highways. It is also used in manufacturing processes.

31 **Existing Conditions in the Study Area**

32 In 2000, the Association of California Water Agencies conducted a study to summarize arsenic data
33 from across the state and to assess the effect of USEPA's arsenic standard on California's drinking
34 water programs (Saracino-Kirby 2000). Sampling data collected by USGS in 1990 and 2000,
35 California Department of Health, DWR, Reclamation, and other sources were analyzed. The study
36 found that the statewide average concentration of arsenic in groundwater measured between 1990
37 and 2000 was 9.8 µg/L, and that 22% of the 4,513 sampling stations recorded arsenic
38 concentrations of 10 µg/L or higher during this time period (Saracino-Kirby 2000) (Table 8-33). The
39 study found no noticeable trend in arsenic concentrations through time (Saracino-Kirby 2000).
40 Thirty percent of the state's groundwater basins were found to have average arsenic concentrations

1 of 10 µg/L or higher at some point between 1990 and 2000 (Saracino-Kirby 2000). The Association
2 of California Water Agencies study also analyzed samples from 188 sampling stations on surface
3 water bodies and found that the statewide average concentration of arsenic in surface water
4 between 1990 and 2000 was 42 µg/L; however, this average was influenced by a small number of
5 data points with very high values—91% of the sampling locations recorded average concentrations
6 less than 10 µg/L during the same time period (Saracino-Kirby 2000).

7 There was a large monitoring effort from 1988 to 1993 to assess metals in the Delta. Results for San
8 Joaquin River at Buckley Cove, Sacramento River at Hood (actually collected at Greene’s Landing),
9 Sacramento River above Point Sacramento, San Joaquin River at Antioch Ship Channel, Old River at
10 Rancho Del Rio, Suisun Bay at Bulls Head Point near Martinez, and Franks Tract are shown in Table
11 8-33. Analysis of the monitoring results indicated that most metal median values were similar
12 between locations, with zinc median values being the highest of all the metals.

13 Results from recent monitoring efforts for trace metals at the Banks pumping plant and Barker
14 Slough pumping plant are shown in Table 8-34. Analytes examined in the present effort for the
15 Banks and Barker Slough pumping plants include arsenic, cadmium, copper, lead, nickel, silver, and
16 zinc. The monitoring program sampled for each of these analytes approximately 72 times during the
17 water years 2001 to 2006 at each location. Arsenic, copper, and nickel were detected in almost all
18 sampling events for each location. Median values for these metals were similar at the two locations.
19 Elevated values for these metals occurred primarily between January and March, although the
20 copper maxima occurred during May. There were one detection of lead and three detections of zinc
21 at the Banks pumping plant. There were no detections of cadmium or silver at either station, and no
22 detections of lead or zinc at the Barker Slough pumping plant. Cadmium values matched the MCL of
23 0.005 mg/L at several locations during the 1988–1993 study, but there were no detections at either
24 the Banks or Barker Slough pumping plants during water years 2001–2006.

25 SFEI data for the Sacramento River above Point Sacramento and the San Joaquin River at Antioch,
26 which have very low detection limits, are presented in Table 8-35. The samples were taken between
27 late July and late August, which does not allow examination of wet versus dry season results. The
28 samples indicate that all selected metals are still present in the Sacramento and San Joaquin River
29 outflows during summer conditions, albeit at low concentrations. Values for all metals were
30 comparable for the two locations. For both locations, copper, nickel, and zinc occurred at higher
31 concentrations than the other metals.

32 Monitoring efforts in the north Delta areas (water years 2001–2006) indicate that mean values for
33 metals at the Feather River at Oroville tended to be lower than those for the Sacramento River sites,
34 with the exception of cadmium and silver (Table 8-36).

35 Arsenic, cadmium, chromium, copper, lead, nickel, silver and zinc are among the 126 priority
36 pollutants identified by the USEPA. Iron and manganese are identified as non-priority pollutants by
37 USEPA. Federal water quality criteria contained in the CTR, state water quality objectives contained
38 in the Region 2 and Region 5 Water Quality Control Plans, and drinking water MCLs are listed in
39 Appendix 8A, *Water Quality Criteria and Objectives*. Based on water quality criteria and objectives,
40 and typical levels in surface waters, it is generally the case that aluminum, arsenic, iron, and
41 manganese are of primary concern for drinking water, while aluminum, cadmium, chromium,
42 copper, lead, nickel, silver, and zinc are of concern because of potential toxicity to aquatic organisms.

1 **Table 8-33. Median Metal Concentrations for Selected Sites, May 1988–September 1993**

Location	Arsenic Dissolved (µg/L)	Arsenic Total (µg/L)	Cadmium Dissolved (µg/L)	Cadmium Total (µg/L)	Copper Dissolved (µg/L)	Copper Total (µg/L)	Lead Dissolved (µg/L)	Lead Total (µg/L)	Zinc Dissolved (µg/L)	Zinc Total (µg/L)
San Joaquin River at Buckley Cove	3	3	5	5	5	5	5	5	6	10
Sacramento River at Green's Landing	2	2	5	5	5	5	5	5	6	8
Sacramento River above Point Sacramento	2	3	5	5	5	7	5	5	5	10
San Joaquin River at Antioch Ship Channel	2	2	5	5	5	6	5	5	5	11
Old River at Rancho Del Rio	2	2	5	5	5	5	5	5	5	8
Suisun Bay at Bulls Head Point near Martinez	2	3	5	5	5	7	5	5	6	15
Franks Tract	2	2	5	5	5	5	5	5	5	7
San Joaquin River at Vernalis	-	-	-	-	-	-	-	-	10	-

Source: Bay Delta and Tributaries Project 2009.

Notes: Units are in micrograms per liter (µg/L). Sample sizes are 10 to 12 (exception: San Joaquin River at Vernalis, with a sample size of 15). Sample size represents water quality samples having values at or greater than the reporting limit.

2 **Table 8-34. Metals Concentrations at the Harvey O. Banks and Barker Slough Pumping Plants, Water Years 2001–2006**

Metal	Harvey O. Banks Pumping Plant (µg/L)				Barker Slough Pumping Plant (µg/L)					
	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic	71	1	3	2	2	72	1	5	2	2
Cadmium		no detections					no detections			
Copper	71	1	9	2	2	72	1	8	3	2
Lead		one detection: 7 µg/L (11/19/03)					no detections			
Nickel	67	1	2	1	1	72	1	7	2	2
Silver		no detections					no detections			
Zinc		15 µg/L (1/16/02), 5 µg/L (9/17/03), 6 µg/L (10/15/03)					no detections			

Source: Bay Delta and Tributaries Project 2009.

Notes: Metals measured as dissolved. All units are in micrograms per liter (µg/L).

Sample size represents water quality samples having values at or greater than the reporting limit.

3
4

1 **Table 8-35. Metals Concentrations at the Mouths of the Sacramento and San Joaquin Rivers, Water Years 2001–2006**

Metal	Fraction	Sacramento River above Point Sacramento (µg/L)					San Joaquin River at Antioch Ship Channel (µg/L)				
		Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic	Dissolved	8	0.800	2.270	1.729	1.758	7	1.190	2.310	1.861	1.900
Arsenic	Total	8	0.800	2.420	2.039	2.253	7	1.250	2.500	2.014	2.130
Cadmium	Dissolved	7	0.007	0.016	0.011	0.010	7	0.006	0.015	0.010	0.011
Cadmium	Total	7	0.015	0.032	0.027	0.026	6	0.013	0.033	0.022	0.020
Copper	Dissolved	8	1.253	3.539	1.738	1.468	7	1.410	1.888	1.654	1.606
Copper	Total	8	2.534	4.613	3.418	3.257	7	2.435	4.811	3.028	2.729
Lead	Dissolved	8	0.019	0.091	0.043	0.034	7	0.017	0.196	0.055	0.027
Lead	Total	8	0.427	1.035	0.663	0.580	7	0.263	0.950	0.530	0.445
Nickel	Dissolved	8	0.766	2.641	1.218	1.006	7	0.727	1.470	1.059	0.975
Nickel	Total	8	2.410	6.503	3.970	3.933	7	2.034	6.726	3.157	2.523
Silver	Dissolved	4	0.001	0.002	0.001	0.001	5	0	0.001	0.001	0.001
Silver	Total	7	0.001	0.009	0.004	0.003	5	0.001	0.005	0.002	0.002
Zinc	Dissolved	8	0.160	1.410	0.711	0.595	7	0.253	1.818	0.712	0.510
Zinc	Total	8	2.283	7.022	4.291	3.924	7	1.983	7.055	3.321	2.705

Source: San Francisco Estuary Institute 2010.

Notes: All units in micrograms per liter (µg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

2

1 **Table 8-36. Metals Concentrations at Selected North- and South-of-Delta Stations, Water Years 2001–2006**

Metal	Sacramento River at Keswick (µg/L)					Sacramento River at Verona (µg/L)					Feather River at Oroville (µg/L)					Check 13 (µg/L)					Check 29 (µg/L)				
	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median	Samples	Minimum	Maximum	Mean	Median
Arsenic (d)	25	0.81	1.93	1.27	1.22	8	0.87	1.48	1.18	1.24	22	0.38	0.67	0.52	0.51	69	1	3	2	2	62	1	4	2	2
Arsenic (t)	28	0.84	1.94	1.36	1.30	11	0.92	1.91	1.29	1.20	23	0.47	0.99	0.60	0.56										
Cadmium (d)	8	0.007	0.036	0.021	0.023	1		0.009			1		0.023												
Cadmium (t)	14	0.008	0.095	0.028	0.019	2	0.010	0.020	0.010	0.010	2	0.029	0.033	0.031	0.031										
Copper (d)	25	0.49	3.18	1.40	1.06	8	0.62	4.22	1.55	1.33	22	0.42	1.54	0.70	0.61	69	1.00	5.00	2.00	2.00	81	1.00	4.00	2.00	2.00
Copper (t)	28	0.71	4.30	1.72	1.23	11	0.85	6.54	2.62	1.91	23	0.47	2.82	1.00	0.88										
Lead (d)	13	0.000	0.113	0.026	0.009	6	0.010	0.170	0.080	0.070	9	0.003	0.077	0.019	0.006										
Lead (t)	21	0.008	1.560	0.139	0.040	11	0.090	1.150	0.340	0.130	20	0.001	0.300	0.050	0.015										
Nickel (d)	25	0.49	2.49	1.39	1.32	8	0.58	2.57	1.27	1.13	22	0.40	1.38	0.89	0.88	67	1.00	3.00	1.00	1.00	79	1.00	3.00	1.00	1.00
Nickel (t)	28	0.50	2.73	1.56	1.47	11	0.99	8.94	2.80	1.71	23	0.79	1.93	1.12	1.05										
Silver (d)	1		0.015			1		0.005			2	0.020	0.030	0.030	0.030										
Silver (t)	4	0.003	0.091	0.037	0.027						3	0.020	0.070	0.040	0.040										
Zinc (d)	25	0.31	7.84	2.28	1.91	7	0.16	1.37	0.63	0.30	18	0.04	2.41	0.46	0.27						1		5.00		
Zinc (t)	28	1.02	11.90	3.44	2.38	11	0.53	8.18	2.68	1.16	23	0.13	2.66	0.79	0.48										

Source: Bay Delta and Tributaries Project 2009.

Notes: All units in micrograms per liter (µg/L). Sample size represents water quality samples having values at or greater than the reporting limit.

d = dissolved; t = total.

2

1 The CTR contains criteria for protection of freshwater aquatic life, saltwater aquatic life, and human
 2 health from consumption of water (drinking water) and organisms (eating fish and shellfish) and
 3 consumption of organisms only. For waters in which the salinity is equal to or less than 1 part per
 4 thousand 95% or more of the time, the applicable CTR criteria are the freshwater criteria. For
 5 waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the
 6 time, the applicable CTR criteria are the saltwater criteria. For waters in which the salinity is
 7 between 1 and 10 parts per thousand, the applicable CTR criteria are the more stringent of the
 8 freshwater or saltwater criteria.

9 CWA Section 303(d) listings in the affected environment include cadmium, copper, and zinc in Lake
 10 Shasta and Keswick Reservoir; copper and zinc in the Mokelumne River (eastern portion of Delta
 11 waterways); copper in Bear Creek (eastern portion of Delta waterways); and many listings in the
 12 Central Coast, Los Angeles, Santa Ana, and San Diego Regions, which include the SWP and CVP
 13 Export Service Areas (State Water Resources Control Board 2011).

14 **8.1.3.17 Turbidity and Total Suspended Solids**

15 **Background and Importance in the Study Area**

16 TSS is a measure of the particulate matter that is suspended in the water column, consisting of
 17 organic materials (e.g., decaying vegetation) and inorganic materials (e.g., inorganic components of
 18 soil). Turbidity is a measure of the optical property of water that causes light to be scattered and
 19 absorbed rather than transmitted through the water column. The scattering and absorption of light
 20 is caused by: (1) water itself; (2) suspended particulate matter (colloidal to coarse dispersions); and
 21 (3) dissolved chemicals. Although suspended solids are only one of the factors affecting turbidity,
 22 they are often the dominant one. Thus, there is typically, but not always, a good relationship
 23 between turbidity and TSS, but this relationship will vary spatially and seasonally.

24 Sensitive receptors that have the potential to be affected by elevated concentrations of turbidity and
 25 TSS are municipal and industrial water supply uses (municipal and domestic supply/industrial
 26 service supply), aquatic life beneficial uses (warm freshwater habitat, cold freshwater habitat,
 27 migration of aquatic organisms and spawning, reproduction, and/or early development), and
 28 estuarine habitat (Table 8-1) because of habitat and other physiological effects. In the Delta, a
 29 declining turbidity trend, which has been attributed to a declining sediment supply and invasive
 30 submerged aquatic vegetation, is believed to have caused, at least in part, changes in Delta ecology
 31 and the decline of delta smelt (Hestir et al. 2013). The filtering of phytoplankton by invasive clams
 32 may also be contributing to reduced turbidity in the Delta (Appendix 11A, Section 11A.1.6, *Threats*
 33 *and Stressors*).

34 Turbidity is a critical measurement for drinking water treatment plants because the constituents
 35 suspended in the water affect the filtration systems used to remove disease-causing microorganisms
 36 such as viruses, parasites, and some bacteria (e.g., fecal coliforms). Turbidity also can reduce the
 37 efficiency of disinfection techniques; disinfectants do not selectively target microbes, but rather
 38 react with many constituents within the water matrix (CALFED Bay-Delta Program 2008b).

39 Monitoring in the San Francisco estuary has used turbidity as a proxy for TSS, which in turn has
 40 been correlated to contaminant concentrations such as metals, PAHs, and organochlorine pesticides
 41 (Schoellhamer et al. 2007a). One study by Anderson et al. (2007) collected sediment samples
 42 between 1994 and 2001 from the mouths of the Sacramento and San Joaquin Rivers; all the samples

1 collected were found to be toxic to mussels. These results suggest that the greatest concern for
2 human health is not TSS itself but rather the contaminants associated with the solids and sediment,
3 which can bioaccumulate up the aquatic food chain and be consumed by humans (e.g., fish,
4 shellfish).

5 Elevated levels of turbidity and TSS limit light penetration into the water column, altering
6 photosynthesis, primary production, and fish behavior (Schoellhamer et al. 2007b). After runoff
7 events, TSS can settle to cover streambed spawning sites for fish and also alter macroinvertebrate
8 habitat.

9 A major historical source of TSS in central California was hydraulic mining for precious metals in the
10 late 1800s and early 1900s. The majority of this mining sediment has passed through the Delta
11 system, although mine tailings remain in many watersheds. The construction and operation of dams
12 in the Sacramento and San Joaquin River system have the effect of reducing TSS concentrations
13 downstream because sediments become trapped in the reservoirs. Floodplain management in the
14 form of levees can contribute to instream erosion by confining the flow to the channel and
15 increasing streambed shear stress, but channels for flood management are often lined to protect the
16 channel and minimize erosion (Schoellhamer et al. 2007b).

17 Given that the dam and levee systems in place are unlikely to be removed, the human activity that
18 most likely affects sediment delivery to the Delta is soil erosion associated with agricultural and
19 urban land uses. These activities are pertinent because they occur downstream from the major dams
20 on the system (Schoellhamer et al. 2007b). Examples include crop production, livestock production,
21 and construction activities. Stormwater runoff and overland flow are the likely mechanisms
22 delivering sediment to streams and larger rivers, although erosion control practices may be
23 implemented to minimize this contribution (Schoellhamer et al. 2007b).

24 Maintenance of the islands and wetlands in the Delta depends on replenishment of their sediments
25 from upstream sources. At the same time, erosion in Delta channels may expose previously
26 contaminated sediments that can negatively affect biota and drinking water supplies. The Delta also
27 has been identified as a source of toxic sediments to the San Francisco estuary (Anderson et al.
28 2007).

29 Some aquatic species, such as the delta smelt, tend to prefer turbid waters (CALFED Bay-Delta
30 Program 2008b). Moreover, relatively turbid Delta waters limit light penetration, thereby limiting
31 the frequency and magnitude of nuisance algal blooms.

32 TSS concentrations in the Delta range from 10 to 50 mg/L but can exceed 200 mg/L during flood
33 events (Schoellhamer et al. 2007b). The size of suspended particles in Delta waters is typically less
34 than 63 microns. These are silts and clays that tend to remain suspended in the water column
35 (Schoellhamer et al. 2007b). Particulates in the water column play an important role in chemical
36 adsorption and the transport of pollutants. The most sediment is supplied to the Delta during high
37 flows (Wright and Schoellhamer 2005; McKee et al. 2006).

38 The average annual Delta sediment budget for 1999–2002 as presented by Schoellhamer et al.
39 (2007b) is shown in Figure 8-46. The Sacramento River supplies the greatest input of sediment
40 (66%), followed by the Yolo Bypass (19%), the San Joaquin River (13%), and the eastside tributaries
41 (2%). The largest contributor of sediment to San Francisco Bay from the Delta is the Sacramento
42 River–Yolo Bypass system.

1 Existing Conditions in the Study Area

2 The cost-effectiveness and simplicity of sampling for turbidity rather than TSS have resulted in
3 fewer TSS data in recent years. Hence, turbidity data are examined here.

4 Most examined locations in the Delta have had low mean values of turbidity in recent years (water
5 years 2001–2006), with mean values typically ranging from 8 to 13 nephelometric turbidity units
6 (NTU) (Figure 8-47). The exceptions include the major system inputs (Sacramento River at Hood [18
7 NTU]) and the San Joaquin River near Vernalis (23 NTU), natural outflows (Sacramento River above
8 Point Sacramento [19 NTU] and San Joaquin River at Antioch Ship Channel [18 NTU]), and the
9 Barker Slough pumps (40 NTU).

10 Mean values for the north-of-Delta area were typically 5 NTU, with the exception of 19 NTU at the
11 Sacramento River at Verona (Table 8-37). South-of-Delta mean values were typically 6 NTU.

12 **Table 8-37. Turbidity Concentrations at Selected North- and South-of-Delta Stations, Water Years**
13 **2001–2006^a**

Location	Turbidity (NTU)				
	Samples	Minimum	Maximum	Mean	Median
Sacramento River at Keswick	17	9	33	5	3
Sacramento River at Verona	18	4	68	19	12
Feather River at Oroville	5	2	10	5	4
American River at WTP	119	1	146	5	2
California Aqueduct at Check 13	69	1	23	6	6
California Aqueduct at Check 29	74	2	21	6	5

Source: California Department of Water Resources 2009b.

Notes: NTU = nephelometric turbidity unit; WTP = water treatment plant.

^a Sample size represents water quality samples having values at or greater than the reporting limit.

14

15 Time series data indicate that turbidity values at the examined stations generally fluctuate on an
16 annual basis (Figures 8-48a, 8-48b, and 8-49), with higher values during the months of December
17 through March.

18 There are no numeric criteria for TSS. Because TSS and turbidity are not priority pollutants, there
19 are no criteria established for these parameters in the NTR or CTR. The San Francisco Bay Water
20 Board Basin Plan objectives for turbidity are associated with waste dischargers such that turbidity
21 relatable to such discharge shall not increase receiving water by more than 10% in areas where
22 natural turbidity is greater than 50 NTUs. Central Valley Water Board Basin Plan objectives are
23 more restrictive. Applicable objectives are detailed in Appendix 8A, *Water Quality Criteria and*
24 *Objectives*. None of the water bodies in the affected environment have been listed as impaired on the
25 state's CWA Section 303(d) list due to elevated TSS or turbidity (State Water Resources Control
26 Board 2011).

27 The current CALFED turbidity goal is 50 NTU for the purposes of reducing turbidity variability
28 (CALFED Bay-Delta Program 2007b).

29 USEPA's Surface Water Treatment Rules require systems using surface water or groundwater under
30 the direct influence of surface water to implement the appropriate disinfection and/or filtration

1 techniques to minimize turbidity in treated drinking water (U.S. Environmental Protection Agency
2 2006a).

3 **8.1.3.18 Microcystis**

4 **Background and Importance in the Study Area**

5 This section provides a brief summary of the background and importance of *Microcystis* in the study
6 area. A detailed discussion of the importance of *Microcystis* in the Delta, its biology, and potential
7 adverse effects due to bloom formation is provided in Section 5.F.7 of BDCP Appendix 5.F, *Biological*
8 *Stressors on Covered Fish*. The occurrence of *Microcystis aeruginosa* (*Microcystis*), a harmful species
9 of cyanobacteria (also referred to as a blue-green algal species), in the Delta was first observed in
10 1999 (Lehman et al. 2005). In addition to producing surface scums that interfere with recreation
11 and cause aesthetic problems, it also produces taste and odor compounds and toxic microcystins
12 that are associated with liver cancer in humans and wildlife. Microcystin-LR is the most widely
13 studied congener of the known microcystins, and it has been associated with most incidents of
14 toxicity involving microcystins. *Microcystis* blooms can cause toxicity to phytoplankton,
15 zooplankton, and fish, and also can affect feeding success or food quality for zooplankton and fish.
16 Blooms of *Microcystis* require high levels of nutrients and low turbidity, but also require high water
17 temperature (i.e., above 19°C) and long residence time, because the species is fairly slow growing
18 (Lehman et al. 2008; Lehman et al. 2013). In addition, low vertical mixing associated with high
19 residence time allows *Microcystis* colonies to float to the surface of the water column, where they
20 out compete other species for light.

21 **Existing Conditions in the Study Area**

22 Since its first observance in the Delta in 1999, annual *Microcystis* blooms have occurred at varying
23 levels throughout the Delta, with blooms typically beginning in the central Delta and spreading
24 seaward into saline environments (Lehman et al. 2008; Lehman et al. 2013). Section 5.F.7 of BDCP
25 Appendix 5.F, *Biological Stressors on Covered Fish*, cites numerous studies showing that *Microcystis*
26 blooms produce adverse effects on phytoplankton, zooplankton and fish populations in the Delta.
27 Water temperatures greater than 19°C, low water velocities, and high water clarity are necessary for
28 *Microcystis* levels to reach bloom-forming scale (Paerl 1988; Lehman et al. 2008; Lehman et al.
29 2013). The water temperature requirement is considered the primary factor that restricts bloom
30 development to the months of June through October (Lehman et al. 2013). Sufficiently high water
31 temperature (i.e., 19°C), low flow and thus sufficiently long residence time, and increased clarity
32 enable bloom formation, which occurs in the San Joaquin River, Old River, and Middle River earlier,
33 and to a greater extent, than other areas of the Delta. Likewise, the Delta's shallow, submerged
34 islands sustain high levels of *Microcystis* during the growing season because the physical drivers of
35 bloom formation are amplified in these areas due to low flushing rates (Lehman et al. 2008).
36 Although elevated pH is tolerated by *Microcystis*, pH is not currently thought to be a primary driver
37 of seasonal and interannual variation in bloom formation (Lehman et al. 2013).

38 Nutrients have historically been sufficiently high to support *Microcystis* growth in the Delta, yet
39 there is currently little evidence that levels of nitrogen, phosphorus, or their ratio control the
40 seasonal or inter-annual variation in the bloom (Lehman et al. 2005; Lehman et al. 2008; Lehman et
41 al. 2013; Lehman et al. 2015). This is likely because nutrient concentrations in the Delta are above
42 the thresholds that limit *Microcystis* growth (Lehman et al. 2008; Lehman et al. 2013). However,

1 blooms of *Microcystis* in the Delta have been shown to utilize ammonia from the Sacramento River
2 over other forms of nitrogen (Lehman et al. 2015).

3 Impacts from *Microcystis* blooms outside of the Delta region have only occurred in highly eutrophic
4 lakes, such as Clear Lake, because most reservoirs in the Central Valley region have relatively low
5 nutrient levels. Hydrodynamic conditions of upstream rivers and watersheds are not conducive to
6 *Microcystis* bloom formation. Microcystins have been detected throughout the Delta, but are
7 generally below (Lehman et al. 2005) the World Health Organization (WHO) drinking water
8 advisory level of 1 µg/L for microcystin-LR, the California water guidance level of 0.8 µg/L and the
9 newly published USEPA 10-day Health Advisories (HA) for microcystins. The USEPA HA include a
10 0.3 µg/L HA for children under 6 and a 1.6 µg/L HA advisory for children over 6 and adults (U.S.
11 Environmental Protection Agency 2015). However, in July and August 2012, microcystin
12 concentrations in the southern area of the Delta exceeded the WHO advisory level, California
13 guidance level and USEPA HA, with a maximum observed concentration of 2.14 µg/L (Spier et al.
14 2013). Problematic *Microcystis* blooms have not occurred in the Export Service Areas, but
15 microcystins produced in waters of the Delta have been exported from Banks and Jones pumping
16 plants to the SWP and CVP (Archibald Consulting et al. 2012). Levels of microcystin measured in
17 water exported from the Delta were below the 1 µg/L reportable limit (Archibald et al. 2012).
18 However, it is unknown if microcystin concentrations were below the California guidance levels or
19 the USEPA 10-day HA.

20 8.2 Regulatory Setting

21 Numerous federal, state and local acts, rules, plans, policies, and programs define the framework for
22 regulating water quality in California. The following discussion focuses on water quality
23 requirements that are applicable to the project alternatives. The federal and state agencies
24 responsible for regulating water quality in the study area are:

- 25 • USEPA.
- 26 • State Water Board.
- 27 • San Francisco Bay Water Board.
- 28 • Central Valley Water Board.

29 USEPA provides guidance and oversight to California in regulating water quality, as it does for other
30 states and for tribes. As in other states across the country, USEPA delegates various authorities for
31 establishing water standards and regulating controllable factors affecting water quality to the state.
32 In California, this authority is delegated to the State Water Board. The State Water Board, in turn,
33 delegates authority to its nine regional water boards to implement the state's water quality
34 management responsibilities in the nine geographic regions. Although the state generally takes the
35 lead on developing and adopting water quality standards for California, USEPA must approve new or
36 modified standards. Thus, USEPA, the State Water Board, and the two Regional Water Boards cited
37 above have worked together to establish existing water quality standards for the study area. Water
38 quality standards have three components: (1) the beneficial uses of the water to be protected; (2)
39 the water quality criteria (referred to as *objectives* in California) that must be met to protect the
40 beneficial uses; and (3) an antidegradation policy to protect and maintain water quality when it is
41 better than the criteria/objectives. Additionally, CDFW, USFWS, NMFS and the Federal Energy

1 Regulatory Commission impose water quality standards such as DO and temperature in the study
2 area.

3 **8.2.1 Federal Plans, Policies, and Regulations**

4 **8.2.1.1 Clean Water Act**

5 The federal CWA (33 United States Code Section 1251 et seq.) places primary reliance for
6 developing water quality standards on the states (e.g., water quality objectives). The CWA
7 established the basic structure for regulating point and nonpoint discharges of pollutants into the
8 waters of the United States and gave USEPA the authority to implement pollution control programs,
9 such as setting wastewater standards for industry. The statute employs a variety of regulatory and
10 nonregulatory tools to sharply reduce direct pollutant discharges into waterways, finance municipal
11 wastewater treatment facilities, and manage polluted runoff. The CWA authorizes USEPA to delegate
12 many permitting, administrative, and enforcement aspects of the law to state governments.
13 However, USEPA still retains oversight responsibilities. In California, such responsibility has been
14 delegated to the state, which administers the CWA through the Porter-Cologne Water Quality
15 Control Act (Porter-Cologne Act)(California Water Code Section 13000 et seq.). Under the Porter-
16 Cologne Act, the State Water Board oversees nine Regional Water Boards that regulate the quality of
17 waters within their regions.

18 **Section 303(d)**

19 If the CWA's permit program fails to clean up a river or river segment, states are required to identify
20 such waters and list them in order of priority. Thus, under CWA Section 303(d), states, territories,
21 and authorized tribes are required to develop a ranked list of water quality-limited segments of
22 rivers and other water bodies under their jurisdiction. Listed waters are those that do not meet
23 water quality standards, even after point sources of pollution have installed the minimum required
24 levels of pollution control technology. The law requires that action plans, or TMDLs, be developed to
25 monitor and improve water quality. *TMDL* is defined as the sum of the individual waste load
26 allocations from point sources, load allocations from nonpoint sources and background loading, plus
27 an appropriate margin of safety. A TMDL defines the maximum amount of a pollutant that a water
28 body can receive and still meet water quality standards. TMDLs can lead to more stringent NPDES
29 permits (CWA Section 402).

30 **Section 401**

31 Under CWA Section 401, applicants for a federal permit or license to conduct activities that may
32 result in the discharge of a pollutant into waters of the United States must obtain certification from
33 the state in which the discharge would originate or, if appropriate, from the interstate water
34 pollution control agency with jurisdiction over affected waters at the point where the discharge
35 would originate. Therefore, all projects that have a federal component and may affect state water
36 quality (including projects that require federal agency approval [such as issuance of a CWA Section
37 404 permit]) must comply with CWA Section 401. In California, the authority to grant water quality
38 certification has been delegated to the State Water Board, and applications for water quality
39 certification are typically processed by the Regional Water Board with local jurisdiction. Water
40 quality certification requires evaluation of potential effects in light of water quality standards and
41 CWA Section 404 criteria governing discharge of dredged and fill materials into waters of the United
42 States. For the proposed project, water quality certifications may be obtained from either the State

1 Water Board (e.g., for large scale authorizations for project actions such as a Section 404 Regional
 2 General Permit), or the Central Valley Water Board or San Francisco Bay Water Board for individual
 3 facility construction elements of the proposed project in each agency's jurisdictional area.

4 **Section 402**

5 Under CWA Section 402, point- and nonpoint-source discharges to surface waters are regulated
 6 through the NPDES program. In California, the State Water Board oversees the NPDES program,
 7 which is administered by the Regional Water Boards. The NPDES program provides both general
 8 permits (those that cover a number of similar or related activities) and individual permits.

9 The NPDES Wastewater Program has responsibility for regulating wastewater discharges to surface
 10 waters. Primary program activities include: 1) issuing NPDES permits (new and renewals); 2)
 11 monitoring discharger compliance with permit requirements (review of discharger self-monitoring
 12 reports and compliance inspections); 3) taking enforcement action as appropriate; 4) investigating
 13 spills and illegal discharges; and 5) handling petitions and litigation.

14 The NPDES Stormwater Program regulates municipal (Municipal Separate Storm Sewer Systems),
 15 construction, industrial, and California Department of Transportation stormwater discharges. BMPs
 16 to control sediment erosion typically are used as part of this program. In general, the stormwater
 17 program differs from many other programs in that it uses general permits adopted by the State
 18 Water Board. Dischargers that desire coverage under these permits must submit a Notice of Intent
 19 to the State Water Board indicating the intent to be covered under the general permit and comply
 20 with its requirements. Exceptions to this process include Phase I Municipalities and the California
 21 Department of Transportation. Beginning in March 2003, all construction activities with 1 acre of
 22 soil disturbance or greater are required to obtain coverage under the General Construction Permit.

23 **Section 404**

24 Under CWA Section 404, a program was established to regulate the discharge of dredged and fill
 25 material into waters of the United States, including some wetlands. USACE is authorized to issue
 26 Section 404 permits. Activities in waters of the United States that are regulated under this program
 27 include fill for development, water resource projects (e.g., dams and levees), infrastructure
 28 development (e.g., highways and airports), and conversion of wetlands to uplands for farming and
 29 forestry. The basic premise of the program is that no discharge of dredged or fill material may be
 30 permitted if: 1) a practicable alternative exists that is less damaging to the aquatic environment, or
 31 2) the nation's waters would be significantly degraded; and that remaining unavoidable impacts will
 32 be addressed with compensatory mitigation. In 2008, USEPA and USACE jointly promulgated
 33 regulations revising and clarifying requirements regarding compensatory mitigation. According to
 34 regulations jointly promulgated in 2008 by USEPA and USACE, compensatory mitigation means the
 35 restoration (re-establishment or rehabilitation), establishment (creation), enhancement, and/or in
 36 certain circumstances preservation of wetlands, streams and other aquatic resources for the
 37 purposes of offsetting unavoidable adverse impacts which remain after all appropriate and
 38 practicable avoidance and minimization has been achieved.

39 Construction for the water conveyance facilities and several other conservation measures associated
 40 with the proposed project would be subject to regulation under Sections 401, 402, and 404 of the
 41 CWA.

1 **8.2.1.2 Rivers and Harbors Act Section 10**

2 Section 10 of the Rivers and Harbors Act of 1899 requires authorization from the USACE for the
3 construction of any structure in or over navigable waters of the United States, the
4 excavation/dredging or deposition of material in these waters, or any obstruction or alteration in
5 navigable water.

6 Construction for the water conveyance facilities and several other conservation measures associated
7 with the proposed project would be subject to regulation under Section 10 of the Rivers and
8 Harbors Act.

9 **8.2.1.3 Federal Antidegradation Policy**

10 The federal antidegradation policy is designed to provide the level of water quality necessary to
11 protect existing uses and provide protection for higher quality and national water resources. The
12 federal policy directs states to adopt a statewide policy that includes the following primary
13 provisions (40 Code of Federal Regulations [CFR] 131.12).

14 Existing instream water uses and the level of water quality necessary to protect the existing uses
15 shall be maintained and protected.

- 16 1. Where the quality of waters exceed levels necessary to support propagation of fish, shellfish,
17 and wildlife and recreation in and on the water, that quality shall be maintained and protected
18 unless the state finds, after full satisfaction of the intergovernmental coordination and public
19 participation provisions of the state's continuing planning process, that allowing lower water
20 quality is necessary to accommodate important economic or social development in the area in
21 which the waters are located.
- 22 2. Where high quality waters constitute an outstanding national resource, such as waters of
23 national and state parks and wildlife refuges and waters of exceptional recreational or ecological
24 significance, that water quality shall be maintained and protected.

25 **8.2.1.4 National Toxics Rule**

26 In 1992, pursuant to the CWA, USEPA promulgated the NTR to establish water quality criteria for
27 12 states and two territories, including California, that had not complied fully with Section
28 303(c)(2)(B) of the CWA (57 FR 60848). As described in the preamble to the final NTR, when a state
29 adopts and USEPA approves water quality criteria that meet the requirements of Section
30 303(c)(2)(B) of the CWA, USEPA will issue a rule amending the NTR to withdraw the federal criteria
31 for that state. If the state's criteria are no less stringent than the promulgated federal criteria, USEPA
32 will withdraw its criteria without notice and comment rules because additional comment on the
33 criteria is unnecessary (65 FR 19659). However, if a state adopts criteria that are less stringent than
34 the federally promulgated criteria, but in USEPA's judgment fully meet the requirements of the CWA,
35 USEPA will provide an opportunity for public comment before withdrawing the federally
36 promulgated criteria (57 FR 60860, December 22, 1992). Amendments to the NTR occurred in May
37 1995 and November 1999. The CTR (described in Section 8.2.2.9) subsequently was promulgated in
38 2000 and carried forward the established criteria of the NTR, thereby providing a single regulation
39 containing California's adopted and applicable water quality criteria for priority pollutants.

1 **8.2.1.5 Safe Drinking Water Act**

2 The SDWA was established to protect the public health and quality of drinking water in the United
3 States, whether from aboveground or underground sources. The SDWA directed USEPA to set
4 national standards for drinking water quality. It required USEPA to set MCLs for a wide variety of
5 potential drinking water pollutants (Appendix 8A, *Water Quality Criteria and Objectives*). The
6 owners and operators of public water systems are required to comply with primary (health-related)
7 MCLs and encouraged to comply with secondary (nuisance- or aesthetics-related) MCLs.

8 SDWA drinking water standards apply to treated water as it is served to consumers. All surface
9 waters require some form of treatment in order to meet drinking water standards. The degree of
10 treatment needed depends on the quality of the raw water. The highest quality raw surface waters
11 need only to be disinfected before being served to consumers. More typically, raw water is treated in
12 a conventional WWTP that includes sedimentation, filtration, and disinfection processes. Municipal
13 water suppliers prefer raw water sources of high quality because their use minimizes risk to public
14 health and because their use minimizes the cost and complexity of treatment to meet SDWA
15 drinking water standards.

16 Some constituents of Delta water are of particular concern to municipal contractors because they
17 are either not removed, only partially removed, or are transformed by the treatment process into
18 hazardous substances by community-used water treatment processes. Constituents of concern
19 include TDS, chloride, bromide, and organic compounds. These substances can be removed from
20 raw water by advanced water treatment processes, but to do so substantially increases the cost
21 borne by municipalities.

22 **8.2.1.6 Surface Water Treatment Rule**

23 The federal Surface Water Treatment Rule is implemented by the California Surface Water
24 Treatment Rule, which satisfies three specific requirements of the SDWA by: 1) establishing criteria
25 for determining when filtration is required for surface waters; 2) defining minimum levels of
26 disinfection for surface waters; and 3) addressing *Cryptosporidium* spp., *Giardia lamblia*, *Legionella*
27 spp., *E. coli*, viruses, turbidity, and heterotrophic plate count by setting a treatment technique. A
28 treatment technique is set in lieu of an MCL for a contaminant when it is not technologically or
29 economically feasible to measure that contaminant. The Surface Water Treatment Rule applies to all
30 drinking water supply activities in California; its implementation is overseen by DPH.

31 **8.2.1.7 Stage 1 and Stage 2 Disinfectants and Disinfection Byproducts 32 Rule and Long-Term 1 and Long-Term 2 Enhanced Surface Water 33 Treatment Rule**

34 The Stage 1 D/DBP Rule established maximum residual disinfectant level goals and maximum
35 residual disinfectant levels for chlorine, chloramines, and chlorine dioxide. It also set MCLGs and
36 MCLs for THMs, five HAAs, chlorite, and bromate. The primary purpose of the Long-Term 1
37 Enhanced Surface Water Treatment Rule is to improve microbial control, especially of
38 *Cryptosporidium*.

39 Water systems that use surface water and conventional filtration treatment are required to remove
40 specified percentages of organic materials, measured as TOC, which may react with disinfectants to

1 form DBPs. Removal is to be achieved through a treatment technique (e.g., enhanced coagulation or
2 enhanced softening), unless the system meets alternative criteria.

3 USEPA adopted the Stage 2 Microbial and Disinfection Byproducts Rules in January 2006. The Rules
4 include both the Stage 2 D/DBP Rule and Long-Term 1, and Long-Term 2 Enhanced Surface Water
5 Treatment Rule. These rules include revised and new requirements, such as water systems having to
6 meet DBP MCLs at each monitoring site in the distribution system, rather than averaging multiple
7 sites. The rules also contain a risk-targeting approach to better identify monitoring sites where
8 customers are exposed to high levels of DBPs. The rules include new requirements for treatment
9 efficacy and *Cryptosporidium* inactivation/removal, as well as new standards for DBPs, disinfectants,
10 and potential contaminants.

11 The overall goal of this group of regulations is to balance the risks from microbial pathogens with
12 those from carcinogenic DBPs. All domestic water suppliers must follow the requirements of these
13 rules, which are overseen by DPH.

14 **8.2.2 State Plans, Policies, and Regulations**

15 **8.2.2.1 Porter-Cologne Water Quality Control Act of 1969**

16 Under the Porter-Cologne Act, water quality objectives are limits or levels of water quality
17 constituents or characteristics established for the purpose of protecting beneficial uses. The act
18 requires the Regional Water Boards to formulate and adopt WQCPs, commonly called *Basin Plans*,
19 that designate the beneficial uses of the water to be protected, and establish water quality objectives
20 and a program to meet the objectives. Water quality objectives means the limits or levels of water
21 quality constituents or characteristics that are established for the reasonable protection of beneficial
22 uses of water or the prevention of nuisance in a specific area. Therefore, the water quality objectives
23 form the regulatory references for meeting state and federal requirements for water quality control.

24 A change in water quality is allowed only if the change is consistent with the maximum beneficial
25 use of the waters of the state, would not unreasonably affect the present or anticipated beneficial
26 uses, and would not result in water quality lower than that specified in applicable Basin Plans
27 (Central Valley Regional Water Quality Control Board 2009a). The proposed project is subject to the
28 Porter-Cologne Act.

29 **8.2.2.2 State Water Resources Control Board** 30 **Water Rights Decisions, Water Quality Control Plans, and Water** 31 **Quality Objectives**

32 The preparation and adoption of Basin Plans is required by the California Water Code (Section
33 13240) and supported by the CWA. Section 303 of the CWA requires states to adopt water quality
34 standards that “consist of the designated uses of the navigable waters involved and the water quality
35 criteria for such waters based upon such uses.” According to Section 13050 of the California Water
36 Code, Basin Plans consist of a designation or establishment for the waters within a specified area of
37 beneficial uses to be protected, water quality objectives to protect those uses, and a program of
38 implementation needed for achieving the objectives. Beneficial uses are defined in Water Code
39 Section 13050(f) as including domestic, municipal, agricultural, and industrial supply; power
40 generation; recreation; aesthetic enjoyment; navigation; and the preservation and enhancement of
41 fish, wildlife, and other aquatic resources or preserves. Because beneficial uses, together with their

1 corresponding water quality objectives, can be defined per federal regulations as water quality
 2 standards, the Basin Plans are regulatory references for meeting the state and federal requirements
 3 for water quality control. One substantial difference between the state and federal programs is that
 4 California’s Basin Plans establish standards for groundwater in addition to surface water. Adoption
 5 or revision of surface water standards is subject to the approval of USEPA.

6 The State Water Board is responsible for protecting, where feasible, the state’s public trust
 7 resources, including fisheries, and has the authority under Article X, Section 2, of the California
 8 Constitution and Water Code Section 100 to prevent the waste or unreasonable use, unreasonable
 9 method of use, or the unreasonable method of diversion of all waters of the state.

10 The State Water Board Water Rights Division has primary regulatory authority over water supplies
 11 and issues permits for water rights—specifying amounts, conditions, and construction timetables—
 12 for diversion and storage facilities. Water rights decisions implement the objectives adopted in the
 13 Delta WQCP and reflect water availability, recognize prior water rights and flows needed to
 14 preserve instream uses (such as water quality and fish habitat), and whether the diversion of water
 15 is in the public interest.

16 Basin Plans adopted by Regional Water Boards are implemented primarily through the NPDES
 17 permitting system and issuance of WDRs to regulate waste discharges so water quality objectives
 18 are met. Basin Plans provide the technical basis for determining WDRs and authorize the Regional
 19 Water Boards to take regulatory enforcement actions if deemed necessary.

20 **8.2.2.3 Water Quality Control Plan for the San Francisco** 21 **Bay/Sacramento–San Joaquin Delta Estuary**

22 The current WQCP in effect in the Delta is the *2006 Water Quality Control Plan for the San Francisco*
 23 *Bay/Sacramento–San Joaquin Delta Estuary* (Bay-Delta WQCP) (State Water Resources Control
 24 Board 2006). The Bay-Delta WQCP identifies beneficial uses of water in the Delta to be protected,
 25 water quality objectives for the reasonable protection of beneficial uses, and an implementation
 26 program to achieve the water quality objectives.

27 The 2006 Bay-Delta WQCP adoption did not involve substantial changes to the prior 1995 Bay-Delta
 28 WQCP. The 1995 Bay-Delta WQCP was developed as a result of the December 15, 1994, Bay Delta
 29 Accord, which committed SWP and CVP to new Delta habitat objectives. In 1999, the State Water
 30 Board, through a water rights decision D-1641, assigned responsibilities to entities holding certain
 31 water rights to help meet the objectives of the WQCP. One key feature of the 1995 Bay-Delta WQCP
 32 is the estuarine habitat objectives (X2) for Suisun Bay and the western Delta. The X2 standard refers
 33 to the position at which 2 ppt salinity occurs in the Delta estuary and is designed to improve
 34 shallow-water fish habitat in the spring of each year. The X2 standard requires specific daily or 14-
 35 day salinity, or 3-day averaged outflow requirements, to be met for a certain number of days each
 36 month from February through June. D-1641 also implemented the Vernalis salinity objective and
 37 directed the Regional Board to adopt salinity objectives and an implementation program for the
 38 lower San Joaquin River. (See 8.2.2.12 below.)

39 Other elements of the Bay-Delta WQCP include export-to-inflow ratios intended to reduce
 40 entrainment of fish at the export pumps, Delta Cross Channel gate closures, minimum Delta outflow
 41 requirements, and San Joaquin River salinity and flow standards.

1 **8.2.2.4 Water Quality Control Plan (Basin Plan) for the Sacramento and**
 2 **San Joaquin River Basins**

3 The Basin Plan for the Central Valley Water Board covers an area including the entire Sacramento
 4 and San Joaquin River basins, involving an area bound by the crests of the Sierra Nevada on the east
 5 and the Coast Range and Klamath Mountains on the west. The area covered in this Basin Plan
 6 extends some 400 miles, from the California-Oregon border southward to the headwaters of the San
 7 Joaquin River. The proposed project will be required to meet the water quality objectives in the
 8 Basin Plan for the Sacramento and San Joaquin River basins, which was designed to protect the
 9 beneficial uses of the Sacramento and San Joaquin Rivers and their tributaries and was last amended
 10 in 2009 (Central Valley Regional Water Quality Control Board 2009a).

11 **8.2.2.5 San Francisco Bay Basin Water Quality Control Plan (Basin Plan)**

12 This Basin Plan covers 1,100 square miles of the 1,600–square mile San Francisco Bay estuary and
 13 includes coastal portions of Marin and San Mateo Counties, from Tomales Bay in the north to
 14 Pescadero and Butano Creeks in the south. The Bay system functions as the only drainage outlet for
 15 waters of the Central Valley. It also marks natural topographic separation between the northern and
 16 southern coastal mountain ranges. The region’s waterways, wetlands, and bays form the centerpiece
 17 of the fourth-largest metropolitan region in the United States, and the region includes all or major
 18 portions of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and
 19 Sonoma Counties.

20 **8.2.2.6 State Water Board Resolution No. 68-16—Statement of Policy**
 21 **with Respect to Maintaining High Quality Waters in California**
 22 **(State Antidegradation Policy)**

23 The goal of State Water Board Resolution No. 68-16 (Statement of Policy with Respect to
 24 Maintaining High Quality Waters in California) is to maintain high quality waters where they exist in
 25 the state. State Board Resolution No. 68-16 states, in part:

- 26 1. Whenever the existing quality of water is better than the quality established in policies as of the
 27 date on which such policies become effective, such existing high quality will be maintained until
 28 it has been demonstrated to the state that any change will be consistent with maximum benefit
 29 to the people of the state, will not unreasonably affect present and anticipated beneficial use of
 30 such water, and will not result in water quality less than that prescribed in the policies.
- 31 2. Any activity that produces or may produce a waste or increased volume or concentration of
 32 waste and that discharges or proposes to discharge to existing high quality waters will be
 33 required to meet waste discharge requirements that will result in the best practicable treatment
 34 or control of the discharge necessary to ensure that (a) a pollution or nuisance will not occur
 35 and (b) the highest water quality consistent with maximum benefit to the people of the state will
 36 be maintained.

37 The State Water Board has interpreted Resolution No. 68-16 to incorporate the federal
 38 antidegradation policy, which is applicable if a discharge that began after November 28, 1975, will
 39 lower existing surface water quality.

1 **8.2.2.7 State Water Resources Control Board Sources of Drinking Water** 2 **Policy (Resolution No. 88-63)**

3 The Sources of Drinking Water Policy established state policy that all waters, with certain
4 exceptions, should be considered suitable or potentially suitable for municipal or domestic supply.
5 Under the policy, unless otherwise designated, Regional Water Boards must consider all surface
6 water and groundwater as suitable, or potentially suitable, for municipal or domestic water supply.
7 The policy defines the following three categories of waters potentially eligible for an exception from
8 the designation and protection of a water source for municipal/domestic supply.

- 9 • Water bodies with high salinity (defined as TDS >3,000 mg/L), that either have naturally high
10 contaminant levels that cannot reasonably be treated using either BMPs or best economically
11 achievable treatment practices, or produce too low yield (<200 gallons per day).
- 12 • Waters designed or modified to treat wastewaters (domestic or industrial wastewater, process
13 water, stormwater, mining discharges, or agricultural drainage), provided that such systems are
14 monitored to ensure compliance with all relevant water quality objectives.
- 15 • Groundwater aquifers regulated as geothermal energy-producing sources or aquifers that have
16 been exempted administratively by federal regulations for the purpose of underground injection
17 of fluids associated with the production of hydrocarbon or geothermal energy.

18 **8.2.2.8 Policy for Implementation and Enforcement of the** 19 **Nonpoint-Source Pollution Control Program** 20 **(Water Code Section 13369[a][2][B])**

21 Agricultural return flows include flows from tile drains and irrigation and stormwater runoff. These
22 discharges can affect water quality by transporting pollutants, including pesticides, sediments, and
23 nutrients, from cultivated fields into surface water. Many surface water bodies are impaired because
24 of pollutants from agricultural sources. Groundwater bodies in California's agricultural areas also
25 have suffered pesticide, nitrate, and salt contamination.

26 Historically, most Regional Water Boards regulated these discharges under waivers, as authorized
27 by Water Code Section 13269, and other administrative tools were seldom used. Section 13269
28 allows the Regional Water Boards to waive the requirement for WDRs if it is in the public interest.
29 Although waivers were always conditional, the historical waivers had few conditions. In general,
30 they required that discharges not cause violations of water quality objectives but did not require
31 water quality monitoring.

32 In May 2004, the State Water Board adopted a new policy regulating nonpoint-source pollution,
33 known as the Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control
34 Program, fulfilling the requirements of Water Code Section 13369(a)(2)(B). This policy affects
35 landowners and operators throughout the state engaged in agricultural production, timber harvest
36 operations, and other potential sources of nonpoint source pollution.

37 The 2004 policy generally expects nonpoint-source dischargers to use management practices that
38 do not impair surface water quality and charges each landowner a fee to cover increased regulatory
39 oversight. Consequently, implementation programs for nonpoint-source pollution control have
40 expanded beyond waivers and now may be developed by a Regional Water Board, the State Water
41 Board, individual dischargers, or by a coalition of dischargers in cooperation with a third-party
42 representative, organization, or government agency. The latter programs are collectively known as

1 *third-party programs*, and the third-party role is restricted to entities that are not actual dischargers
 2 under Regional Water Board/State Water Board point-discharge permitting and enforcement
 3 jurisdiction.

4 **8.2.2.9 California Toxics Rule**

5 As a result of a court-ordered revocation of California's statewide objectives for priority pollutants
 6 in September 1994, USEPA initiated efforts to promulgate additional numeric water quality criteria
 7 for California. In May 2000, USEPA issued the CTR that promulgated numeric criteria for priority
 8 pollutants not included in the NTR. The CTR documentation (65 FR 31682, May 18, 2000) carried
 9 forward the previously promulgated standards of the NTR, thereby providing a single document
 10 listing California's adopted and applicable water quality criteria for priority pollutants.

11 **8.2.2.10 Policy for the Implementation of Toxics Standards for Inland** 12 **Surface Waters, Enclosed Bays, and Estuaries of California**

13 In March 2000, the State Water Board adopted the Standards for Inland Surface Waters, Enclosed
 14 Bays, and Estuaries of California (SIP), which implemented criteria for priority toxic pollutants
 15 contained in the CTR as well as other priority toxic pollutant criteria and objectives. The SIP applies
 16 to discharges of toxic pollutants into inland surface waters, enclosed bays, and estuaries of
 17 California subject to regulation under the state's Porter-Cologne Act (Division 7 of the Water Code)
 18 and the federal CWA. Such regulation may occur through the issuance of NPDES permits or other
 19 relevant regulatory approaches. The goal of this policy is to establish a standardized approach for
 20 permitting discharges of toxic pollutants to nonocean surface waters in a manner that promotes
 21 statewide consistency. As such, SIP is a tool to be used in conjunction with watershed management
 22 approaches and, where appropriate, the development of TMDLs to ensure achievement of water
 23 quality standards (water quality criteria or objectives and the beneficial uses they are intended to
 24 protect, as well as the state and federal antidegradation policies).

25 SIP established: (1) implementation provisions for priority pollutant criteria promulgated by USEPA
 26 through the NTR and CTR and for priority pollutant objectives established by Regional Water
 27 Boards in their WQCPs; (2) monitoring requirements for 2,3,7,8-TCDD equivalents; and (3) chronic
 28 toxicity control provisions. In addition, the SIP includes special provisions for certain types of
 29 discharges and factors that could affect the application of other provisions in the policy.

30 **8.2.2.11 Department of Public Health Safe Drinking Water Act** 31 **Implementation**

32 DPH is designated by USEPA as the primary agency to administer and enforce requirements of the
 33 federal SDWA in California. Public water systems are required to monitor for regulated
 34 contaminants in their drinking water supply. California's drinking water standards (e.g., MCLs) are
 35 the same or more stringent than the federal standards and include additional contaminants not
 36 regulated by USEPA. Like the federal MCLs, California's primary MCLs address health concerns,
 37 while secondary MCLs address aesthetics, such as taste and odor. The California SDWA is
 38 administered by DPH primarily through a permit system.

1 **8.2.2.12 State Water Resources Control Board Decision 1641**

2 The Bay-Delta WQCP (discussed previously) outlines current water quality objectives for the Delta.
3 State Water Resources Control Board D-1641 contains the current water right requirements,
4 applicable to DWR and Reclamation's operations of the SWP and CVP facilities, respectively, to
5 implement the Bay-Delta water quality objectives. Objectives included in D-1641 include those
6 related to salinity and DO, spring outflow (i.e., X2) objectives, export pumping, Delta cross-channel
7 operations, and flow objectives in the Sacramento and San Joaquin Rivers.

8 Regarding X2, D-1641 specifies that, from February through June, the location of X2 must be west of
9 Collinsville and additionally must be west of Chippis Island or Port Chicago for a certain number of
10 days each month, depending on the previous month's Eight River Index. D-1641 specifies that
11 compliance with the X2 standard may occur in one of three ways: 1) the daily average EC at the
12 compliance point is less than or equal to 2.64 millimhos/cm; 2) the 14-day average EC is less than or
13 equal to 2.64 millimhos/cm; or 3) the 3-day average Delta outflow is greater than or equal to the
14 corresponding minimum outflow.

15 In D-1641, the State Water Board assigned responsibilities to Reclamation and DWR for meeting
16 these requirements on an interim basis. These responsibilities required that SWP and CVP be
17 operated to meet water quality objectives in the Delta, pending a water rights hearing to allocate the
18 obligation to meet the water quality and flow-dependent objectives among all users of the
19 Sacramento and San Joaquin River basins with appropriate water rights with post-1914 priority
20 dates. However, in lieu of this hearing, the San Joaquin River Agreement and Sacramento Valley
21 Water Management Agreement are settlements between Reclamation and DWR with water users
22 upstream of the Delta, in which SWP and CVP committed to continue to meet the D-1641 water
23 quality requirements in return for other commitments by major upstream water-rights holders.
24 After these agreements were executed, the State Water Board cancelled the water rights hearing to
25 allocate that responsibility.

26 In February 2006, the State Water Board issued a Cease and Desist Order (CDO, Water Rights Order
27 No. 2006-0006) to DWR and Reclamation that established actions and a compliance schedule for
28 implementation of the requirements contained in D-1641, in particular to ensure compliance with
29 the salinity objectives for the interior southern Delta. The CDO also revised the previously issued
30 (July 1, 2005) Water Quality Response Plan approval governing Reclamation's and DWR's Joint Point
31 of Diversion (JPOD) operations (i.e., use of the other agency's respective point of diversion in the
32 southern Delta). The CDO specified that the agencies may conduct JPOD operations provided that
33 both agencies are in compliance with all of the conditions of their respective water right permits and
34 licenses at the time that the JPOD operations would occur. The CDO was amended in January 2010
35 (Water Rights Order No. 2010-0002) to modify the time schedule of actions to follow the State
36 Water Board's next review of the 2006 Bay-Delta WQCP and separate hearings completed in 2010
37 for the consideration of changes to the interior southern Delta salinity objectives.

38 D-1641 also established the Vernalis Adaptive Management Plan, (VAMP), a 12-year
39 experimental/adaptive management program to assess effects of changes in flows and aquatic
40 habitat resources on juvenile Chinook salmon migrating from the San Joaquin River through the
41 Delta. This 12-year experimental/adaptive management program concluded in 2011. No formal
42 plans for its continuation have been adopted.

1 **SWP and CVP Coordinated Operations Agreement**

2 SWP and CVP are relatively independent projects that use a common water supply. However, the
 3 SWP and CVP operations are linked by the requirement that they meet Delta flow and water quality
 4 standards and are linked by joint operations south of the Delta at the San Luis complex and the joint-
 5 use San Luis Canal. In 1986, Public Law 99-546 authorized the Coordinated Operations Agreement
 6 (COA) between Reclamation and DWR, intended to define the rights and responsibilities of SWP and
 7 CVP with respect to use of that common water supply and provide an infrastructure to monitor
 8 those rights and responsibilities. Specifically, the COA defines the project facilities and their water
 9 supplies, sets forth procedures for coordination of operations, identifies formulas for sharing joint
 10 responsibilities for meeting Delta flow and water quality standards and other legal uses of water,
 11 identifies how unstored flow will be shared, sets up a framework for exchange of water and services
 12 between the projects, and provides for periodic review every 5 years (Bureau of Reclamation 2004).

13 **SWP and CVP Project Water Acceptance Criteria**

14 In consultation with SWP contractors and DHS, DWR developed acceptance criteria to govern the
 15 water quality of nonproject water conveyed through the California Aqueduct. Non-project water
 16 with chemical concentrations less than the acceptable criteria is routinely accepted by DWR. Non-
 17 project water with chemical concentrations greater than the criteria is managed on a case-by-case
 18 basis.

19 **8.2.2.13 Central Valley Water Board Drinking Water Policy**

20 A commitment of the CALFED Bay-Delta Program process and Record of Decision was the
 21 development of a new drinking water policy for Delta waters. Currently, both the Bay-Delta WQCP
 22 and the Sacramento–San Joaquin Basin Plan lack numeric water quality objectives for several known
 23 drinking water constituents of concern, such as organic carbon and pathogens (CALFED Bay-Delta
 24 Program 2008b). In response to the CALFED commitment, the Central Valley Water Board is in the
 25 process of a multiyear effort to develop a drinking water policy for surface waters in the Central
 26 Valley (Central Valley Regional Water Quality Control Board 2011a). Existing policies and plans lack
 27 water quality objectives for several known drinking water constituents of concern, including DBP
 28 precursors and pathogens, and also lack implementation strategies to provide effective source water
 29 protection. The new policy will culminate in the incorporation of new requirements into a Basin
 30 Plan amendment, adopted in 2013. The Central Valley Water Board Drinking Water Policy will apply
 31 to Delta waters and any activities, such as discharges, that affect Delta water quality.

32 **8.2.3 Nonregional and Local Plans, Policies, and Regulations**

33 The boundaries of Contra Costa, Sacramento, San Joaquin, Solano, and Yolo Counties include water
 34 bodies that would be most directly affected by implementation of project alternatives. The
 35 respective general plans for these counties include goals and policies regarding water resources and
 36 stormwater management, and overall water quality management, designed for protection of
 37 beneficial uses of importance within the Delta and elsewhere. Cities and counties also have
 38 developed numerous ordinances, policies, and other regulatory mechanisms for controlling
 39 stormwater drainage and related contaminant discharges to surface water bodies. General plan
 40 policies and local regulations, and potential consistency of project alternatives with such policies
 41 and regulations, are described below.

1 **8.2.3.1 General Plan Goals and Policies**

2 **Contra Costa County General Plan**

3 A comprehensive update to the Contra Costa County General Plan was adopted on January 18, 2005,
4 to guide future growth, development, and resource conservation through 2020. Goal 8-T reflects the
5 principal relevant water quality goal of the Contra Costa County General Plan, which states: “To
6 conserve, enhance and manage water resources. Protect their water quality, and assure an adequate
7 long-term supply of water for domestic, fishing, industrial and agricultural use.” Accompanying
8 policy 8-75 states, “Preserve and enhance the quality of surface and groundwater quality.”

9 **Sacramento County General Plan**

10 The Sacramento County General Plan, amended on November 9, 2011, provides for growth and
11 development in the unincorporated area through 2050. The principal goal of the Sacramento County
12 General Plan pertaining to water resources states: “Ensure that a safe, reliable water supply is
13 available for existing and planned urban development and agriculture while protecting beneficial
14 uses of Waters of the state of California, including important associated environmental resources.”
15 Supporting policies include those following.

- 16 • **CO-21.** Support protection and restoration of the Sacramento River Delta.
- 17 • **CO-24.** Comply with the Sacramento Areawide National Pollutant Discharge Elimination System
18 Municipal Stormwater Permit (NPDES Municipal Permit) or subsequent permits, issued by the
19 Central Valley Water Board to the County, and the Cities of Sacramento, Elk Grove, Citrus
20 Heights, Folsom, Rancho Cordova, and Galt (collectively known as the Sacramento Stormwater
21 Quality Partnership [SSQP]).
- 22 • **CO-27.** Support surface water quality monitoring programs that identify and address causes of
23 water quality degradation.
- 24 • **CO-28.** Comply with other water quality regulations and NPDES permits as they apply to County
25 projects or activities, such as the State’s Construction General Permit and Aquatic Pesticides
26 Permit.
- 27 • **CO-29.** Continue to support the County’s participation in regional NPDES Municipal Permit
28 compliance activities through collaborative efforts such as the Sacramento Stormwater Quality
29 Partnership.
- 30 • **CO-30.** Require development projects to comply with the County’s stormwater
31 development/design standards, including hydromodification management and low impact
32 development standards, established pursuant to the NPDES Municipal Permit.

33 **San Joaquin County General Plan**

34 The “Resources” section of the San Joaquin County General Plan that addresses objectives and
35 policies for water resources management was last updated in 1992 (San Joaquin County 1992). The
36 General Plan contains the following four objectives that are directly or indirectly address protection
37 of water quality conditions for the county:

- 38 • **Objective 1.** To ensure adequate quantity and quality of water resources for municipal and
39 industrial uses, agriculture, recreation, and fish and wildlife.

- 1 • **Objective 2.** To obtain sufficient water supplies to meet all municipal and agricultural water
- 2 needs.
- 3 • **Objective 4.** To prevent and eliminate contamination of surface and groundwater resources.
- 4 • **Objective 5.** To recognize the surface water resources of San Joaquin County as resources of the
- 5 State and national significance for which environmental and scenic values must be protected

6 The General Plan further contains the following three specific water quality policies:

- 7 • **Policy 1.** Water quality shall meet the standards necessary for the uses to which the water
- 8 resources are put.
- 9 • **Policy 2.** Surface water and groundwater quality shall be protected and improved when
- 10 necessary.
- 11 • **Policy 3.** The use and disposal of toxic chemicals, the extraction of resources, and the disposal of
- 12 wastes into injection wells shall be carefully controlled and monitored to protect water quality.

13 Solano County General Plan

14 The Solano County General Plan was adopted on August 5, 2008. The general plan is the guide for

15 both land development and conservation in the unincorporated portions of the county and contains

16 the policy framework necessary to fulfill the community's vision for Solano County in 2030. Relevant

17 policies of the Solano County General Plan pertaining to water resources are described below.

18 The primary water resources goal (Goal RS.G-9) states: "Protect, monitor, restore and enhance the

19 quality of surface and groundwater resources to meet the needs of all beneficial uses." Supporting

20 polices include those following.

- 21 • **RS.P-64:** Identify, promote, and seek funding for the evaluation and remediation of water
- 22 resource or water quality problems through a watershed management approach. Work with the
- 23 regional water quality control board, watershed-focused groups, and stakeholders in the
- 24 collection, evaluation and use of watershed-specific water resource information.
- 25 • **RS.P-73:** Use watershed planning approaches to resolve water quality problems. Use a
- 26 comprehensive stormwater management program to limit the quantity and increase the water
- 27 quality of runoff flowing to the county's streams and rivers.

28 Yolo County General Plan

29 The Yolo County 2030 Countywide General Plan was adopted on November 10, 2009, and provides

30 for growth and development in the unincorporated area through 2030. Among all the county

31 general plans in the Primary Zone of the Delta, Yolo County contains the most specific policies

32 relating to protection of water resources. Relevant water resource policies and actions of the Yolo

33 County general plan are listed below.

- 34 • **Policy CO-5.1:** Coordinate with water purveyors and water users to manage supplies to avoid
- 35 long-term overdraft, water quality degradation, land subsidence and other potential problems.
- 36 • **Policy CO-5.6:** Improve and protect water quality for municipal, agricultural, and
- 37 environmental uses.
- 38 • **Policy CO-5.7:** Support mercury regulations that are based on good science and reflect an
- 39 appropriate balancing of sometimes competing public values including health, food chain,

1 reclamation and restoration of Cache Creek, sustainable and economically viable Delta
 2 agriculture, necessary mineral extraction, flood control, erosion control, water quality, and
 3 habitat restoration.

- 4 • **Policy CO-5.21:** Encourage the use of water management strategies, biological remediation, and
 5 technology to address naturally occurring water quality problems such as boron, mercury, and
 6 arsenic.
- 7 • **Policy CO-5.23:** Support efforts to meet applicable water quality standards for all surface and
 8 groundwater resources.

9 **8.2.3.2 Local Regulations**

10 The principal regulatory requirements for surface water quality protection at the local
 11 governmental agency level consist primarily of stormwater management programs to implement
 12 responsibilities under the statewide NPDES stormwater permits for Municipal Separate (MS) Storm
 13 Sewer Systems adopted by the State Water Board. Larger entities such as the core municipal areas of
 14 Sacramento and Stockton are regulated under individual permits (MS1 permits), whereas smaller
 15 cities and unincorporated county areas typically are regulated by the State Water Board's MS4
 16 permit. Entities must prepare Storm Water Management Plans (SWMPs) for the stormwater NPDES
 17 permits that outline the agency actions that will be conducted to reduce the discharge of pollutants
 18 from storm drainage systems. The SWMPs must address urban runoff and construction site runoff.
 19 Additional city and county code and regulations for water quality protection typically may include
 20 grading permits, erosion and sediment control ordinances, and stormwater drainage facility design
 21 and management requirements.

22 **8.2.3.3 Policy Consistency**

23 The implementation of the selected alternative by the project proponent will comply with applicable
 24 stormwater management programs. In particular, as part of the environmental commitments
 25 (Appendix 3B, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and*
 26 *Cumulative Impact Conditions*) for each alternative, project construction activities will be conducted
 27 in compliance with the State Water Board's *NPDES Stormwater General Permit for Stormwater*
 28 *Discharges Associated with Construction and Land Disturbance Activities* (Order No. 2009-0009-
 29 DWQ/NPDES Permit No. CAS000002). This General Construction NPDES Permit requires the
 30 preparation and implementation of Stormwater Pollution Prevention Plans (SWPPPs) that outline
 31 the temporary construction-related BMPs to prevent and minimize erosion, sedimentation, and
 32 discharge of other construction-related contaminants, as well as permanent post-construction BMPs
 33 to minimize adverse long-term stormwater related-runoff water quality effects. Therefore,
 34 implementation of the alternatives would be anticipated to be consistent with local plans and
 35 regulations for stormwater management.

36 Although the state and federal project proponents and decision-makers are not required to comply
 37 with county general plans and policies, it is important for CEQA and NEPA compliance purposes to
 38 identify any relevant local land use plans, policies, and regulations that are adopted for the purpose
 39 of avoiding or mitigating an environmental effect. Potential inconsistencies with such enactments do
 40 not *per se* translate into adverse environmental effects under either CEQA or NEPA. Even where a
 41 lead agency is subject to an environmentally protective policy, the mere fact of inconsistency (a
 42 "paper" phenomenon) is not by itself an adverse effect on the environment. Such paper
 43 inconsistencies sometimes indicate, however, that a proposed physical activity might harm the

1 environmental resource intended to be protected by the plans, policies, or regulations at issue.
 2 Potential adverse effects on such resources (e.g., water quality) are addressed in Section 8.3,
 3 *Environmental Consequences*, where the extent and significance of such effects are addressed.

4 **8.3 Environmental Consequences**

5 This section describes potential direct (both temporary construction-related and permanent
 6 operations-related) and indirect effects on water quality within the affected environment that would
 7 result from implementation of each alternative. For the purposes of this chapter, temporary impacts
 8 refer to those effects that are caused directly or indirectly through implementation of some
 9 temporary or intermittent activity associated with the proposed project, and thus ultimately the
 10 effect ceases to exist. Given the large scale of the potential temporary activities associated with the
 11 project, such as construction activities, it should be noted that temporary impacts may still occur
 12 over a relatively extended time period of many months or years at some project locations. An
 13 analysis of the consistency of the alternatives with applicable state water quality standards, plans,
 14 and policies, including the federally promulgated NTR and CTR, is provided for the Upstream of the
 15 Delta Region, Delta Region, and the SWP and CVP Export Service Areas Region of the affected
 16 environment. The impact analysis separates temporary construction-related impacts from those
 17 associated with long-term facilities operations for the alternatives. Each of the BDCP alternatives'
 18 proposed features are divided into two categories: physical/structural components associated with
 19 the new conveyance facilities (CM1) and their operations and maintenance, which are project-level
 20 features, and restoration actions or CM2–CM21), which are programmatic features. Alternatives 4A,
 21 2D, and 5A are evaluated at a project level of detail.

22 **8.3.1 Methods for Analysis**

23 Each Alternative consists of two broad categories of actions relevant to water quality concerns.
 24 These are: (1) temporary construction activities associated with construction of the water
 25 conveyance facilities and conservation measures/Environmental Commitments and (2) non-
 26 construction-related actions associated with the water conveyance facilities and conservation
 27 measures/Environmental Commitments. The non-construction-related actions associated with the
 28 conservation measures/Environmental Commitments are further characterized by the following
 29 four major components.

- 30 1. New north Delta diversion and conveyance facilities to be operated in conjunction with SWP and
 31 CVP existing facilities (collectively called *conveyance*).
- 32 2. Detailed criteria that will govern the operations of the new SWP conveyance facilities and other
 33 in-Delta facilities across a range of hydrological conditions (collectively called *operations*).
 34 Number 1 and 2 together are referred to as CM1 for the BDCP alternatives, and “facilities
 35 operations and maintenance” for Alternatives 4A, 2D, and 5A.
- 36 3. Habitat Restoration: each action alternative would include a range of tidal marsh, floodplain,
 37 riparian, and upland transition habitat activities within the Plan Area (CM2–CM11 for the BDCP
 38 alternatives; Environmental Commitments 3, 4, and 6–11 for Alternatives 4A, 2D, and 5A).
- 39 4. Actions to address and control contaminants, nonnative invasive species, and predation, and to
 40 address other potentially important non-conveyance and non-habitat-related stressors on

1 covered species (collectively called *other stressors*) (CM12–CM21 for the BDCP alternatives;
2 Environmental Commitments 12, 15, and 16 for Alternatives 4A, 2D, and 5A).

3 Implementation of the alternatives would result in changes to SWP and CVP operations, Delta
4 habitats, channel flows, and Delta hydrodynamics (i.e., how water moves through the Delta).
5 Implementation of conservation measures/Environmental Commitments also could directly affect
6 water quality positively or negatively at certain locations. Thus, the components of the alternatives
7 could collectively result in complex water quality changes within the affected environment (see
8 Section 8.1, *Environmental Setting/Affected Environment*). For the purposes of this assessment, the
9 study area is divided into the three regions (Figure 1-4).

- 10 ● Plan Area, including the Yolo Bypass, SWP North Bay Aqueduct service area, and Suisun Marsh.
- 11 ● Upstream of the Delta (including the Sacramento and San Joaquin River watersheds).
- 12 ● SWP/CVP Export Service Area (south of the Delta, areas served by the California Aqueduct,
13 Delta-Mendota Canal, and South Bay Aqueduct [SBA]).

14 Each constituent assessment and the assessment of construction-related impacts address the three
15 regions above. In addition, a separate impact discussion is provided to address the effects of the
16 alternatives on the San Francisco Bay.

17 The two key questions to be addressed by this surface water quality impact assessment are as
18 follows.

- 19 1. Would implementation of the alternatives result in water quality changes to the Plan Area,
20 Upstream of the Delta, or SWP/CVP Export Service Areas that would result in exceedances of
21 water quality criteria/objectives, or substantially degrade water quality, of/by sufficient
22 frequency, magnitude, and geographic extent as to cause or substantially contribute to
23 significant adverse effects on the beneficial uses of water in these areas of the affected
24 environment?
- 25 2. Would implementation of the alternatives result in beneficial effects on water quality in these
26 areas?

27 Appropriately addressing these questions is a complex task because:

- 28 ● The full effects of the alternatives would occur in the future, and “project effects” on water
29 quality involve numerous constituents of interest (many having adopted water quality
30 objectives/criteria and some without adopted objectives/criteria).
- 31 ● Multiple beneficial uses could be affected by changes in water quality.
- 32 ● Numerous locations of interest are found throughout the large affected environment.

33 Moreover, models available for use in addressing such questions have been previously developed
34 for the effects of operations of the SWP–CVP facilities for only a few water quality parameters (e.g.,
35 EC, DOC, and temperature) in defined portions of the affected environment (i.e., the Delta), and are
36 poorly developed or not developed at all for nearly all other water quality parameters and locations,
37 nor for most of the conservation measures proposed for implementation. Consequently, the
38 methodology developed for assessing water quality impacts differed for each of the three areas of
39 the affected environment because:

- 40 ● The beneficial uses of water in each area are affected differently by the alternatives.

- 1 • Each area has different constituents of concern and different historical data availability for those
2 constituents.
- 3 • The availability of models that can be used to support quantitative assessments differs in each
4 area.

5 Hence, a combination of both quantitative and qualitative analyses (as appropriate) was performed
6 to estimate the changes in water quality attributable to implementation of the alternatives within
7 the three areas of the affected environment. Depending on the constituent and location, these
8 changes could be significant/adverse (e.g., increase in concentration or mass loading of harmful
9 constituents), insignificant, or beneficial.

10 In general, the fewest water quality changes of importance are expected to occur Upstream of the
11 Delta, followed by the SWP/CVP Export Service Areas, with the greatest number and magnitude of
12 water quality changes expected for the Plan Area. The Plan Area was analyzed in the greatest detail
13 for the following reasons.

- 14 • Its water quality would be most affected by the action alternatives.
- 15 • It has complex hydrodynamic characteristics.
- 16 • Models are available to simulate hydrodynamic and water quality changes within the Delta
17 region.
- 18 • Delta water quality is critically important to the water supplies of California residents that use
19 water within the Delta and in the SWP/CVP Export Service Areas.

20 All constituents for which data were compiled were run through an initial screening analysis that
21 determined the appropriate levels of analysis needed for each constituent, and whether further
22 analysis beyond that provided by the screening analysis itself, if needed, would be qualitative or
23 quantitative. The details of the screening analysis are discussed later in this section.

24 The constituents of concern in the affected environment included both physically and chemically
25 conservative and non-conservative parameters. The concentrations of conservative constituents
26 tend to not be affected substantially by physical, chemical, or biological mechanisms that would
27 result in a loss of the constituent from the system. Thus, the concentrations of conservative
28 constituents can be reasonably estimated and changes assessed with mass-balance accounting of the
29 mixing of known volumes and concentrations of different water sources. Non-conservative
30 constituents can be affected by mechanisms that result in loss from the water such as physical (e.g.,
31 settling, volatilization), chemical (e.g., adsorption, oxidation-reduction, complexation), or biological
32 (e.g., uptake, decay) mechanisms such that mass-balance accounting becomes much more complex.
33 Historical monitoring data for the majority of these constituents were collected and reviewed from
34 various locations of interest within the affected environment.

35 Conservative parameters were evaluated using available models used for SWP/CVP planning and
36 operations (i.e., California Water Resources Simulation Model [CALSIM II, Delta Simulation Model 2
37 [DSM2], and Reclamation's Temperature Model) wherever applicable, as well as constituents
38 directly addressed by these models, and included EC, DOC, and temperature. It should be noted that
39 because aquatic life beneficial uses are the only uses expected to be affected by temperature changes
40 under the various alternatives, the water quality chapter cross-references to Chapter 11, *Fish and*
41 *Aquatic Resources*, for all impact assessments for temperature.

1 These models produce detailed estimates of existing and future flow and water quality conditions
 2 for the major reservoir, river, Delta, and constructed features such as agricultural diversions,
 3 municipal diversions, and associated conveyance facilities within the study area. As such, the
 4 CALSIM and DSM2 model outputs also were used to support quantitative mass-balance assessments
 5 for several other constituents that exhibit generally conservative characteristics. Non-conservative
 6 parameters were evaluated qualitatively. Detailed discussion on when and where qualitative or
 7 quantitative analyses were performed is included later in this section.

8 Mercury and selenium were analyzed in detail because of their bioaccumulative properties.
 9 Bioaccumulation refers to the uptake of a constituent by a biological organism which exceeds the
 10 excretion or loss from the organism, such that concentrations within the organism are increased
 11 over time. The specific methodologies used to evaluate these two parameters are discussed
 12 separately in this section. Various models used in analyzing these constituents of interest and their
 13 interrelationship have also been discussed in detail.

14 Based on the components of the alternatives (described previously in this section), three categories
 15 of potential changes in water quality conditions are described, as follows.

- 16 • Changes attributable to construction-related conservation measures/Environmental
 17 Commitments.
- 18 • Changes attributable to operations and maintenance of new conveyance facilities and new SWP
 19 and CVP operational criteria.
- 20 • Changes attributable to non-construction related actions associated with implementation of
 21 other defined conservation measures/Environmental Commitments.

22 It was determined that the action alternatives would result in all three categories of potential water
 23 quality effects within the Plan Area. However, based on the description of alternatives (see Chapter
 24 3, *Description of Alternatives*) for construction activities and conservation measures/Environmental
 25 Commitments in the Upstream of the Delta and the SWP/CVP Export Service Area, water quality
 26 changes were expected to be minimal and, hence, are not addressed in as much detail. For those
 27 alternatives that include specific water conveyance facilities measures in the Plan Area, however, a
 28 project specific level of analysis is included.

29 The frequency, magnitude, and geographic extent of any change in specific water quality
 30 constituents, or change in mass loading, is of primary importance in determining effects on
 31 beneficial uses (aquatic biology, municipal and domestic supply, agricultural uses, recreation, etc.).
 32 Consequently, findings regarding estimated concentrations at each assessment location for
 33 individual constituents of concern under the alternatives were compared to thresholds of
 34 significance (Section 8.3.2, *Determination of Effects*) for the purposes of making CEQA and NEPA
 35 impact determinations. Thresholds of significance define the criteria used to define the level at
 36 which an impact would be considered significant in accordance with CEQA and NEPA. Thresholds
 37 were based on the checklist in Appendix G of the CEQA Guidelines (CCR, Title 14, Division 6,
 38 Chapter 3), scientific information and data, and regulatory standards. These thresholds take into
 39 account the factors under NEPA to determine the significance of an action in terms of the context
 40 and intensity of its effects (40 CFR 1508.27).

41 If the estimated water quality conditions for a constituent under an Alternative triggers one or more
 42 of the five water quality conditions defined as effects assessment criteria (NEPA) and thresholds of
 43 significance (CEQA) (see Section 8.3.2.3, *Effects Determinations*) at one or more of the assessment

1 locations, then that Alternative was determined to have an adverse water quality effect (under
 2 NEPA) and a significant impact on water quality (under CEQA) for that water quality constituent or
 3 parameter. Improvements to water quality conditions, where modeled or estimated to occur, also
 4 were generally identified as beneficial if considered to reflect a substantial change.

5 In summary, the impact assessment methodology includes the following:

- 6 1. Addresses all constituents of concern based on available information and the current science
 7 regarding concentrations/levels that would affect beneficial uses of waters within the affected
 8 environment.
- 9 2. Quantitatively evaluates constituents of primary concern where modeling tools were developed
 10 and were available for doing so, and qualitatively assesses effects where appropriate modeling
 11 tools were unavailable.
- 12 3. Evaluates the overall effect of the alternatives on beneficial uses in a comparative manner
 13 throughout the affected environment, during three distinct time frames, which address climate
 14 change considerations.

15 The details of this methodological approach are discussed below. In the following sections, the
 16 specific methodologies used to assess water quality impacts within the three distinct areas of the
 17 affected environment (i.e., Upstream of the Delta, Plan Area, and SWP/CVP Export Service Areas) are
 18 discussed.

19 **8.3.1.1 Models Used and Their Linkages**

20 The models used in support of the quantitative water quality analyses were: (1) Reclamation and
 21 DWR's CALSIM II hydrologic model; and (2) DWR's DSM2. A description of each model is provided
 22 below, including a discussion of how the models were used to assess compliance with water quality
 23 objectives for EC and chloride in the Delta, as well as how results from these models were used to
 24 quantify changes in other water quality constituent concentrations/parameter levels. More
 25 information on these models and the assumptions included in their application is described in
 26 Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*.

27 **CALSIM II**

28 The CALSIM II model, which has been jointly developed and maintained by DWR and Reclamation to
 29 provide hydrologic-based information for planning, managing, and operating the integrated SWP
 30 and CVP system, was used to simulate system operations and resulting hydrologic conditions under
 31 the alternatives. CALSIM II operates on a monthly time step from water year 1922 through 2003
 32 using historical rainfall and runoff data which have been adjusted for changes in water and land uses
 33 that have occurred or are projected to occur in the future. In the model, the reservoirs and pumping
 34 facilities of the SWP and CVP are operated to ensure the flow and water quality requirements for
 35 these systems are met. The model assumes that facilities, land uses, water supply contracts, and
 36 regulatory requirements are constant throughout the 82-year hydrologic period of record, thus
 37 providing a simulation representing a fixed level of development. Among other output, CALSIM II
 38 provides end-of-month reservoir storage levels, and mean monthly reservoir releases, flows at
 39 various locations along the major rivers, X2 location, Delta inflow, and Delta outflow for the 82-year
 40 hydrologic period of record.

1 The 2010 version of CALSIM II was used to model the SWP and CVP system and, thus, support the
 2 assessments in this chapter. This differs from the version being used to support the Biological
 3 Assessment being prepared for the proposed project, which is the 2015 version of CALSIM II. For the
 4 reasons described in Appendix 5F, the modeling results presented herein may differ from those
 5 presented in the Biological Assessment; however, the nature of those differences would not lead to
 6 different impact conclusions from those presented herein. Input assumption details for each
 7 scenario modeled using CALSIM II are provided in Appendix 5A, *BDCP/California WaterFix*
 8 *FEIR/FEIS Modeling Technical Appendix*.

9 The primary linkage of these models is for CALSIM II output to serve as input to DSM2, as shown in
 10 Figure 8-50. Key considerations in the CALSIM II modeling logic for the water quality assessment
 11 include how CALSIM II operations rules are configured to meet particular Delta water quality
 12 objectives for salinity and how daily patterning techniques were applied to the monthly CALSIM II
 13 operations. These topics are addressed further below.

14 **Artificial Neural Network for Flow-Salinity Relationship**

15 Flow-salinity relationships in the Delta are critical to both SWP/CVP and ecosystem management.
 16 Operation of the SWP/CVP facilities and management of Delta exports are often dependent on Delta
 17 flow needs for meeting salinity standards. Salinity in the Delta cannot be simulated accurately by the
 18 simple mass-balance routing and coarse time-step used in CALSIM II. An Artificial Neural Network
 19 (ANN) has been developed (Sandhu et al. 1999) that attempts to mimic the flow-salinity
 20 relationships as simulated in DSM2, but provides a rapid transformation of this information into a
 21 form usable by the CALSIM II operations model. The ANN is implemented in CALSIM II to constrain
 22 the operations of the upstream reservoirs and the Delta export pumps in order to satisfy particular
 23 salinity requirements. A more detailed description of the use of ANNs in the CALSIM II model is
 24 provided in Wilbur and Munévar (2001: Chapter 7).

25 The flow-salinity ANN developed by DWR (Sandhu et al. 1999, Seneviratne and Wu 2007) attempts
 26 to statistically correlate the salinity results from a particular DSM2 run to the various peripheral
 27 flows (Delta inflows, exports and diversions), gate operations, and an indicator of tidal energy. The
 28 ANN is calibrated, or trained, on DSM2 results that represent a specific Delta configuration using a
 29 full circle analysis (Seneviratne and Wu 2007). For example, a future reconfiguration of the Delta
 30 channels to improve conveyance may significantly affect the hydrodynamics of the system. The ANN
 31 would be able to represent this new configuration by being retrained by DSM2 results that included
 32 the new configuration. The ANN approximates DSM2-generated salinity at the following key
 33 locations for the purpose of modeling Delta water quality standards: Sacramento River at Emmaton,
 34 San Joaquin River at Jersey Point, Sacramento River at Collinsville, and Old River at Rock Slough. In
 35 addition, the ANN is capable of providing salinity estimates for Clifton Court Forebay, CCWD
 36 Alternate Intake Project (AIP) and Los Vaqueros diversion locations. The ANN may not fully capture
 37 the dynamics of the Delta under conditions other than those for which it was trained. It is possible
 38 that the ANN will exhibit errors in flow regimes beyond those for which it was trained. Therefore, a
 39 new ANN was developed for scenarios with sea level rise and/or restoration areas in the Delta
 40 which result in changed flow-salinity relationships in the Delta. A more complete description of the
 41 ANNs developed and used is included in Appendix 5A, Section A.5.3.

42 **Monthly-to-Daily Patterning for Sacramento River at Freeport**

43 In an effort to better represent the sub-monthly flow variability, particularly in early winter, a
 44 monthly-to-daily flow patterning technique is applied directly in CALSIM II for the Fremont Weir,

1 Sacramento Weir, and the north Delta intakes. The technique applies historical daily patterns, based
2 on the hydrology of the year, to transform the monthly volumes into daily flows. In all cases, the
3 monthly volumes are preserved between the daily and monthly flows. It is important to note that
4 this daily patterning approach does not in any way represent the flows resulting from operational
5 responses on a daily time step. It is simply a technique to incorporate representative daily
6 variability into the flows resulting from CALSIM II's monthly operational decisions to help provide a
7 better estimate of the Fremont and Sacramento weir spills, which are sensitive to the daily flow
8 patterns and provides the upper bound of the available north Delta diversion in the alternatives. The
9 incorporation of daily patterning in CALSIM II is described in the Section A.3.3 of Appendix 5A,
10 *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*.

11 **DSM2**

12 DSM2 is a one-dimensional mathematical model for dynamic simulation of hydrodynamics, water
13 quality, and particle tracking throughout the Delta. DSM2 can be used to calculate stages, flows,
14 velocities, mass transport processes for conservative constituents, and transport of individual
15 particles. The model runs on a 15-minute time step for a 16-year hydrologic period of record. DSM2
16 currently consists of three modules: HYDRO, QUAL, and PTM. HYDRO simulates one-dimensional
17 hydrodynamics including flows, velocities, depth, and water surface elevations. HYDRO provides the
18 flow input for QUAL and PTM. QUAL simulates one-dimensional fate and transport of conservative
19 water quality constituents given a flow field simulated by HYDRO. PTM simulates pseudo three-
20 dimensional transport of neutrally buoyant particles based on the flow field simulated by HYDRO.
21 Input assumption details for each scenario modeled are provided in Appendix 5A.

22 **Simulation Period**

23 DSM2 was utilized to simulate the 16-year, 1976–1991 hydrologic period of record. This hydrologic
24 period of record contains a sequence of water years that contains all water year types: wet, above
25 normal, below normal, dry, and critical. This hydrologic period is bracketed at each end by two
26 critical years: 1976 and 1977 at the beginning of the period and 1990 and 1991 at the end of the
27 period. This hydrologic period also contains an extended drought period, 1987–1991. Additional
28 information regarding the selection of the simulation period is provided in Appendix 5A, Section D
29 (Additional Modeling Information).

30 **Monthly-to-Daily Patterning**

31 DSM2 is simulated on a 15-minute time step to address the changing tidal dynamics of the Delta
32 system. However, the boundary flows, which are provided from CALSIM II output, are mean monthly
33 flows. As shown in Figures A-6 and A-7 of Appendix 5A, Sacramento River flow at Freeport exhibits
34 significant daily variability around the monthly mean in the winter and spring periods in most water
35 year types. The winter-spring daily flow variability is deemed important to aquatic species of
36 concern. To better represent the sub-monthly flow variability, particularly in early winter, a
37 monthly-to-daily flow patterning technique was applied to the boundary flow inputs to DSM2. The
38 monthly-to-daily flow patterning approach used in CALSIM II and DSM2 are consistent. A detailed
39 description of the implementation of the daily variability in DSM2 boundary flows is provided in
40 Appendix 5A, Section D.9.

41 It is important to note that this monthly-to-daily patterning approach does not in any way represent
42 the flows that would result from any operational responses on a daily time step. It is simply a

1 technique to incorporate representative daily variability into the flows resulting from CALSIM II's
2 monthly operational decisions.

3 **Calibration and Validation**

4 DSM2 hydrodynamics and salinity (EC), which is directly modeled by DSM2, were initially calibrated
5 in 1997 (California Department of Water Resources 1997). In 2000, a group of agencies, water users,
6 and stakeholders recalibrated and validated DSM2 in an open process resulting in a model that
7 could replicate the observed data more closely than the 1997 version (DSM2PWT 2001). In 2009,
8 CH2M HILL performed a calibration and validation of DSM2 by including the flooded Liberty Island
9 in the DSM2 grid, which allowed for an improved simulation of tidal hydraulics and EC transport in
10 DSM2 (CH2M HILL 2009). The technical report documenting this calibration and validation effort is
11 included in Appendix 5A, Section D.5. Simulation of DOC transport in DSM2 was successfully
12 validated in 2001 by DWR (Pandey 2001). The version of DSM2 used for evaluating the alternatives
13 incorporates these latest calibrations.

14 **Corroboration**

15 To evaluate DSM2's ability to represent the effects of sea level change and the proposed restoration
16 actions on Delta hydrodynamics and salinity, DSM2 results were compared with results from two
17 other Delta simulation models. The effects of sea level rise were simulated by the three-dimensional
18 UNTRIM Bay-Delta model and the effects of tidal marsh restoration were simulated by the two-
19 dimensional RMA Bay-Delta model. Detailed descriptions of the UnTRIM modeling of the sea level
20 rise scenarios, RMA modeling of the tidal marsh restoration, and DSM2 corroboration are included
21 in Appendix 5A, Sections D.7, D.6, and D.8, respectively. Overall the results show that DSM2 is
22 capable of simulating similar incremental changes in flows and salinity at most Delta locations as in
23 the RMA model. Further, DSM2 is capable of simulating similar incremental changes in salinity as
24 UnTRIM in the west Delta where sea level rise is expected to have an influence.

25 **Modeling Limitations and Uncertainty**

26 Because DSM2 is a one-dimensional model, it has inherent limitations in simulating hydrodynamic
27 and transport processes in a complex estuarine environment such as the Delta. DSM2 assumes that
28 velocity in a channel can be adequately represented by a single average velocity over the channel
29 cross-section, meaning that variations both across the width of the channel and through the water
30 column are negligible. DSM2 does not have the ability to model short-circuiting of flow through a
31 reach, where a majority of the flow in a cross-section is confined to a small portion of the cross-
32 section. DSM2 does not conserve momentum at the channel junctions and does not model the
33 secondary currents in a channel. DSM2 also does not explicitly account for dispersion due to flow
34 accelerating through channel bends. It cannot model the vertical salinity stratification in the
35 channels. It has inherent limitations in simulating the hydrodynamics related to the open water
36 areas. Since a reservoir surface area is constant in DSM2, it impacts the stage in the reservoir and
37 thereby impacting the flow exchange with the adjoining channel. Due to the inability to change the
38 cross-sectional area of the reservoir inlets with changing water surface elevation, the final entrance
39 and exit coefficients were fine tuned to match a median flow range. This causes errors in the flow
40 exchange at breaches during the extreme spring and neap tides. Using an arbitrary bottom elevation
41 value for the reservoirs representing the proposed marsh areas to get around the wetting-drying
42 limitation of DSM2 may increase the dilution of salinity in the reservoirs. Accurate representation of

1 tidal marsh areas, bottom elevations, location of breaches, breach widths, cross-sections, and
2 boundary conditions in DSM2 is critical to the corroboration with RMA results for tidal marsh areas.

3 For open water bodies DSM2 assumes uniform and instantaneous mixing over an entire open water
4 area. Thus it does not account for the salinity gradients that may exist within the open water bodies.
5 Significant uncertainty exists in flow and EC input data related to in-Delta agriculture, which leads to
6 uncertainty in the simulated EC values. Caution needs to be exercised when using EC outputs on a
7 sub-monthly scale. Water quality results inside the water bodies representing the tidal marsh areas
8 were not validated specifically. Additionally, localized withdrawals and returns are not simulated for
9 Suisun Marsh in DSM2. In some areas of Suisun Marsh where these play a major role in water
10 quality, DSM2 modeling may not be accurate.

11 Notwithstanding the above limitation, DSM2 remains the best available tool from which to simulate
12 water quality changes within the Delta over an extended hydrologic period.

13 **Use of CALSIM II and DSM2 for Assessment of Meeting of Bay-Delta WQCP Water** 14 **Quality Objectives**

15 **Water Quality Objectives Incorporated into CALSIM II**

16 In CALSIM II, the reservoirs and facilities of the SWP and CVP are operated to assure the flow and
17 water quality requirements for these systems are met. Meeting regulatory requirements, including
18 Delta water quality objectives, is the highest operational priority in CALSIM II. As mentioned above,
19 CALSIM II uses an ANN to configure system operations to meet salinity objectives. Because CALSIM
20 II operates on a monthly time step, the model attempts to meet these objectives on a monthly
21 average basis, even though the objectives themselves are often based on 14-day or 30-day running
22 averages, and may start or end in the middle of a month. The ANN can only predict salinity at a few
23 of the locations that have water quality objectives for salinity, which are specific to Delta beneficial
24 uses:

- 25 ● Municipal and Industrial Use:
 - 26 ○ Old River at Rock Slough
 - 27 ○ Banks/Jones Pumping Plants
- 28 ● Agricultural Beneficial Use:
 - 29 ○ Sacramento River at Emmaton or Threemile Slough
 - 30 ○ San Joaquin River at Jersey Point
- 31 ● Fish and Wildlife Beneficial Uses:
 - 32 ○ Sacramento River at Collinsville

33 At the locations denoted above, because meeting the objectives is the highest priority in CALSIM II,
34 only two conditions in CALSIM II are possible: (1) applicable water quality objectives are met on a
35 monthly average basis according to the ANN, or (2) there is no feasible way to meet the objective.

36 Note that the certain alternatives contain an important element regarding the Sacramento River at
37 Emmaton water quality objective. Alternatives 1A–C, 2A–C, 3, 5, 6A–C, 7, 8, and 9 include, as part of
38 the definition of the alternative, a change in the compliance point to the Sacramento River at
39 Threemile Slough. The ANN for these alternatives was retrained based on this change, so CALSIM II

1 operated in such a way as to meet this objective at Threemile Slough under these alternatives. The
 2 Existing Conditions and No Action Alternative did not include this change to the compliance point or
 3 ANN. Also, for Alternatives 4, 4A, 2D, and 5C, the Sacramento River at Emmaton compliance location
 4 is retained.

5 Threemile Slough is located approximately two and one-half miles upstream of Emmaton. Because
 6 of their relative locations, when the EC water quality objective is met at Emmaton, it is generally also
 7 met at Threemile Slough. However, it is not always the case that meeting the objective at Threemile
 8 Slough results in meeting the objective at Emmaton, because the Threemile Slough is further
 9 upstream from the effects that salinity intrusion can have on EC. Thus, under the alternatives that
 10 include a change in compliance location from Emmaton to Threemile Slough, there are more
 11 exceedances of the water quality objective at Emmaton (were it to be still in place) than under the
 12 Existing Conditions or No Action Alternative (which do have the compliance location at Emmaton).

13 When DSM2 is run using the output from CALSIM II, exceedances of the water quality objectives
 14 above can occur for the reasons below.

- 15 1. CALSIM II found no feasible way to meet the objective – i.e., both CALSIM II and DSM2 agree that
 16 the objective is exceeded.
- 17 2. The ANN that CALSIM II uses predicted that the objective would be met on a monthly average
 18 basis under the operations simulated in CALSIM II, but either:
 - 19 a. The ANN is an imperfect predictor of compliance generally, or specifically on the time-step
 20 and averaging basis by which these objectives are defined; or
 - 21 b. The monthly-to-daily patterning discussed above resulted in a pattern of flows at the DSM2
 22 boundary conditions that resulted in the objective being exceeded.

23 In the water quality analysis, if exceedances of these objectives were predicted via the DSM2 results,
 24 depending on the specific objective in question, various approaches were employed to determine if
 25 the exceedances fell into reason 1 or 2 above. If they fell into reason 2 (i.e., objective met in CALSIM
 26 II), additional sensitivity analyses were performed to determine if changes in modeling assumptions
 27 or operational changes could result in compliance with the objective. Additional information
 28 regarding these analyses is provided in Appendix 8H, *Electrical Conductivity*, Attachments 1 and 2.

29 **Water Quality Objectives not Incorporated into CALSIM II**

30 There are also water quality objectives for salinity that are not incorporated into the ANN and
 31 CALSIM II. These include objectives that apply for the following beneficial uses and locations:

- 32 ● Municipal and Industrial Use:
 - 33 ○ Cache Slough at City of Vallejo Intake
 - 34 ○ Barker Slough at North Bay Aqueduct Intake
- 35 ● Agricultural Beneficial Use:
 - 36 ○ Interior Delta
 - 37 ● South Fork Mokelumne River at Terminous
 - 38 ● San Joaquin River at San Andreas Landing
 - 39 ○ Southern Delta and Export Area

- 1 • San Joaquin River at Airport Way Bridge, Vernalis
- 2 • San Joaquin River at Brandt Bridge Site
- 3 • Old River near Middle River
- 4 • Old River at Tracy Road Bridge
- 5 • West Canal at mouth of Clifton Court Forebay
- 6 • Delta-Mendota Canal at Tracy Pumping Plant
- 7 • Fish and Wildlife Beneficial Uses:
 - 8 ○ San Joaquin River at and between Jersey Point and Prisoners Point
 - 9 ○ Suisun Marsh
 - 10 • Sacramento River at Collinsville
 - 11 • Montezuma Slough at National Steel
 - 12 • Montezuma Slough near Beldon's Landing
 - 13 • Chadbourne Slough at Sunrise Duck Club
 - 14 • Suisun Slough, 300 feet south of Volanti Slough
 - 15 • Cordelia Slough at Ibis Club
 - 16 • Goodyear Slough at Morrow Island Clubhouse
 - 17 • Water supply intakes for waterfowl management areas on Van Sickle and Chipps Islands

18 Although CALSIM II does not specifically operate to meet these objectives, they are nonetheless
 19 often if not always incidentally met when DSM2 is run using the CALSIM II output as boundary
 20 conditions. Meeting of some of these objectives is not directly related to operations that CALSIM II
 21 simulates. For example, some of these objectives relate more to discharges and local sources of
 22 salinity, as opposed to system-wide operation. Others, specifically the fish and wildlife objectives in
 23 Suisun Marsh, are based on sub-daily (i.e., high tide) EC values, and also take into account other
 24 factors related to effects on wildlife when evaluating exceedance of an objective, and thus CALSIM II
 25 cannot operate to specifically meet the objective. When DSM2 is run using the output from CALSIM
 26 II, exceedances of the water quality objectives above can occur for the following reasons.

- 27 1. The exceedances are real reflections of water quality conditions for the given scenario due to
 28 system operations simulated in the CALSIM II model run and other assumptions inherent in the
 29 DSM2 run.
- 30 2. The system operations that CALSIM II simulated were incidentally sufficient to meet the water
 31 quality objective on a monthly average basis, but the monthly-to-daily patterning discussed
 32 above resulted in a pattern of flows at the DSM2 boundary conditions that resulted in the
 33 objective being exceeded.

34 In the water quality analysis, if exceedances of these objectives were predicted via the DSM2 results,
 35 depending on the specific objective in question, various approaches were employed to determine if
 36 the exceedances fell into reason 1 or 2 above. If they fell into reason 1 (i.e., exceedances are due to
 37 system operations), additional sensitivity analyses were performed to determine if changes in
 38 modeling assumptions or operational changes could result in compliance with the objective.

1 Additional information regarding these analyses is provided in Appendix 8H, *Electrical Conductivity*,
2 Attachments 1 and 2.

3 **Real-Time Operations of the SWP and CVP**

4 In reality, staff from DWR and Reclamation constantly monitor Delta water quality conditions and
5 adjust operations of the SWP and CVP in real time as necessary to meet water quality objectives.
6 These decisions take into account real-time conditions and are able to account for many factors that
7 the best available models cannot simulate. In Section 8.1.3.4 and 8.1.3.7, the history of compliance
8 with Delta water quality objectives is summarized and discussed. In the 30-plus year history of the
9 water quality standards, there are relatively few instances in which water quality objectives were
10 exceeded when SWP and CVP operations had any ability to prevent the exceedance (see Sections
11 8.1.3.4 and 8.1.3.7 for more detail). Environmental conditions arise that cannot be foreseen or
12 simulated in the model that can affect compliance with water quality objectives. These include
13 unpredictable tidal and/or wind conditions, gate failures, operational needs to improve fish
14 habitat/conditions, and prolonged extreme drought conditions, among others. At times, negotiations
15 with the State Water Resources Control Board occur in order to effectively maximize and balance
16 protection of beneficial uses and water rights. These activities are expected to continue in the future.
17 Thus, it is likely that some objective exceedances simulated in the modeling would not occur under
18 the real-time monitoring and operational paradigm that will be in place to prevent such
19 exceedances.

20 **8.3.1.2 Upstream of the Delta Region**

21 Water quality changes in the affected environment upstream from the north-Delta boundary, which
22 includes the Sacramento River to Shasta Lake, the Feather River to Lake Oroville, and the American
23 River to Folsom Lake, were primarily assessed qualitatively. Assessment of water quality changes
24 was limited to facilities operations-related water quality changes for all alternatives, and the
25 implementation of CM2–CM21 for the BDCP alternatives or Environmental Commitments under
26 Alternatives 4A, 2D, and 5A. Conveyance facility construction-related effects are not anticipated
27 upstream of the Delta.

28 The assessment of water quality changes in water bodies upstream of the Delta relied, in part, on
29 making determinations as to how reservoir storage and releases would be changed. Specific changes
30 in reservoir storage and releases were determined from CALSIM II modeling of the SWP and CVP
31 system (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*, describes
32 the CALSIM II modeling performed in support of this assessment). Reservoir storage and river flow
33 changes were then evaluated to make determinations regarding the capacity for the affected water
34 bodies to provide dilution of watershed contaminant inputs. Also, if a particular parameter was
35 found to be correlated to seasonal reservoir levels or river flows, how the parameter would be
36 altered seasonally by operational changes in reservoir levels or river flows was assessed.

37 **8.3.1.3 Plan Area**

38 Water quality changes in the Delta were assessed quantitatively to the extent that data and models
39 were available to do so; otherwise, water quality changes were assessed qualitatively. Using the
40 methodology described below, changes in boron, bromide, chloride, mercury, methylmercury,
41 nitrate, organic carbon, and selenium within the Delta were determined quantitatively at

1 11 assessment locations (Figure 8-7), while electrical conductivity and chloride were assessed at D-
2 1641 compliance locations.

3 Operations-related water quality changes (i.e., CM1 under the BDCP alternatives) would be partly
4 driven by geographic and hydrodynamic changes resulting from restoration actions (i.e., altered
5 hydrodynamics attributable to new areas of tidal wetlands (CM4), for example). There is no way to
6 disentangle the hydrodynamic effects of CM4 and other restoration measures from CM1, since the
7 Delta as a whole is modeled with both CM1 and the other conservation measures implemented. To
8 the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing
9 of source waters, these effects were included in the modeling assessment of operations-related
10 water quality changes (CM1 under the BDCP alternatives). Other effects of CM2–CM21 not
11 attributable to hydrodynamics, for example, additional loading of a water quality constituent to the
12 Delta, are discussed within the impact heading for CM2–CM21.

13 Methodologies to determine the effects attributable to construction activities and actions to address
14 the other stressors are discussed later in this section.

15 **Constituent Screening Analysis**

16 Constituents assessed in the water quality chapter were identified based on the following
17 considerations.

- 18 • Availability of historical monitoring data.
- 19 • Constituents having adopted federal water quality criteria or state water quality objectives.
- 20 • Constituents on the state’s CWA Section 303(d) list in the Delta.
- 21 • Constituents identified in public scoping comments.
- 22 • Constituents deserving assessment based on professional judgment.

23 A constituent *screening analysis* was conducted on 182 water quality constituents/parameters. The
24 screening analysis determined which constituents had no potential to exceed the thresholds of
25 significance by implementation of the alternatives and, thus, did not warrant further assessment.
26 This analysis identified a list of “constituents of concern” that were further analyzed as part of
27 assessing their potential water quality related impacts under the alternatives. For a detailed
28 description of the approach employed in the constituent screening analysis, see Appendix 8C,
29 *Screening Analysis*.

30 **Determining Whether Assessment is Qualitative or Quantitative**

31 For many constituents, lack of adequate representative data precluded a quantitative assessment.
32 Tables SA-8 and SA-9 of Appendix 8C identify the types of constituents that were carried forward for
33 detailed analysis and were automatically determined to be assessed qualitatively. For constituents
34 for which at least one data point in the representative data set was a detected value (see Table SA-7,
35 Appendix 8C), the assessment was either quantitative or qualitative, depending on three factors:
36 (1) adequacy of data to perform a quantitative assessment, (2) adequacy of modeling tools, relative
37 to the physical/chemical properties of the constituent, to perform a quantitative assessment, and
38 availability of these tools, and (3) whether a quantitative analysis was necessary to perform the
39 assessment.

1 Available tools were considered appropriate for modeling only those constituents that could be
2 assumed to be conservative. Other gain/loss mechanisms were accounted for and addressed
3 qualitatively within the quantitative modeling-based assessment. Constituents of concern that could
4 not be analyzed through quantitative modeling were carried forward for qualitative analysis.
5 Appendix 8C, Table SA-11 contains a list of water quality constituents for which individual
6 assessments were performed and denotes the constituents that were assessed quantitatively
7 through modeling and those that were assessed qualitatively.

8 **Quantitative Assessments**

9 Using the methodology described below, changes in water quality were determined at
10 11 assessment locations across the Delta (Figure 8-7) for each of the constituents assessed
11 quantitatively, with the exception of EC. Assessment locations for EC aligned with compliance
12 locations contained in the Bay-Delta WQCP and are described in further detail below. Chloride was
13 also assessed at Bay-Delta WQCP compliance locations, in addition to the 11 other assessment
14 locations.

15 **Calculation of Changes in Constituent Levels**

16 Output from DSM2 was used to calculate changes in constituent concentrations as they would be
17 affected primarily from operations-related actions of the conveyance features of the alternatives.
18 DSM2 produced: (1) flow-fraction or “fingerprinting” output; and (2) EC and DOC concentrations for
19 specified Delta locations. Because the DSM2 model directly simulated EC and DOC concentrations
20 throughout the Delta, the estimated concentrations of these constituents were simply compared
21 among alternatives for impact assessment purposes. Additionally, because DSM2 accounts for
22 hydrodynamic conditions in the Delta, the effects of some of the habitat restoration actions (i.e., CM2
23 and CM4) on EC and DOC are evaluated quantitatively. Restoration actions that resulted in water
24 quality changes associated with altered hydrodynamics, which were captured in the DSM2
25 modeling, are discussed in constituent-specific impact assessment sections as operations-related
26 water quality changes. Restoration actions that could result in a potential increase in constituent
27 loading (e.g., increased nutrient, organic carbon, or suspended solids) to the Delta region were
28 assessed qualitatively.

29 The methods described in the following sections were used to calculate levels/concentrations for
30 water quality parameters on a daily or monthly average basis for the DSM2 period of record (1976–
31 1991). Results were generally compiled and presented based on two averaging periods: all water
32 years, and the drought period (water years 1987–1991). The drought period was chosen to
33 represent water quality in “worst-case” conditions, as it includes several dry and critical years in
34 sequence. This was done in lieu of calculating water quality effects on a water year type basis (using
35 the Sacramento River Water Year Hydrologic Classification Index). The reasons for this included
36 simplicity of presenting and discussing results, and also because the 1987–1991 drought period
37 represents truly worst-case conditions, whereas discussion of dry or critical year water types
38 includes individual years when water supply and quality would not be significantly affected because
39 they were preceded and succeeded by wet or above normal water years (e.g., 1981, 1985). However,
40 when necessary, analysis of effects during certain water year types was conducted (for example, for
41 chloride and EC, whose water quality standards depend on the water year type).

42 In the following sections, the validity and/or validation studies that have been performed for the
43 various modeling approaches are discussed. It must be noted that comparison of modeling results

1 for Existing Conditions to historical water quality monitoring data is not an appropriate means of
 2 model validation. SWP/CVP operations have changed several times in the past as a result of various
 3 legal and regulatory determinations, and also vary as a result of changing land uses and water
 4 demands over time. Historical water quality data in general can represent times when the SWP/CVP
 5 system was operated differently than under the simulated Existing Conditions model run, which
 6 represents operation of the SWP and CVP at the time the Notice of Preparation was issued. The
 7 modeled Existing Conditions overlays this operational scheme on a period of varied historical
 8 hydrology. Therefore, it is not expected that the modeled Existing Conditions will approximate
 9 historical water quality data at a given location or time.

10 **Mass-Balance Method**

11 For constituents assessed quantitatively (See Appendix 8C, *Screening Analysis*, Table SA-11) for
 12 which concentrations were not directly estimated by DSM2—boron, bromide, chloride, mercury,
 13 methylmercury, nitrate, selenium—mean monthly flow-fraction output from DSM2 was used in
 14 mass-balance calculations (processed outside of DSM2) to estimate constituent concentrations. The
 15 flow-fraction output from DSM2 is the average percentage of water at each specified Delta location
 16 that was constituted by the five primary source waters (i.e., Sacramento River [SAC], San Joaquin
 17 River [SJR], eastside tributaries [EST], San Francisco Bay [BAY], and agriculture [AGR]). These flow-
 18 fractions were used together with source water constituent concentrations derived from historical
 19 data to estimate a given constituent concentration at assessment locations according to equation 1:

$$20 \quad f_{SAC,i}(C_{SAC}) + f_{SJR,i}(C_{SJR}) + f_{EST,i}(C_{EST}) + f_{BAY,i}(C_{BAY}) + f_{AGR,i}(C_{AGR}) = C_i \quad (1)$$

21 In the above equation, $f_{X,i}$ is the mean monthly flow fraction from source X at assessment location i,
 22 C_X is the constituent concentration from source X, and C_i is the constituent concentration at
 23 assessment location i. Contribution from the Yolo Bypass was added to contribution from the
 24 Sacramento River to constitute a single source, except in the case of selenium. Source water
 25 concentrations in the above equation are described for each of the constituents assessed via this
 26 method in Section 8.3.1.7, *Constituent-Specific Considerations Used in the Assessment*. Source water
 27 concentrations may vary seasonally, and this was examined. In some cases, source water
 28 concentrations were varied seasonally based on historical trends.

29 A key assumption for the mass-balance calculation is that the constituent acts in a conservative
 30 manner throughout the system, as the various source waters mix and flow through the Delta,
 31 although most behave, to some degree, in a nonconservative manner. For constituents where this
 32 assumption does not hold because of decay, uptake, or other losses, this mass-balance method
 33 would be expected to overestimate the actual concentrations at any given Delta location. The mass-
 34 balance method for calculating constituent concentrations in the Delta was validated in 2011 and
 35 2012 for chloride and bromide (MWH 2011; Liu and Suits 2012). There was one key difference,
 36 however, between the validation study methodology and the method used in this water quality
 37 assessment. In the validation study, the chloride and bromide concentrations for the Delta source
 38 waters (Sacramento River, San Joaquin River, East Side Streams, and San Francisco Bay/Martinez)
 39 were determined via regression equations relating the chloride or bromide concentration to
 40 modeled EC in the source waters. Thus, the source water concentration for chloride and bromide
 41 varied with each time step according to the EC at the boundaries. In this assessment, source water
 42 concentrations were not dependent on EC, but were either static (if review of historical data
 43 indicated little to no seasonality), or varied by month (if review of historical data indicated
 44 seasonality).

1 Because the bromide and chloride concentrations are relatively constant for the Sacramento River
 2 and East Side Streams, the mass-balance method is believed to be valid for modeling these. Likewise,
 3 although bromide and chloride from the San Joaquin River vary, the variations are small enough that
 4 for the purposes of this comparative study, the method is believed to be valid for San Joaquin River
 5 contributions to constituent concentrations in the Delta. However, this method does introduce
 6 uncertainty for areas influenced by San Francisco Bay contributions. This is because it is recognized
 7 that C_{BAY} in Equation 1 is dependent on flows in the Sacramento and San Joaquin Rivers as well as
 8 Delta exports (i.e., net Delta outflow), which may change due to climate change/sea level rise, and
 9 altered operations of the SWP/CVP system. It is also dependent on the tidal exchange volume, which
 10 may change as a result of restoration associated with CM4. However, beyond accounting for
 11 seasonal trends in the historical data, neither of these factors was taken into account in determining
 12 a constituent concentration for C_{BAY} . Therefore, for cases in which net Delta outflow increases or
 13 decreases relative to what has historically occurred, the constituent concentration used for C_{BAY} may
 14 overestimate or underestimate the concentrations associated with San Francisco Bay water (as
 15 measured at Martinez). Additionally, if restoration component CM4 increases tidal exchange volume,
 16 the value used for C_{BAY} would underestimate concentrations associated with San Francisco Bay
 17 water (as measured at Martinez).

18 Finally, it must be noted that no formal validation studies have been performed to validate the mass-
 19 balance method that was used for boron, mercury, methylmercury, nitrate, or selenium. The
 20 validation studies performed to date on conservative constituents (e.g., EC, chloride, bromide) have
 21 validated the approach for using DSM2 to evaluate changes in mixing of Delta source waters on
 22 water quality constituents. Although it is known that mercury, methylmercury, and selenium do not
 23 behave conservatively in the Delta, the mass-balance method is believed valid for assessing the
 24 impact of changed source water mixing on concentrations of these species, because the same mixing
 25 mechanisms apply to all dissolved constituents, and altered mixing of Delta source waters is one of
 26 the primary mechanisms by which the alternatives change water quality in the Delta. The model
 27 results are not meant to be taken as predictions of future mercury, methylmercury, or selenium
 28 concentrations, since known mechanisms such as sorption, settling, and transformation are not
 29 quantitatively taken into account, but rather are to be used to assess water quality differences
 30 between alternatives and to make determinations regarding potential effects on beneficial uses
 31 relative to assessment baselines.

32 ***Regression Method for Chloride and Bromide***

33 For chloride, the quantitative assessment applied relationships between EC and chloride developed
 34 based on historical water quality data to the DSM2 output for EC. This relationship was developed
 35 based on data at Mallard Island, Jersey Island, and Old River at Rock Slough (Contra Costa Water
 36 District 1997). The relationship was:

$$37 \quad Cl = \max \left(\begin{array}{l} 0.15 * EC - 12 \\ 0.285 * EC - 50 \end{array} \right) \quad (2)$$

38 In the equation above, Cl is the chloride concentration in mg/L, and EC is in $\mu\text{S}/\text{cm}$.

39 The chloride regression method was developed using data for the west Delta and is thus valid for
 40 that area (Contra Costa Water District 1997). The chloride regression method has not been validated
 41 for other areas of the Delta. However, chloride poses the greatest risk of environmental impacts
 42 under the alternatives in the west Delta where sea water intrusion has the greatest potential to
 43 increase chloride concentrations. If the results of this method indicated that there may be

1 environmental impacts in other areas of the Delta, further assessment was conducted to determine
2 if the method is valid or if another method is more appropriate.

3 For bromide, the same EC to chloride relationship was used, followed by a relationship between
4 chloride and bromide, to estimate bromide concentrations. The chloride to bromide relationship is
5 approximately the same in multiple areas in the west Delta, including Old River at Rock Slough
6 (Contra Costa Water District 1997), the intakes at Banks Pumping Plant (CALFED 2007a), and
7 Mallard Island (Appendix 8E, *Bromide*, Figure 1). The relationship used was:

$$8 \qquad \qquad \qquad Br = 0.0035 * Cl \qquad \qquad \qquad (3)$$

9 In the equation above, Br is the bromide concentration in mg/L, and Cl is the chloride concentration
10 in mg/L. The chloride-to-bromide regression method was developed based on west Delta ratios of
11 chloride to bromide that were indicative of sea-water influence, and so for the purposes of this
12 water quality assessment, is considered valid for that area. However, unlike chloride, bromide
13 concentrations in other areas of the Delta may pose environmental risk. Therefore, in areas outside
14 of the west Delta, further assessment was conducted when this method indicated a potential for
15 environmental risk in order to determine if the method was valid or if another method was more
16 appropriate.

17 Although the regression methods are valid for this water quality assessment where noted above,
18 uncertainty in the results is nonetheless present. The validation studies above describe
19 circumstances in which the model overestimates or underestimates water quality conditions at
20 various locations in the Delta. However, despite this, the methods are still considered valid for
21 comparison purposes as used in this assessment.

22 This alternative to the mass-balance method for calculating bromide and chloride concentrations in
23 the Delta is limited in the sense that the relationships described above are based on historical water
24 quality data that is representative of historical Delta hydrodynamics. It is unknown whether these
25 relationships will still apply in the future with sea-level rise, and particularly under an altered Delta
26 hydrodynamic regime (as would be expected under the action alternatives). Because each of the two
27 methods have limitations and uncertainty, there is no way to determine which method results in
28 more accurate estimates of chloride or bromide. Thus, where applicable (i.e., for west Delta
29 locations), both methods were applied and the results of both methods discussed. In general, when
30 the methods displayed disagreement, impacts were assessed based on the more conservative of the
31 two methods.

32 Both the mass-balance and regression methods include assumptions that limit their ability to
33 accurately account for bromide concentrations that would be likely to occur under project
34 implementation. Some of these include:

- 35 ● Projected sea level rise and climate change (i.e., changes in precipitation patterns and
36 snowpack),
- 37 ● Inability of the models to account for watershed sources of bromide,
- 38 ● Assumed footprint and design of restoration areas, and
- 39 ● Simplifications of restoration area geometry necessary to implement in DSM2.

1 Calculation of Use of Assimilative Capacity

2 The concept of assimilative capacity was used as a measure of the extent of water quality
 3 degradation that could occur under the alternatives, relative to water quality conditions under the
 4 baselines. Water quality degradation was assessed in order to address the Federal and State
 5 Antidegradation Policies, which state that existing instream water uses and the level of water quality
 6 necessary to protect the existing uses shall be maintained and protected (see Section 8.2.1.3 for a
 7 full discussion). Assimilative capacity is the capacity of a water body to experience increased levels
 8 of a water quality constituent without exceeding the adopted water quality criterion/objective. In
 9 practical terms, when levels or concentrations of a water quality constituent are below water quality
 10 criteria/objectives, use of available assimilative capacity by an action is the relative amount of water
 11 quality degradation that the action causes (i.e., causing an existing constituent concentration to
 12 increase such that its resulting concentration is now closer to, but still below the applicable
 13 criterion/objective). If the action causes sufficient degradation of water quality such that the
 14 resulting constituent level or concentration is now greater than the criterion/objective, then 100%
 15 of the available assimilative capacity would be “used” by the action, and thus no assimilative
 16 capacity would remain for that constituent.

17 In this assessment, assimilative capacity available under a baseline was calculated according to
 18 equation 2:

$$19 \quad A_{avail} = C_{WQO} - C_{base} \quad (2)$$

20 In the equation above, A_{avail} is the available assimilative capacity, C_{WQO} is the concentration of the
 21 water quality objective, and C_{base} is the concentration in the modeled baseline.

22 The amount of assimilative capacity used by an alternative was calculated according to equation 3:

$$23 \quad A_{used} = C_{ALT} - C_{base} \quad (3)$$

24 In the equation above, A_{used} is the assimilative capacity that was used under the alternative, relative
 25 to the baseline, and C_{ALT} is the concentration in the modeled alternative.

26 The determination of the percent use of available assimilative capacity under an alternative was
 27 dependent on the relative values of A_{used} and A_{avail} , and thus was calculated according to equation 4:

$$28 \quad -\frac{A_{used}}{A_{avail}} \times 100 \quad \text{for} \quad A_{used} \leq A_{avail} > 0$$

$$29 \quad \text{No Calculation} \quad \text{for} \quad A_{avail} \leq 0 \quad (4)$$

$$30 \quad -100 \quad \text{for} \quad A_{used} \geq A_{avail}$$

31 In the above equation, the second case in which no calculation was performed occurs when there is
 32 no assimilative capacity under the baseline (i.e., concentrations are above water quality objectives),
 33 in which case the concept of assimilative capacity is not a useful tool for assessing water quality
 34 changes. In the third case, all of the available assimilative capacity is used by the alternative, but the
 35 percent use of assimilative capacity is limited to what was initially available (i.e., cannot have
 36 greater than 100% use of available assimilative capacity).

1 Qualitative Assessments

2 Some constituents were assessed strictly qualitatively (Appendix 8C, *Screening Analysis*, Table SA-
 3 11) because: 1) insufficient historical monitoring data were available to adequately characterize the
 4 concentrations of the five source waters to the Delta (i.e., to accurately define the distribution of
 5 concentrations observed in the SAC, SJR, BAY, eastside tributaries, AGR), which are necessary to
 6 implement the quantitative mass-balance assessment approach described above; 2) the locations for
 7 which the constituent was assessed (within the affected environment) was outside of any available
 8 modeling domain, or available modeling tools were not appropriate for predicting constituent
 9 concentrations based on the physical, chemical, and/or biological properties and environmental fate
 10 and transport of the constituent. Nevertheless, the same conceptual framework was used for
 11 qualitatively assessing constituents of concern. Best available information regarding
 12 concentrations/levels in the Delta source waters was evaluated relative to how flow-fractions at
 13 various Delta locations would change under the alternatives, as defined by DSM2 model flow-
 14 fraction output (Appendix 8D, *Source Water Fingerprinting Results*), to estimate the relative
 15 frequency and magnitude of change expected for a given constituent at a specified location.

16 Additionally, assessments of the effects of implementing CM2–CM21 were qualitative, at a
 17 programmatic level, for all constituents. Construction-related water quality changes also were
 18 assessed qualitatively. Potential water quality effects of these generally specific and/or
 19 geographically localized actions were assessed by evaluating the anticipated type, duration, and
 20 geographic extent of construction activities to take place, and location and type of water bodies
 21 potentially affected. The potential for soil, sediment, and contaminants to be discharged to water
 22 bodies was determined by identifying construction practices and equipment that could be used,
 23 common materials or contaminants that may be present or be used for construction or construction
 24 equipment, and pathways by which contaminants may enter receiving waters, and measures to
 25 minimize or eliminate adverse construction-related effects on water quality.

26 8.3.1.4 SWP/CVP Export Service Areas

27 Assessment of water quality changes in the SWP/CVP Export Service Areas, which begin at the
 28 export pumps (i.e., Banks and Jones pumping plants) and extend to facilities receiving exported
 29 Delta water, was conducted for construction-related, operations-related, and restoration-related
 30 (CM2–CM21) effects.

31 Water quality changes in the SWP/CVP Export Service Areas were assessed both quantitatively and
 32 qualitatively. Water quality changes at the export pumps (i.e., Banks and Jones pumping plants)
 33 were quantified using DSM2 for EC and DOC and from mass-balance calculations based on DSM2
 34 flow-fraction output data and Delta source water quality data. Because DSM2 does not account for
 35 water sourced from the new north Delta intakes (that are part of all alternatives except Alternative
 36 9), modeled water quality at Banks and Jones pumping plants under the various alternatives was
 37 accounted for in post-processing the DSM2 data. For the Existing Conditions, No Action Alternative,
 38 and Alternative 9, no post-processing was necessary, since all of the exported water was from the
 39 existing south Delta intakes (i.e., “Through-Delta” conveyance). For all “Dual-Conveyance”
 40 alternatives (i.e., Alternatives 1A–5, 7, and 8), EC, DOC, and fingerprinting data at the export pumps
 41 were blended according to equation 5:

$$42 \quad \frac{Q_N C_N + Q_S C_S}{Q_N + Q_S} = C_{EXP} \quad (5)$$

1 In the equation above, Q_N is the flow diverted from the north Delta intakes to either Banks or Jones
 2 pumping plants, C_N is the value of the water quality parameter (EC, DOC, or fingerprinting for the 5
 3 source waters) in the Sacramento River at Green's Landing (used as representative of intake water
 4 quality), Q_S is the flow exported from the south Delta in either Banks or Jones pumping plants, C_S is
 5 the value of the water quality parameter at the existing south Delta intakes for the pumping plants,
 6 and C_{EXP} is the value of the water quality parameter in the exported water. For the "Isolated-
 7 Conveyance" alternative, Alternative 6, all water quality parameters for the exports at both pumping
 8 plants were set equal to the values in the Sacramento River at Green's Landing.

9 Water quality changes at the export pumps served as the basis for making determinations of water
 10 quality changes within the associated primary conveyance facilities, Delta-Mendota Canal and
 11 California Aqueduct, as well as the other locations within the service area outside of the Delta, such
 12 as San Luis Reservoir and reservoirs operated by southern California water purveyors. Water
 13 quality changes in the conveyance and terminus facilities were assessed qualitatively, with
 14 consideration of dilution, transformation, uptake, and loss to the extent such factors were applicable
 15 to the constituents evaluated.

16 8.3.1.5 Mercury and Selenium Bioaccumulation Assessment

17 Mercury and selenium are bioaccumulative constituents of concern in Delta waters. They also are
 18 listed as causes of impairment under the Clean Water Act Section 303(d), and a substantial amount
 19 is known about their fate and transport within the Delta or similar systems. Consequently, a specific
 20 analysis approach was developed for these two constituents.

21 Mercury and selenium concentrations in surface water were estimated at Delta assessment
 22 locations (Figure 8-51) as described previously in Section 8.3.1.3, *Plan Area*. Linkages between
 23 abiotic media (sediment and surface water, as applicable) and biological tissues (fish muscle, whole-
 24 body fish, and bird eggs) that provide an estimate of the potential bioaccumulation and impacts on
 25 ecological and human receptors were evaluated to determine the linkages with the greatest degree
 26 of confidence. Potential linkages explored included the following.

- 27 • **Literature-based regression models or bioaccumulation factors.** These resources provide a
 28 basis for estimating tissue concentrations for mercury and selenium from concentrations in
 29 surface water or sediment.
- 30 • **Site-specific linkages.** Methods were developed to describe existing relationships between
 31 waterborne concentrations of mercury and selenium at the nearest modeling nodes, existing
 32 sediment (for mercury), and fish tissue concentrations in an attempt to create predictive
 33 relationships for impact analysis and alternatives comparisons.
- 34 • **Delta methylmercury.** The TMDL translation equation for mercury (Central Valley Water
 35 Quality Board 2011b) was used to estimate fish tissue concentrations from waterborne
 36 concentrations. In addition, DSM2 water quality model predictions were investigated separately
 37 for their ability to predict measured fish tissue concentrations at discrete locations. The two
 38 translation models were compared for their predictive ability.
- 39 • **Delta selenium.** U.S. Geological Survey bioaccumulation and trophic transfer factors for uptake
 40 of selenium from water to the lowest trophic level (e.g., suspended particulates or algae) and
 41 from that level to invertebrates and then to fish and bird eggs developed by Presser and Luoma
 42 (2009, 2010a) were used initially to estimate uptake from water to fish and to bird eggs. In
 43 calibrating the Delta-wide bioaccumulation model for largemouth bass, the particulate selenium

1 concentration initially was estimated using a default K_d of 1,000 (K_d = particulate/water ratio;
2 Presser and Luoma 2010a). Because this first step in selenium bioaccumulation typically is
3 much more variable than other steps in the bioaccumulation model, the K_d was then adjusted to
4 calibrate the model so that the modeled concentrations for fish approximated the measured
5 concentrations in bass for normal and wet years (2000 and 2005) and for dry years (2007), as
6 described in Appendix 8M, *Selenium*, Section 8M.4. Initial modeling for fish was based on a
7 model calibrated for largemouth bass as the representative species because of the available data
8 for bass across the Delta. However, because there would be more bioaccumulation of selenium
9 by species such as sturgeon that feed in part on clams that are known to bioaccumulate
10 selenium readily in Suisun Bay, additional modeling was conducted for sturgeon in the western
11 Delta.

12 Adverse effects on ecological and human receptors were quantified through comparisons of
13 measured and modeled surface water, and tissue (fish [fillets for mercury; whole body and fillets for
14 selenium] and bird eggs [selenium only]) data to established benchmarks, including the following.

- 15 • Water quality objectives, criteria, and drinking water standards for mercury, methylmercury,
16 and selenium.
- 17 • Literature-derived effect levels for mercury, methylmercury, and selenium in fish fillets for
18 species most representative of the Delta.
- 19 • Literature-derived effect levels for selenium in whole-body fish for species most representative
20 of the Delta.
- 21 • Literature-derived effect levels for selenium in eggs of bird species most representative of the
22 Delta.
- 23 • State of California Office of Environmental Health Hazard Assessment's fish contaminant goals
24 and advisory tissue levels for mercury, methylmercury, and selenium.

25 The alternatives were evaluated with regard to potential adverse impacts on ecological and human
26 receptors through a weight-of-evidence approach. The Existing Conditions and each alternative
27 were evaluated for their potential to cause exceedances of water quality or tissue benchmarks and
28 for qualitative differences in the spatial extent of those exceedances. Exceedances of tissue
29 benchmarks were determined by evaluating exceedance quotients, which are ratios of the modeled
30 fish or bird egg tissue concentrations divided by the tissue benchmark (e.g., Level of Concern,
31 Toxicity Level, or Advisory Tissue Level) in similar units. Values over 1.0 indicate modeled tissue
32 concentrations exceed the lowest threshold (e.g., Level of Concern for selenium in whole-body fish
33 or in bird eggs) or potentially toxic levels of bioaccumulation (if there is exceedance of the higher
34 Toxicity Level benchmark). The water and tissue concentrations associated with modeled
35 alternatives were compared to modeled Existing Conditions and the No Action Alternative. In
36 addition, spatial changes in the extent of marshlands associated with each alternative (i.e., CM4–
37 CM10) were evaluated qualitatively for their potential to enhance mercury or selenium
38 bioavailability and risk.

1 **8.3.1.6 Summary of Methods Used to Assess Water Quality Changes**
2 **Related to Construction Activities, Conveyance Facilities**
3 **Operations and Maintenance, and Habitat Restoration and**
4 **Other Stressor-Related Conservation Measures/Environmental**
5 **Commitments**

6 The construction-related water quality changes associated with conveyance facilities and habitat
7 restoration and other stressor-related conservation measures/Environmental Commitments were
8 assessed qualitatively by evaluating the anticipated type, duration, and geographic extent of
9 construction activities to take place, and location and type of water bodies potentially affected. The
10 potential for soil, sediment, and contaminants to be discharged to water bodies was determined by
11 identifying best management/construction practices and equipment that could be used, common
12 materials or contaminants that may be present or be used for construction or construction
13 equipment, and pathways by which contaminants may enter receiving waters.

14 Actions associated with new conveyance facilities and operations criteria that resulted in water
15 quality changes associated with altered hydrodynamics, which were captured in the DSM2
16 modeling, were assessed quantitatively for all alternatives.

17 For the BDCP alternatives, restoration actions that would result in water quality changes associated
18 with altered hydrodynamics, which were captured in the DSM2 modeling, are discussed with
19 operations-related water quality changes of the conveyance facilities operations and maintenance.
20 For Alternatives 4A, 2D, and 5A, the small amount of restoration was not included in the DSM2
21 modeling. Restoration actions that could result in a potential increase in constituent loading (e.g.,
22 increased nutrient, organic carbon, or suspended solids) to the Delta region were assessed
23 qualitatively for all alternatives.

24 Certain conservation measures/Environmental Commitments address other stressors that may
25 affect water quality through reducing contaminants and reducing predators and other sources of
26 direct mortality to listed species. Changes in water quality associated with these other stressor-
27 related conservation measures/Environmental Commitments were assessed qualitatively under a
28 numbered impact separate from the numbered impact addressing effects of facilities operations and
29 maintenance.

30 Table 8-38 provides a summary of the methodologies used to assess water quality impacts that
31 could result from implementing the alternatives.

1 **Table 8-38. Summary of Methodologies Used for Water Quality Impact Analyses**

Project/Alternative Component	Available Models/ Techniques	Methodology Components		
		Upstream of the Delta	Plan Area	SWP/CVP Export Service Areas
Conveyance Facilities Operations and Maintenance	CALSIM II	Hydrologic changes (e.g., seasonal changes in reservoir storage and river flows) used to evaluate dilution effects on constituent levels in reservoirs and rivers.	CALSIM II hydrologic output served as input to the DSM2 model.	Operations of San Luis Reservoir.
	DSM2	NA	EC, DOC concentrations and flow fractions.	EC, DOC concentrations directly modeled at the south Delta export pumps
	Mass Balance Using Flow Fraction and Constituent Concentrations	NA	Estimated concentrations of constituents addressed quantitatively, other than EC and DOC, which are directly modeled by DSM2.	Estimated concentrations of constituents addressed quantitatively, other than EC and DOC, at the south Delta export pumps.
	Qualitative Analysis	All parameters. Qualitative approach determined whether constituent concentrations were correlated to reservoir storage or river flow levels.	For all parameters not addressed quantitatively (see Appendix 8C, Table SA-11). Qualitative approach varied based on constituent of concern and location, but attempted to estimate concentration changes attributable to the alternatives.	For all parameters not addressed quantitatively (see Appendix 8C, Table SA-11). Qualitative approach varied based on constituent of concern, but attempted to estimate concentration changes attributable to the alternatives.

Project/Alternative Component	Available Models/ Techniques	Methodology Components		
		Upstream of the Delta	Plan Area	SWP/CVP Export Service Areas
Habitat Restoration Conservation Measures/Environmental Commitments	DSM2	NA	BDCP alternatives: To degree possible, the DSM2 model simulated altered Delta hydrodynamics attributable to restoration tidal and riparian habitats (CM2-CM4). Alternatives 4A, 2D, and 5A: NA	BDCP alternatives: To degree possible, the DSM2 model simulated altered Delta hydrodynamics attributable to restoration tidal and riparian habitats (CM2-CM4). Alternatives 4A, 2D, and 5A: NA
	Qualitative Analysis	NA	Additional qualitative impact analysis of how restoration wetlands may affect specific constituent concentrations (e.g., DOC) in specific areas was provided.	Additional qualitative impact analysis of how restoration wetlands may affect specific constituent concentrations (e.g., DOC) at the south Delta pumps was provided.
	Qualitative Analysis	NA	Qualitative analysis of how temporary conveyance construction activities would affect water quality (e.g., turbidity, sedimentation) was provided.	Qualitative impact analysis of how conveyance construction activities may affect specific constituent concentrations (e.g., turbidity, nutrients) at the south Delta pumps was provided.
Other Stressor-related Conservation Measures/Environmental Commitments	Qualitative Analysis	NA	Qualitative analysis of how actions would affect water quality was provided.	Qualitative impact analysis of how the actions may affect specific constituent concentrations at specified locations was provided.
Construction of Conveyance Facilities and Conservation Measures/Environmental Commitments	Qualitative Analysis	NA	Qualitative impact analysis of how the actions may affect specific constituent concentrations at specified locations was provided.	Qualitative impact analysis of how the actions may affect specific constituent concentrations at specified locations was provided.

1

8.3.1.7 Constituent-Specific Considerations Used in the Assessment

Constituent-specific considerations that are common to the assessment of all project alternatives are discussed below. Water quality constituents are also discussed in Section 8.1, *Environmental Setting/Affected Environment*. Data in Section 8.1 is meant to characterize general conditions in the affected environment, and water quality criteria and objectives presented in Section 8.1 are a comprehensive set of all applicable criteria and objectives. In the sections below, the methodology for each constituent assessment is presented, and only historical data and water quality criteria and objectives that are applicable to the assessment are presented. A summary of methods used in the assessments, including the specific methodologies for the quantitative assessments, is shown in Table 8-38.

Construction-Related Water Quality Effects

Water quality effects associated with construction activities for all conservation measures (CM1–CM21) were assessed in a qualitative manner. The potential construction-related water quality effects were assessed considering many aspects of the work involved and potential environmental exposure to contaminants, including, but not limited to the following factors:

- Types of materials and contaminants that may be handled, stored, used, or produced at project facilities during project construction, and which could be released to the environment, and the related fate, transport, and harmful characteristics of the contaminants.
- Magnitude, timing, and duration of the potential contaminant discharges, and exposure sensitivity of water bodies and beneficial uses that could be affected by the discharge.
- Routes of exposure for contaminants, sediment and other constituents from the construction activity causing potential discharges to sensitive water bodies, including likelihood of seasonal exposure to rainfall and runoff, proximity of inland work to drainage ways, occurrence of direct instream discharges, and whether exposure would involve long-term effects of tidal flow in the estuary.

The assessment of potential water quality effects considered all of the beneficial uses. However, given the generally temporary and intermittent characteristics of construction and maintenance discharges, a focus of the assessment is on effects to aquatic life as the likely most sensitive beneficial uses in the receiving water (also refer to Chapter 11, *Fish and Aquatic Resources*, for additional discussion of the effects of construction). In particular, large or sudden increases in sediment, or contaminant concentrations in sediment from construction or operations/maintenance activities are most likely to affect short-term, sensitive water quality characteristics such as acute health responses of aquatic organisms and their habitats. Other beneficial uses, such as municipal/industrial water supplies, recreational activities, or livestock/agricultural irrigation, are generally anticipated to be less sensitive to short-term water quality disturbances.

Ammonia

For the purposes of this analysis, the U.S. EPA's 1999 National Recommended Water Quality Criteria for ammonia and the 2009 draft criteria were used. U.S. EPA's 2009 draft recommended criteria are more restrictive than its 1999 recommended criteria. Values derived for water at 25 °C and pH 8 are shown in Table 8-39, and were used as the reasonable worst case (i.e., most sensitive) criteria in the affected environment. The chronic criteria derived according to the 2009 draft documentation (0.26

1 mg/L-N) is also lower than the LOEL of 0.36 mg/L-N for chronic effects recently derived to *P. forbesi*,
2 a copepod within the affected environment (Teh et al. 2011:2).

3 A final relevant threshold includes a recommended goal for sensitive crops of 1.5 mg/L-N (Ayers
4 and Westcot 1994). It is assumed that ammonia is beneficial for crops at levels below this threshold,
5 and thus that any increases in ammonia-N concentrations that are below the 1.5 mg/L-N threshold
6 are generally not of concern for agriculture.

7 **Table 8-39. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for**
8 **Ammonia (mg N/L)**

	Region 5 Basin Plan	Region 2 Basin Plan ^a	California Toxics Rule	Drinking Water MCL	U.S. EPA Recommended Criteria	Other Relevant Thresholds
Ammonia-N	-	25	-	-	5.6/1.2 (1999) ^b 2.9/0.26 (2009) ^c	1.5 ^d , 0.36 ^e

Notes: MCL = maximum contaminant level; mg/L = milligrams per liter.

^a San Francisco Bay Regional Water Quality Control Board 2007. 25 mg/L 4-day average for ammonia-N.

^b First value represents acute, salmon present, second value represents chronic, fish early life stage s present, for water temperature 25 °C and pH 8.

^c First value represents acute, freshwater mussels present, second value represents chronic, freshwater mussels present, for water temperature 25 °C and pH 8.

^d Ayers and Westcot (1994). Recommended goals for sensitive crops

^e Lowest Observed Effect Level (LOEL) determined in Teh et al. 2011, for chronic effects on *P. forbesi*.

9
10 Figure 8-52 shows the seasonal levels of ammonia in the three major source waters to the Delta—
11 SAC, SJR, and BAY. The data indicate that SJR and BAY concentrations are similar during all months
12 of the year. SAC concentrations are greater than BAY or SJR virtually all of the time, being more
13 similar in January through March and much greater during the rest of the year. The high
14 concentrations of ammonia in SAC are a result of the SRWTP, which discharges into the Sacramento
15 River at Freeport. Ammonia concentrations upstream of the SRWTP are similar to those in BAY and
16 SJR (Central Valley Regional Water Quality Control Board 2010a:5). Thus, the primary way in which
17 project alternatives could affect ammonia concentrations is by altering flows in the Sacramento
18 River at Freeport, which would alter available dilution for ammonia from the SRWTP. Consequently,
19 the assessment of ammonia in the Plan Area focused on the changes in flows in the Sacramento
20 River at Freeport and the subsequent effects on dilution and ammonia concentrations downstream.

21 The SRWTP NPDES permit was renewed by the Central Valley Water Board on December 20, 2010.
22 The permit contains seasonal effluent limitations for ammonia-N of 1.5 mg/L on an average monthly
23 basis and 2.0 mg/L on a maximum daily basis for the months April through October, and of 2.4 mg/L
24 on an average monthly basis and 3.3 mg/L on a maximum daily basis for the months November
25 through March (Central Valley Regional Water Quality Control Board 2010b:14), that must be
26 achieved by May of 2021. In order to meet these limits, the SRWTP must be upgraded to include
27 nitrification. For the purposes of this assessment, assumptions were made regarding the status of
28 the upgrades under the various baselines, alternatives, and time-steps, and these are summarized in
29 Table 8-40.

Table 8-40. Assumptions on Status of Sacramento Regional Wastewater Treatment Plant Nitrification Upgrades under Assessment Scenarios

Scenario	Status of Upgrades	Average Monthly Effluent Limit for Ammonia, mg/L as N
Existing Conditions	No Upgrades	33
No Action Alternative (2060)	Upgrades Complete	1.5 (Apr–Oct) 2.4 (Nov–Mar)
Alternatives 1A–9 (2060)	Upgrades Complete	1.5 (Apr–Oct) 2.4 (Nov–Mar)

Note: mg/L = milligrams per liter.

Boron

Applicable boron objectives for the affected environment utilized in this assessment are summarized in (Table 8-41).

Table 8-41. Applicable Federal Criteria, State Objectives, and other Relevant Effects Thresholds for Boron

	Region 5 Basin Plan ^a	Region 2 Basin Plan	USEPA Recommended Criteria
Boron (µg/L)	800/2000 ^b 1,000/2,600 ^c 1,300 ^d	500/2,000 ^e 5,000 ^f	2,000/5,000 ^g

^a Basin Plan objectives apply to the lower San Joaquin River from the mouth of the Merced River to Vernalis (Central Valley Regional Water Quality Control Board 2009a).

^b Agricultural objective for March 15 through September 15 specified as (monthly average) / (maximum) concentration (except critical water years).

^c Agricultural objective for September 16 through March 14 specified as (monthly average) / (maximum) concentration (except critical water years).

^d Agricultural objective applicable year-round as a monthly average for critical water years.

^e Basin Plan agricultural objectives specified for irrigation as (threshold concentration) / (limit concentration) (San Francisco Bay Regional Water Quality Control Board 2007).

^f Basin Plan agricultural objective specified for stock watering (San Francisco Bay Water Board 2007).

^g Recommended human health advisory levels for long-term exposure through drinking water supplies specified in the form of (children)/(adults) (U.S. Environmental Protection Agency 2008b).

Sources of boron to Delta waters include the Sacramento River, the San Joaquin River, the Eastside tributaries, Delta agricultural return drains, and the San Francisco Bay. Among these sources, San Francisco Bay water contains the highest boron concentrations, followed by Delta agricultural returns, the San Joaquin River, the Sacramento River, and the Eastside tributaries (Table 8-42). Point source discharges containing boron contribute a small fraction of the boron burden to the lower San Joaquin River (Central Valley Regional Water Quality Control Board 2009a).

The lower San Joaquin River is listed on the State's CWA Section 303(d) list of impaired water bodies for salt and boron (State Water Resources Control Board 2011). Boron is paired with salt in this listing due to its regular association with saline waters. The Central Valley Water Board has prepared a TMDL with implementation program where it is assumed that actions taken to control salts also will control for boron as well (Central Valley Regional Water Quality Control Board 2004).

1 **Table 8-42. Historical Boron Concentrations in the Five Delta Source Waters**

Data Parameters	Source Water				
	Sacramento River	San Joaquin River	San Francisco Bay ^a	East Side Tributaries	Delta Agriculture Return Waters ^b
Mean micrograms per liter (µg/L)	100	349	880	68	492
Minimum (µg/L)	100	100	-	10	103
Maximum (µg/L)	200	1,100	-	250	1,192
75 th Percentile (µg/L)	100	400	-	100	584
99 th Percentile (µg/L)	100	918	-	244	1,159
Data source	DWR	DWR	Paulsen and List (1997) and DWR	USGS	DWR
Station(s)	Sacramento River at Greene's Landing, Sacramento River at Hood	San Joaquin River at Vernalis	Martinez and Sacramento River at Mallard Island	Cosumnes River	- ^b
Date range	1986–2009	1986–2009	1986–2009	1953–1977	1987–2001
ND replaced with RL ^c	Yes	No	No	Yes	Yes
Data omitted	Two data points assumed to be in error (1,900 µg/L, 1,000 µg/L)	None	None	None	None
No. of Data Points	468	483	265	60	339

^a No data available for boron at Martinez in any of the available data sets. Paulsen and List (1997) measured boron daily at Martinez from 4/13/96–8/29/96. Paulsen and List (1997) lists only the mean, minimum, and maximum concentrations found. However, extensive boron data was available for the Sacramento River at Mallard Island (i.e., DWR MWQI program data for 1986–2009) which indicated a strong seasonal concentration pattern in the western Delta. Consequently, to estimate the seasonal monthly average boron concentrations at Martinez, the monthly average mean values for Mallard Island were multiplied by the ratio of the average Martinez (Paulsen and List 1997) to long term average Mallard Island mean concentrations. Refer to Appendix 8F, Table Bo-1, for additional information and tabulation of the calculated monthly average boron concentrations for the Bay source water.

^b Agricultural return drains are distributed unevenly throughout the Delta. Water quality associated with these drains varies depending on the specific location of the drain within the Delta, and largely coincides with the water quality of the water that is withdrawn from the Delta for application onto agricultural lands. In order to characterize boron concentrations in agricultural drain water as a whole, the following process was followed:

All boron data from those agricultural drains from the DWR Water Data Library, which had historical boron data, were placed into a database.

The drains were assigned a region in the Delta according to their location (Central, North, East, South, and West)

Three drains from each region were chosen at random, and the data from each of these drains was downloaded. The stations selected included: Ag Drain on Jersey Island, Ag Drain on King Island, Pumping Plant (PP.) No. 1, Ag Drain on King Island, PP. No. 2, Ag Drain on Orwood Tract, Ag Drain on Palm Tract, Ag Drain on Pescadero Tract, PP. No. 3, Ag Drain on Pescadero Tract, PP. No. 4, Ag Drain on Rindge Tract, PP. No. 1, Ag Drain on Twitchell Island, PP. No. 1, Ag Drain on Pescadero Tract, PP. No. 1

To derive an overall mean, minimum, maximum, 75th, and 95th percentile, the mean, minimum, maximum, 75th and 95th percentiles of the individual drain averages was calculated.

The process was an attempt to derive values that were representative of the Delta as a whole, regardless of how many drains in each region had data, and how many data points existed at each drain.

^c In some cases, data were reported as non-detections (ND), and the entry contained an accompanying reporting limit (RL). "Yes" indicates that at least one non-detection was replaced with the reporting limit in order to calculate summary statistics, while "No" indicates that this was not done, generally because no data were reported as non-detection.

2

1 Because of boron's elemental nature, it is considered a conservative constituent, not subject to
2 degradation through volatilization, breakdown, or uptake as it moves through the system. Boron,
3 however, does adsorb to mineral soils and organic matter, which allows for its accumulation in soils
4 irrigated with water containing boron. Because of its ability to leach through soils, this partitioning
5 can be considered temporary; therefore, the assessment of potential impacts from boron assumes
6 that mass is generally conserved. Consequently, boron concentrations at any location in the Delta
7 primarily reflect the mass balance of the flow and concentrations of the major water sources.
8 Therefore, a quantitative mass-balance approach using the source water flow fractions from the
9 DSM2 model output and source water concentrations was used to estimate boron concentration
10 changes that would occur with the alternatives. The long-term average source water concentrations
11 were used for most locations in the mass-balance assessment; however, due to the presence of a
12 distinct seasonal pattern in the boron concentrations of the San Francisco Bay source water at the
13 interface with the Delta in relation to seasonal Delta outflow pattern, monthly average
14 concentrations were used for this location. Additionally, sample data for boron at the Martinez
15 location were limited to literature values for the annual average concentration, whereas substantial
16 monthly data were available for the Sacramento River at Mallard Island. Consequently, monthly
17 average Martinez concentrations were estimated by simple linear extrapolation of the monthly
18 average Mallard Island concentrations by the ratio of the annual average Mallard Island to Martinez
19 concentration.

20 The mass-balance modeling results were used to compare predicted changes in assessment
21 variables (e.g., exceedances of objectives/criteria, amount of water quality degradation relative to
22 boron, and contribution to 303(d) impairment effects). The assessment of effects relative to
23 applicable objectives/criteria for the protection of agricultural beneficial uses was based on changes
24 in monthly average concentrations modeled for all water year types for the 16-year (1976–1991)
25 hydrologic period of record and for the drought years only (i.e., 1987–1991), and the effects relative
26 to municipal and industrial water supply was based on changes in annual average concentrations for
27 the modeled 16-year and drought periods.

28 The implementation of CM4 would restore substantial areas of tidal habitat that is expected to
29 increase the magnitude of daily tidal water exchange at the restoration areas, and could alter other
30 hydrodynamic conditions in adjacent Delta channels. San Francisco Bay water is a substantial source
31 of boron, thus, the increased tidal exchange resulting from tidal habitat restoration may increase
32 boron concentrations in the portion of the Bay water that enters the western Delta. The DSM2
33 modeling included assumptions regarding possible locations of tidal habitat restoration areas, and
34 how restoration would affect Delta hydrodynamic conditions and source water flow fractions.
35 However, the magnitude of increased boron concentrations in Bay source water in the western Delta
36 as a result of increased tidal exchange is uncertain. Consequently, the potential effects of tidal
37 restoration on boron concentrations in the Bay source water was assessed qualitatively based on
38 predicted changes in the Bay source water fraction. The effects of other conservation measures (i.e.,
39 CM2, CM3, and CM5–CM21) which do not substantially affect flows or Delta hydrodynamic
40 conditions, also were assessed qualitatively.

1 Bromide

2 Bromide concentrations at a particular location and time in the Delta are determined primarily by
3 the sources of water to that location, at a given time. Hence, long-term average concentrations at a
4 particular Delta location are determined primarily by the long-term average sources of water to that
5 location, and the long-term average concentration of bromide in each of the major source waters to
6 the location. The major source waters to any given Delta location are: (1) Sacramento River, (2) San
7 Joaquin River, (3) Bay water, (4) eastside tributaries, and (5) agricultural return water.

8 Bromide is not routinely monitored in surface water samples collected north of the Delta, primarily
9 due to the low concentration of bromide in this region. Data available for the American River
10 suggests that bromide concentrations are <10 µg/L. Table 8-43 provides a summary of bromide
11 concentrations in the primary source waters of the Delta, as well as information on the source of the
12 data and summary statistics. Due to the quality and quantity of data available, as well as the
13 conservative nature of the constituent, a quantitative assessment utilizing a mass-balance approach
14 was employed in the assessment of alternatives. Additionally, results of a second modeling approach
15 utilizing EC to chloride and chloride to bromide relationships were used to supplement the results of
16 the mass-balance approach (see Section 8.3.1.3, *Plan Area*). Because bromide is a precursor to the
17 formation of DBPs which represent a long-term risk to human health, and because the existing
18 source water quality goal is based on a running annual average, the quantitative assessment focuses
19 on the degree to which an alternative may result in change in long-term average bromide
20 concentrations at various locations throughout the affected environment. For municipal intakes
21 located in the Delta interior, assessment locations at Contra Costa Pumping Plant No.1 and Rock
22 Slough are taken as representative of Contra Costa's intakes at Rock Slough, Old River and Victoria
23 Canal, and the assessment location at Buckley Cove is taken as representative of the City of
24 Stockton's intake on the San Joaquin River. Municipal intakes at Mallard Slough, City of Antioch, and
25 the North Bay Aqueduct are represented by their respective assessment locations. For the purposes
26 of this assessment, bromide concentrations for water transported into the SWP/CVP Export Service
27 Areas are assessed based on concentrations at the primary SWP and CVP Delta export locations (i.e.,
28 Banks and Jones pumping plants).

29 As demonstrated in Table 8-43, achieving the CALFED goal of 50 µg/L bromide at drinking water
30 intakes is challenged by the bromide concentrations in two main source waters to the Delta, the San
31 Joaquin River and San Francisco Bay (seawater), where long-term average concentrations exceed
32 this goal many fold. In establishing its source water goal for bromide, CALFED assumed more
33 stringent DBP criteria for treated drinking water than are currently in place. Source water with
34 bromide between 100 µg/L and 300 µg/L is believed sufficient to meet currently established
35 drinking water criteria for DBPs, depending on the amount of *Giardia* inactivation required
36 (California Urban Water Agencies 1998, ES2). This assessment of alternatives evaluates how each
37 alternative would affect the frequency with which predicted future bromide concentrations would
38 exceed 50 µg/L (based directly on the CALFED goal) and 100 µg/L (based on the lower limit of the
39 range considered sufficient for meeting currently established drinking water criteria) on a long-
40 term average basis at the assessment locations. Because, in many cases, existing bromide
41 concentrations in Delta water bodies already exceed 50 µg/L, the focus of the assessment is on the
42 frequency with which bromide would exceed 100 µg/L, as well as the change in long-term average
43 bromide concentration.

1 As described in Section 8.3.1.3, *Plan Area*, there are uncertainties present in the two modeling
2 approaches used to estimate bromide concentrations that would occur under the action alternatives.
3 Regardless of whether the modeling may have overestimated or underestimated bromide
4 concentrations that would occur under the alternatives, the modeling results allow for making
5 determinations of whether concentrations would increase or decrease under a particular
6 alternative, by comparing the modeled concentrations under the alternative to concentrations
7 modeled for Existing Conditions and the No Action Alternative. 4Thus, for bromide, the magnitude of
8 change in long-term average bromide concentrations in addition to the comparison of exceedance of
9 the 100 µg/L threshold served as the basis for the impact determinations in the EIR/EIS. Because
10 100 µg/L is at the low end of the range of concentrations considered sufficient to meet current
11 drinking water criteria for DBPs, the assessment is conservative relative to potential impacts on
12 drinking water treatment facilities.

13 The modeling relies on several assumptions that could have large impacts on the predicted level of
14 seawater intrusion. The two most major assumptions are: 1) the assumed level of sea level rise and
15 2) the assumed restoration area footprints used in the modeling. Changes in either of these
16 assumptions would likely affect predicted bromide concentrations at Barker Slough. Additionally,
17 DSM2 is known to not account well for local diversions and returns in the Barker Slough area, and
18 the assumed modeled pumping schedule for the Barker Slough Pumping Plant may not accurately
19 reflect actual operations. Local diversions and returns, as well as the pumping schedule, can affect
20 Barker Slough hydrodynamics, but it is unknown whether these factors would play a major role in
21 Barker Slough bromide concentrations under the alternatives.

1 **Table 8-43. Source Water Concentrations for Dissolved Bromide ($\mu\text{g/L}$)**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay ^a	Eastside Tributaries	Agriculture in the Delta
Mean micrograms per liter ($\mu\text{g/L}$)	15	251	13,149–32,951	16	456
Minimum ($\mu\text{g/L}$)	1	20	28–17,465	14	20
Maximum ($\mu\text{g/L}$)	100	650	33,985–44,100	17	2,720
75 th Percentile ($\mu\text{g/L}$)	20	345	22,313–38,500	NA	580
99 th Percentile ($\mu\text{g/L}$)	44	565	22,313–38,500	NA	1,850
Data Source	DWR	DWR	BDAT	BDAT	DWR
Station(s)	Sac River at Greene's Landing, Sac River at Hood	San Joaquin River at Vernalis	^b	Mokelumne River at Sacramento Road	^c
Date Range	1990–2009	1990–2009	1980–2007	1990–1990	1990–2001
Non-Detections Replaced with Reporting Limit	Yes	No	No	No	No
Data Omitted	None	None	None	None	Yes ^d
No. of Data Points	560	547	26–27	2	991

Notes: BDAT = Bay Delta and Tributaries Project; DWR = California Department of Water Resources.

^a Values reported as range of monthly values (minimum monthly–maximum monthly). Trends in monthly average bromide at Martinez suggested a seasonality to concentration. Due to the appearance of seasonality in monthly average concentration at this location, average monthly concentration was used. Actual monthly values for the dataset are provided in Appendix 8E, *Bromide*, Table 1.

^b Measured bromide data at Martinez was not available for this analysis. Bromide data at Martinez was estimated from the regressed relationship of bromide to chloride at Mallard Island (Appendix 8E, *Bromide*, Figure 1). The empirical relationship of bromide to chloride obtained at Mallard Island was similar to that of ocean water (Morris and Riley 1966), or 0.0035 parts bromide to 1 part chloride. Bromide data at Martinez used in this analysis therefore represents measured Martinez chloride multiplied by a factor of 0.0035.

^c Values calculated from all agriculture drain data pooled together. All bromide data from agricultural drains contained in the DWR Water Data Library were placed into a single database. Due to the uneven distribution of agricultural drains in the Delta, geographical trends in agricultural drain water quality were evaluated by categorizing the data based on their associated location in the Delta. Categories included western, southern, northern, eastern, and central Delta, following the geographical delineations of the State Water Resources Control Board. With data pooled and categorized by region, average concentration by region were compared. Average bromide varied by less than a factor of 3, with highest concentration in the southern Delta and lowest in the central Delta. No bromide data was available for the northern Delta. Due to the apparent low regional variability, values were obtained by pooling all data together and obtaining summary statistics from this pooled database.

^d Data for the Byron Tract #2 and Byron Tract #3 agricultural drains were omitted from the database due to their reported values being substantially outside the distribution of all other values. These values were: 65,000 $\mu\text{g/L}$ and 46,800 $\mu\text{g/L}$. In total, 2 data points were omitted and 991 were retained.

2

1 Chloride

2 As an inorganic anion, chloride is generally conservative in the aquatic environment and its fate and
3 transport characteristics are similar to other salinity constituents. Consequently, chloride
4 concentrations at any location in the Delta primarily reflect the mass balance of the flow and
5 concentrations of the major water sources. Therefore, a quantitative mass-balance approach using
6 the source water flow fractions from the DSM2 model output and source water concentrations was
7 used to estimate chloride concentration changes that would occur as a result of implementation of
8 the project alternatives.

9 In addition, under Alternatives 1A-C, 2A-C, 3, 4, 5, 6A-C, 7, 8, and 9, the implementation CM4 would
10 restore substantial areas of tidal habitat that would increase the magnitude of daily tidal water
11 exchange at the restoration areas, and could alter other hydrodynamic conditions in adjacent Delta
12 channels. San Francisco Bay water is a major source of chloride, thus, the increased tidal exchange
13 resulting from tidal habitat restoration may increase chloride concentrations in the portion of the
14 Bay water that enters the western Delta. The DSM2 modeling for these alternatives included
15 assumptions regarding possible locations of tidal habitat restoration areas, and how restoration
16 would affect Delta hydrodynamic conditions and source water flow fractions. However, the
17 magnitude of increased chloride concentrations in Bay source water in the western Delta as a result
18 of increased tidal exchange is uncertain. Consequently, the potential effects of tidal restoration on
19 chloride concentrations in the Bay source water was assessed qualitatively based on predicted
20 changes in the Bay source water fraction.

21 The effects of other conservation measures (i.e., CM2, CM3, and CM5-CM21) under Alternatives 1A-
22 C, 2A-C, 3, 4, 5, 6A-C, 7, 8, and 9, and Environmental Commitments under Alternatives 4A, 2D, and
23 5A, which do not substantially affect flows or Delta hydrodynamic conditions, were assessed
24 qualitatively.

25 Applicable chloride objectives for the affected environment utilized in this assessment are
26 summarized in Table 8-44. The mass-balance modeling results were used to compare predicted
27 changes in assessment variables (e.g., exceedances of objectives/criteria, amount of water quality
28 degradation relative to chloride) based on averaging periods appropriate for each relevant
29 beneficial use. Results of a second modeling approach utilizing relationships between EC and
30 chloride were used to supplement those results (see Section 8.3.1.3, *Plan Area*). The assessment of
31 effects relative to designated beneficial uses and associated water quality objectives/criteria was
32 based on changes in long-term average concentrations modeled for all water year types for the 16-
33 year (1976-1991) hydrologic period of record and for the drought years only (i.e., 1987-1991).
34 Compliance for some applicable objectives/criteria are based on short-term averaging period
35 concentrations; e.g., daily data for Bay-Delta WQCP objectives for municipal and industrial water
36 supply for specific locations in the Delta (e.g., daily data). The available monitoring data for source
37 water chloride concentrations are not adequate to characterize daily variability, and the channel
38 flows modeled in CALSIM, which provides the hydrologic input to the DSM2 model, are on a monthly
39 time-step. Therefore, the mass-balance approach can only be used for monthly average assessment,
40 and thus for the chloride assessment cannot be used to evaluate exceedances of the 150 mg/L
41 objective, and can only evaluate exceedances of the 250 mg/L objective on a monthly average basis
42 instead of a daily average basis. Consequently, the assessment of potential effects of alternatives
43 relative to the 150 mg/L objective was based only on daily chloride data obtained via the EC to
44 chloride relationships and DSM2 EC output (as described in Section 8.3.1.3). Relative to the 250

1 mg/L objective, assessment was based on both monthly average concentrations from the mass-
2 balance approach and daily average concentrations from the EC to chloride relationship approach.

3 Understanding the uncertainties and limitations in the modeling and assessment approach is
4 important for interpreting the results and effects analysis, including assessment of compliance with
5 water quality objectives. Please refer to Section 8.3.1.1, *Models Used and Their Linkages*, and Section
6 8.3.1.3, *Plan Area*, for a description of these limitations. In light of these limitations, the assessment
7 of compliance is conducted in terms of assessing the overall direction and degree to which Delta
8 chloride would be affected relative to a baseline, and discussion of compliance does not imply that
9 the alternative would literally cause Delta chloride to be out of compliance a certain period of time.
10 In other words, the model results are used in a comparative mode, not a predictive mode. The fact
11 that modeling shows potential violations does not mean that under real time operations such
12 violations would actually occur in the real world.

13 The U.S. EPA has also published recommended national aquatic life criteria for chloride (Table 8-
14 44). This recommended chloride criterion is not used in the assessment of Delta effects for several
15 reasons. Firstly, the U.S. EPA recommended chloride criterion is only applicable to freshwater, and
16 its appropriate application in a dynamic estuary such as the Delta is uncertain. Secondly, the
17 national recommended criterion is currently being revised by U.S. EPA. New toxicity studies have
18 resulted in a different understanding of species sensitivities in freshwater, and have revealed a
19 hardness and sulfate dependence (i.e., similar to that of trace metals) that was not taken into
20 consideration in the drafting of the most current criterion. Thirdly, with regard to aquatic life
21 beneficial uses in the Delta, the State has taken the approach of regulating salinity through the
22 establishment of EC objectives. Chloride is a major component of salinity, as measured by EC. Effects
23 on compliance with EC-related aquatic life objectives is addressed for each project alternative
24 relative to model predicted changes in Delta EC. In addition, salinity-based project alternative effects
25 to covered and uncovered fish species, invasive benthic invertebrates, invasive aquatic vegetation,
26 and cyanobacteria (blue-green algae) are addressed in Chapter 11, *Fish and Aquatic Resources*.

1 **Table 8-44. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for Chloride (mg/L unless specified)**

Location	Bay-Delta Water Quality Control Plan	Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL	U.S. EPA Recommended Criteria
<i>All Receiving Waters Other Than the Delta</i>	--	250 ^{a, b} 500 ^{a, c} 600 ^{a, d}	142/355 ^e 250 ^{a, b} 500 ^{a, c} 600 ^{a, d}	250 ^b 500 ^c 600 ^d	230/860 ^f
<i>Delta-Specific</i>					
Contra Costa Canal @ Pumping Plant No. 1 or San Joaquin River @ Antioch Water Works Intake	Year Type	Objective ^g	--	--	--
	W	<150–240 days/calendar year (66%)			
	AN	<150–190 days/calendar year (52%)			
	BN	<150–175 days/calendar year (48%)			
	D	<150–165 days/calendar year (45%)			
Contra Costa Canal @ Pumping Plant #1, West Canal @ Mouth of Clifton Court Forebay, Jones Pumping Plant, Barker Slough @ North Bay Aqueduct, and Cache Slough @ the City of Vallejo Intake	250 (Oct.–Sep.) ^h		--	--	--

Notes: Water year types: W = wet; AN = above normal; BN = below normal; D = dry; C = critical. mg/L = milligrams per liter.

^a State secondary maximum contaminant level (MCL) incorporated by reference in the Basin Plan. No fixed consumer acceptance contaminant level has been established. Municipal water systems must monitor for compliance based on a running average of four quarterly values. The Region 5 Basin Plan incorporates the MCLs by reference, but do not specify an averaging period for assessment of compliance.

^b Recommended Contaminant Level for the state secondary MCL. Constituent concentrations lower than the recommended contaminant level are desirable for a higher degree of consumer acceptance.

^c Upper Contaminant Level for the state secondary MCL. Constituent concentrations ranging to the upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.

^d Short Term Contaminant Level for the state secondary MCL. Constituent concentrations ranging to the short term contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.

^e Objectives for agricultural water supply identified in Basin Plan as a “threshold value/limit value”; no averaging period is defined for assessment of compliance.

^f U.S. EPA National Recommended Water Quality Criteria specified as Criterion Continuous Concentration (CCC)/Criteria Maximum Concentration (CMC).

^g Municipal and industrial water supply beneficial use objective, specified as a maximum mean daily value for at least the number of days shown during the calendar year. Must be provided in intervals of not less than two weeks duration (percentage of calendar year shown in parentheses).

^h Municipal and industrial water supply beneficial use objective, specified as a maximum mean daily value to be applied year-round for all water year types.

2

1 Table 8-45 provides a summary of chloride concentrations in the primary source waters of the Delta
 2 used for the mass-balance approach, as well as information on the source of the data and summary
 3 statistics. The long-term average source water concentrations were used for most locations in the
 4 mass-balance assessment; however, due to the presence of a distinct seasonal pattern in the chloride
 5 concentrations of the San Francisco Bay source water at the interface with the Delta in relation to
 6 seasonal Delta outflow pattern, monthly average concentrations were used for this location.

7 **Table 8-45. Historical Chloride (Dissolved) Concentrations in the Five Delta Source Waters**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay ^a	East Side Tributaries	Delta Agriculture Return Waters ^b
Mean (mg/L)	6.38	81.4	3,757–9,414	2.36	136
Minimum (mg/L)	1.00	1.00	8–4,990	0.30	3.0
Maximum (mg/L)	33.0	221	9,710–12,600	8.60	830
75 th Percentile (mg/L)	8.00	111	6,375–11,000	3.05	175
99 th Percentile (mg/L)	12.3	186	9,643–1,2574	5.79	636
Data Source	DWR, BDAT	DWR, BDAT	BDAT	USGS	DWR
Station(s)	Sac River at Greene’s Landing, Sac River at Hood	San Joaquin River at Vernalis	Suisun Bay at Bulls Head near Martinez	Mokelumne River, Cosumnes River	^b
Date Range	1980–2009	1980–2009	1980–2007	1952–1994	1987–2001
ND Replaced with RL	No	No	No	No	No
Data Omitted	None	None	None	Single <0.1 value from each data set, 0 values from Cosumnes River	None
No. of Data Points	867	844	26–27	391	1,543

Notes: BDAT = Bay Delta and Tributaries Project; DWR = California Department of Water Resources; mg/l = milligrams per liter; ND = non-detections; RL = reporting limit; USGS = U.S. Geological Survey.

^a Values reported as range of monthly values (minimum monthly–maximum monthly). Review of available sample data for the Martinez location suggests that there is a generally seasonal trend in monthly average chloride concentration.

Chloride concentrations used to represent San Francisco Bay water in the mass-balance assessment were determined on a monthly average basis. Refer to Appendix 8G, Table CI-61, for additional information and tabulation of the calculated monthly average chloride concentrations for the Bay source water.

^b Values calculated from all agriculture drain data pooled together. All chloride data from agricultural drains contained in the DWR Water Data Library were placed into a single database.

8

9 Seasonal or long-term changes in chloride concentrations at western Delta locations would be
 10 associated with changes in the location of the tidal mixing zone and interface of the elevated Bay salt
 11 water and freshwater Delta outflow. Changes in the salt water/freshwater interface may result in
 12 shifts of the acceptability of a location between freshwater- and salinity-tolerant aquatic fish,
 13 aquatic vegetation, and other aquatic organisms. The significance of these potential effects relative
 14 to applicable freshwater and estuarine water quality objectives is not assessed in the chloride
 15 assessment. Rather, the reader is referred to Chapter 11, *Fish and Aquatic Resources*, for the detailed
 16 assessment of changes in the location of the tidal mixing zone (e.g., as measured by the location of
 17 X2) and for its impact(s) to aquatic life beneficial uses.

1 **Dissolved Oxygen**

2 DO levels in the reservoirs and rivers upstream of the Delta are primarily affected by water
 3 temperature, flow velocity, turbulence, amounts of oxygen demanding substances present (e.g.,
 4 ammonia, organics), and rates of photosynthesis (which is influenced by nutrient levels),
 5 respiration, and decomposition. Water temperature and salinity affect the maximum DO saturation
 6 level (i.e., the highest amount of oxygen the water can dissolve). Flow velocity affects the turbulence
 7 and re-aeration of the water (i.e., the rate at which oxygen from the atmosphere can be dissolved in
 8 water). High nutrient content can support aquatic plant and algae growth, which in turn generates
 9 oxygen through photosynthesis and consumes oxygen through respiration and decomposition.

10 Effects of the alternatives on temperature in the Delta relative to the No Action alternative were not
 11 considered in the DO assessment. This is because, as stated in the USFWS (2008b:194) Operations
 12 Criteria and Plan BiOp:

13 The [state and federal] water projects have little if any ability to affect water temperatures in the
 14 Estuary (Kimmerer 2004). Estuarine and Delta water temperatures are driven by air temperature.
 15 Water temperatures at Freeport can be cooled up to about 3°C by high Sacramento River flows, but
 16 only by very high river flows that cannot be sustained by the projects. Note also that the cooling
 17 effect of the Sacramento River is not visible in data from the west Delta at Antioch (Kimmerer 2004)
 18 so the area of influence is limited.

19 Since Delta water temperatures are driven by air temperature, climate change (as included in the No
 20 Action Alternative and all action alternatives) that increases air temperatures relative to existing
 21 conditions would be expected to increase water temperatures in the Delta as well. Effects of climate
 22 change on air and Delta water temperatures are discussed in Appendix 29C, *Climate Change and the*
 23 *Effects of Reservoir Operations on Water Temperatures in the Study Area*. In general, waters of the
 24 Delta would be expected to warm less than 5 degrees F, which translates into a < 0.5 mg/L decrease
 25 in DO.

26 The DO assessments were conducted in a qualitative manner based on anticipated changes in these
 27 factors.

28 Additionally, concerns have been raised that the project may increase flows on the San Joaquin River
 29 at Stockton, causing the location of the minimum DO point to shift downstream (see Section 8.1.3.6,
 30 *Dissolved Oxygen*, for a discussion of the existing DO impairment in the Stockton Deep Water Ship
 31 Channel). To assess this possibility, flows in San Joaquin River at Stockton were evaluated.

32 **Electrical Conductivity**

33 EC and TDS values tend to be highly correlated, because the majority of chemicals that contribute to
 34 TDS are charged particles that impart conductance of water. Because EC measurement is easily
 35 conducted with a portable meter, as compared to the requirement for physical sample collection and
 36 laboratory gravimetric analysis for TDS, the majority of water quality regulatory criteria/objectives
 37 are established for EC. Moreover, where regulatory objectives for TDS exist, they co-occur with the
 38 equivalent EC value (i.e., there are no independent TDS-only regulatory criteria/objectives or
 39 guidance values). EC also is the parameter modeled to represent salinity in DSM2. Therefore, this
 40 impact assessment for "salinity" as indicated by EC and TDS is based on EC values only and TDS is
 41 not addressed separately.

42 Applicable EC objectives for the affected environment utilized in this assessment are summarized in
 43 Table 8-46.

1 **Table 8-46. Applicable State Objectives and Other Relevant Effects Thresholds for Electrical Conductivity (µmhos/cm[at 25°C] unless specified)**

Location	Bay-Delta Water Quality Control Plan	Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL
<i>All Receiving Waters Other than the Delta</i>	--	900 ^{a, b}	200–3,000 ^e	900 ^{a, b}
		1,600 ^{a, c}	900 ^f	1,600 ^{a, c}
		2,200 ^{a, d}		2,200 ^{a, d}
<i>Delta-Specific</i>	<u>Year Type</u>	<u>Objective^s for Agricultural Beneficial Uses</u>		
Western Delta– Sacramento River at Emmaton	Wet (W)	450 (Apr. 1–Aug. 15)	--	--
	Above Normal (AN)	450 (Apr. 1–Jun. 30); 630 (Jul. 1–Aug. 15)		
	Below Normal (BN)	450 (Apr. 1–Jun. 19); 1,140 (Jun. 20–Aug. 15)		
	Dry (D)	450 (Apr. 1–Jun. 14); 1,670 (Jun. 15–Aug. 15)		
	Critical (C)	2,780 (Apr. 1–Aug. 15)		
Western Delta– San Joaquin River at Jersey Point	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Jun. 19); 740 (Jun. 20–Aug. 15)		
	D	450 (Apr. 1–Jun. 14); 1,350 (Jun. 15–Aug. 15)		
	C	2,200 (Apr. 1–Aug. 15)		
Interior Delta– South Fork Mokelumne River at Terminous	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Aug. 15)		
	D	450 (Apr. 1–Aug. 15)		
	C	540 (Apr. 1–Aug. 15)		
Interior Delta– San Joaquin River at San Andreas Landing	W	450 (Apr. 1–Aug. 15)	--	--
	AN	450 (Apr. 1–Aug. 15)		
	BN	450 (Apr. 1–Aug. 15)		
	D	450 (Apr. 1–Jun. 24); 580 (Jun. 25–Aug. 15)		
	C	870 (Apr. 1–Aug. 15)		

Location	Bay-Delta Water Quality Control Plan				Region 5 Basin Plan	Region 2 Basin Plan	Drinking Water MCL
Southern Delta	<u>Objective for Agricultural Beneficial Uses</u>				--	--	-
	700 (Apr. 1–Aug. 31)						
	1,000 (Sep. 1–Mar. 31) ^h						
Export Area	<u>Objective for Agricultural Beneficial Uses</u>				--	--	--
	1,000 (Oct. 1–Sep. 30) ⁱ						
San Joaquin River at and between Prisoners Point and Jersey Point	<u>Objective for Fish and Wildlife Beneficial Uses</u>				--	--	--
	440 (Apr. 1–May 31) ^j						
Eastern Suisun Marsh (Sacramento River at Collinsville; Montezuma Slough at National Steel; Montezuma Slough near Beldon’s Landing)	<u>Month</u>	<u>Objective^k for Fish and Wildlife Beneficial Uses</u>			--	--	--
	Oct	19,000					
	Nov–Dec	15,500					
	Jan	12,500					
	Feb–Mar	8,000					
	Apr–May	11,000					
Western Suisun Marsh (Chadbourne Slough at Sunrise Duck Club, Suisun Slough [300 feet south of Volanti Slough], Cordelia Slough at Ibis Club, Goodyear Slough at Morrow Island Clubhouse, and water supply intakes for water fowl management areas on Van Sickle and Chipps Island)	<u>Month</u>	<u>Objective^l</u>	<u>Month</u>	<u>Objective^m for Fish and Wildlife Beneficial Uses</u>	--	--	--
	Oct	19,000	Oct	19,000			
	Nov	16,500	Nov	16,500			
	Dec	15,500	Dec–Mar	15,600			
	Jan	12,500	Apr	14,000			
	Feb–Mar	8,000	May	12,500			
	Apr–May	11,000					

1

1 Notes for Table 8-46

-
- ^a State secondary maximum contaminant level (MCL). No fixed consumer acceptance contaminant level has been established. Municipal water systems must monitor for compliance based on a running average of four quarterly values. The Region 5 Basin Plan incorporates the MCLs by reference, but do not specify an averaging period for assessment of compliance.
 - ^b Recommended Contaminant Level. Constituent concentrations lower than the recommended contaminant level are desirable for a higher degree of consumer acceptance.
 - ^c Upper Contaminant Level. Constituent concentrations ranging to the upper contaminant level are acceptable if it is neither reasonable nor feasible to provide more suitable waters.
 - ^d Short Term Contaminant Level. Constituent concentrations ranging to the short term contaminant level are acceptable only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.
 - ^e Objectives for agricultural water supply specified as a “limit” consisting of a range of concentrations and no averaging period is defined for assessment of compliance.
 - ^f Objective for municipal supply.
 - ^g Agricultural objective is a 14-day running average of mean daily electrical conductivity (EC).
 - ^h Agricultural objective is a maximum 30-day running average of mean daily EC. Objectives applicable to all southern Delta channels and specified compliance stations (i.e., San Joaquin River at Airport Way Bridge-Vernalis, San Joaquin River at Brandt Bridge, Old River near Middle River, and Old River at Tracy Road Bridge).
 - ⁱ Agricultural objective is a maximum monthly average of mean daily EC. Compliance stations are West Canal at Mouth of Clifton Court Forebay and Delta-Mendota Canal at Tracy Pumping Plant.
 - ^j Fish and wildlife objective is a maximum 14-day running average of mean daily EC.
 - ^k Fish and wildlife objectives for Sacramento at Collinsville, Montezuma Slough at National Steel, and Montezuma Slough near Beldon’s Landing. Compliance based on maximum monthly average of both daily high tide EC values, or demonstrate that equivalent of better protection will be provided at the location. Applies in all water year types except during deficiency period.
 - ^l Fish and wildlife objectives for Chadbourne Slough at Sunrise Duck Club, Suisun Slough (300 feet south of Volanti Slough), Cordelia Slough at Ibis Club, Goodyear Slough at Morrow Island Clubhouse, and water supply intakes for water fowl management areas on Van Sickle and Chippis Island. Compliance based on maximum monthly average of both daily high tide EC values, or demonstrate that equivalent of better protection will be provided at the location. Applies in all water year types except during deficiency period.
 - ^m A deficiency period is: (1) the second consecutive dry water year following a critical year; (2) a dry water year following a year in which the Sacramento River Index (described in footnote e) was less than 11.35; or (3) a critical water year following a dry or critical water year. The determination of a deficiency period is made using the prior year’s final Water Year Type determination and a forecast of the current year’s Water Year Type; and remains in effect until a subsequent water year is other than a Dry or Critical water year as announced on May 31 by the California Department of Water Resources and U.S. Bureau of Reclamation as the final water year determination.
-

2

1 The assessment of effects on EC in the reservoirs and rivers upstream of the Delta was qualitative,
 2 and evaluates changes in EC based on anticipated changes in EC-contributing sources in the
 3 watersheds under the various project alternatives assessed.

4 The assessment of hydrodynamic effects of the project alternatives operations on EC in the Plan
 5 Area relied on DSM2 output. Because under Alternatives 1A-C, 2A-C, 3, 4, 5, 6A-C, 7, 8, and 9
 6 implementation CM4 would restore substantial areas of tidal habitat that would increase the
 7 magnitude of daily tidal water exchange at the restoration areas, and could alter other
 8 hydrodynamic conditions in adjacent Delta channels, the DSM2 modeling for these alternatives
 9 included assumptions regarding possible locations of tidal habitat restoration areas, and how
 10 restoration would affect Delta hydrodynamic conditions and source water flow fractions.

11 The effects of other conservation measures (i.e., CM3 and CM5-CM21) under Alternatives 1A-C, 2A-
 12 C, 3, 4, 5, 6A-C, 7, 8, and 9, and Environmental Commitments under Alternatives 4A, 2D, and 5A,
 13 which do not substantially affect Delta hydrodynamic conditions, were assessed qualitatively.

14 DSM2 directly models Delta EC levels on a 15-minute interval. DSM2 output for EC was post-
 15 processed to compare results to the Bay-Delta WQCP objectives at the following locations.

- 16 • Western Delta: Sacramento River at Emmaton and San Joaquin River at Jersey Point
- 17 • Interior Delta: South Fork Mokelumne River at Terminous, San Joaquin River at San Andreas
 18 Landing, and San Joaquin River at Prisoners Point
- 19 • Southern Delta: San Joaquin River at Vernalis, San Joaquin River at Brandt Bridge, Old River near
 20 Middle River, and Old River at Tracy Road Bridge

21 For the assessment of Alternatives 1A-3 and 5-9, the Sacramento River at Emmaton compliance
 22 location is relocated to Threemile Slough near the Sacramento River. For comparing effects of the
 23 alternatives on EC in this portion of the Delta, two comparisons were made.

- 24 • Changes in EC in the Sacramento River at Emmaton under the alternatives are compared to EC
 25 at Emmaton under Existing Conditions and the No Action Alternative.
- 26 • Changes in EC in Threemile Slough under the alternatives are compared to EC at Emmaton
 27 under Existing Conditions and the No Action Alternative.

28 Alternative 4 does not include a change in compliance point from Emmaton to Threemile Slough.
 29 However, modeling was originally performed for Alternative 4 assuming the compliance point did
 30 shift from Emmaton to Threemile Slough. To understand the impact of maintaining the compliance
 31 point at Emmaton under Alternative 4, sensitivity analysis model runs were performed. These are
 32 discussed in the assessment of Alternative 4 to contextualize Alternative 4 results.

33 The western and interior Delta EC objectives are expressed as a 14-day running average, and the
 34 southern Delta EC objectives are expressed as a 30-day running average. Compliance with these EC
 35 objectives was assessed by calculating 14-day and 30-day running averages of the 15-minute DSM2
 36 EC results and tallying the number of days out of compliance with the applicable objective. The Bay-
 37 Delta WQCP considers all days in an averaging period out of compliance, if the objective is exceeded
 38 on the last day of the averaging period. Because this could overestimate the general change in EC at
 39 compliance locations, the number of days the running average EC objective was exceeded was also
 40 assessed to identify general trends in EC changes under the alternatives assessed.

1 Some of the EC objectives are dependent on water year type. It must be noted that 3 of the 16 water
2 years in the simulation change in the late long term, as compared to Existing Conditions, as a result
3 of climate change. For each year of the DSM2 simulation for each scenario, the water year type that
4 was used to define the objective was the water year type for the time step of interest. Thus, for the
5 late long-term scenarios, compliance was based on the objective defined according to the late long
6 term water year types, and for Existing Conditions compliance was based on the objective defined
7 according to the Existing Conditions water year types.

8 The effects on EC in SWP/CVP Export Service Areas also relied on DSM2 output. For assessment of
9 alternatives involving conveyance of north Delta water to the Banks and Jones pumping plants,
10 DSM2 results for the south Delta pumping plant locations were blended, or mass-balanced, with
11 modeled north Delta diversions to provide an estimate of the EC of the water conveyed by these
12 pumping plants to the SWP/CVP Export Service Areas south of the Delta. The resulting blended
13 monthly mean EC levels were compared to the Bay-Delta WQCP objectives for the export areas,
14 which are the objectives for protection of the agricultural beneficial uses in the south Delta
15 SWP/CVP Export Service Areas.

16 Assessment of Suisun Marsh EC was conducted qualitatively, utilizing average EC for the entire
17 period modeled (1976–1991) to determine the overall change and degree to which EC could be
18 affected by the alternatives. The Suisun Marsh locations utilized in the analysis correspond to the EC
19 compliance locations in the Bay-Delta WQCP: Sacramento River at Collinsville, Montezuma Slough at
20 National Steel, Montezuma Slough near Beldon’s Landing, Chadbourne Slough at Sunrise Duck Club,
21 and Suisun Slough 300 feet south of Volanti Slough. These locations represent a geographic range
22 from which to assess changes.

23 The assessment of Bay-Delta WQCP EC objectives showed exceedances of these objectives at several
24 locations under Existing Conditions, No Action, and project alternatives. Understanding the
25 uncertainties and limitations in the modeling and assessment approach is important for interpreting
26 the results and effects analysis, including assessment of compliance with water quality objectives.
27 Please refer to Section 8.3.1.1, *Models Used and Their Linkages*, and Section 8.3.1.3, *Plan Area*, for a
28 description of these limitations. In light of these limitations, the assessment of compliance is
29 conducted in terms of assessing the overall direction and degree to which Delta EC would be
30 affected relative to a baseline, and discussion of compliance does not imply that the alternative
31 would literally cause Delta EC to be out of compliance a certain period of time. In other words, the
32 model results are used in a comparative mode, not a predictive mode.

33 Furthermore, there are several factors related to the modeling approach that may result in modeling
34 artifacts that show objective exceedance, when in reality no such exceedance would occur.
35 Sensitivity analyses and further other analyses were performed to evaluate whether exceedances
36 were indeed modeling artifacts or were potential project related impacts that may actually occur.
37 The sensitivity analysis modeling runs were limited to the Existing Conditions, No Action
38 Alternative, and Alternative 4 Scenario H3, but the findings from these analyses can generally be
39 extended to other scenarios of Alternative 4 and the other project alternatives. These analyses
40 included modeling runs investigating the impact of: changing the Emmaton electrical conductivity
41 compliance location to Threemile Slough, monthly-daily patterning at the Delta boundary locations,
42 including the Montezuma Slough Salinity Control Gates under the alternatives, removing 65,000
43 acres of Delta restoration (as a means of understanding the contribution to exceedances of
44 restoration vs. CM1), and revising head of Old River Barrier operations during April–May.
45 Additionally, evaluation of individual exceedances at Emmaton was conducted to determine the

1 most likely cause of each exceedance. A complete discussion of the sensitivity analysis modeling
2 runs performed and the results for EC is included in Appendix 8H, *Electrical Conductivity*,
3 Attachment 1.

4 **Mercury and Methylmercury**

5 Mercury is an element of concern for the Delta, its tributaries, Suisun Marsh, and San Francisco Bay
6 because of contamination from historical upstream sources originating from mercury mines in the
7 Coast Ranges (via Putah and Cache creeks to the Yolo Bypass) and gold extraction processes in the
8 Sierra Nevada (via Sacramento, San Joaquin, Cosumnes, and Mokelumne river sources) (Alpers et al.
9 2008; Wiener et al. 2003). Examples of primary mercury sources include mercury ore tailings (e.g.,
10 Cache Creek) or elemental mercury from gold field use (e.g., Eastside tributaries). The mercury
11 supplied from historical gold mining processes appears to be the most bioavailable of the two
12 primary sources (Central Valley Regional Water Quality Control Board 2008a). Although
13 atmospheric deposition is a source of mercury, none of the proposed actions affect that source and
14 in the case of the California Central Valley, mining sources completely dominate loading (Central
15 Valley Regional Water Quality Control Board 2011b).

16 The bioavailability and toxicity of mercury (from whatever primary source) is greatly enhanced
17 through the natural, bacterial conversion of mercury to methylmercury in marshlands or wetlands.
18 These stagnant locations with reduced oxygen concentrations promote chemical reduction
19 processes that make methylation possible.

20 Areas of enhanced bioavailability and toxicity of mercury (created through the mercury methylation
21 process) exist in the Delta, and elevated mercury concentrations in fish tissue produce subsequent
22 exposure and risk to humans and wildlife. Consequently, the beneficial uses (Table 8-1) most
23 directly affected by mercury include shellfish harvesting and commercial and sport fishing activities
24 that pose a human health concern, and wildlife habitat and Rare, Threatened, and Endangered
25 species resources that can be exposed to bioaccumulation of mercury. Because of these concerns,
26 mercury was the first TMDL approved for San Francisco Bay in 2007 (San Francisco Bay Water
27 Board 2006), and a methylmercury TMDL was promulgated for the Delta (Central Valley Regional
28 Water Quality Control Board 2011b). The Delta, many direct tributaries to the Delta (i.e., Sacramento
29 River, San Joaquin River, Mokelumne River, Putah Creek, and Calaveras River), and downstream
30 areas (e.g., Suisun Bay and Suisun Marsh) are listed as impaired water bodies on the Clean Water Act
31 Section 303(d) lists for mercury in fish tissue (State Water Resources Control Board 2011).

32 This section summarizes the potential impacts from project-related changes to concentrations of
33 mercury and methylmercury in water and estimated changes to fish tissue concentrations of
34 mercury. A model was developed linking methylmercury concentrations in water to concentrations
35 in Largemouth Bass muscle tissue. Bass tissue mercury concentrations were estimated for each
36 location and time step based on the co-located waterborne methylmercury concentration estimates
37 from DSM2. Details are provided in Appendix 8I, *Mercury*. Refer also to Chapter 25, *Public Health*, for
38 discussion of the effects of mercury to human health.

39 Applicable mercury objectives for the affected environment for waterborne concentrations are
40 summarized in Table 8-47. In evaluating the potential effects of waterborne mercury as measured
41 by percentage change in assimilative capacity, only total mercury concentrations are judged against
42 the lowest mercury objective of 25 ng/L; all estimates of methylmercury concentrations in water
43 already exceed recommended objectives of 0.06 ng/L and, therefore, no assimilative capacity exists

1 for that compound and no comparable percentage changes in assimilative capacity were used in the
2 evaluation of differences among alternatives.

3 **Table 8-47. Applicable Federal Criteria, State Objectives, and Other Relevant Effects Thresholds for**
4 **Mercury and Methylmercury in Water**

Analyte	CTR ^a	USEPA Recommended Criteria ^b	Delta Methylmercury TMDL ^c	San Francisco Bay Mercury TMDL ^d
Mercury (ng/L)	50	770	–	25
Methylmercury (ng/L)	–	–	0.06	–

Notes: CTR = California Toxics Rule; ng/L = nanograms per liter; TMDL = total maximum daily load.

^a Criterion for the protection of human health from total recoverable mercury in freshwater (U.S. Environmental Protection Agency 2012b).

^b Criterion for the protection of chronic exposure from total mercury to freshwater aquatic life (U.S. Environmental Protection Agency 2012b).

^c The recommended water column TMDL concentration of methylmercury for the protection of fish bioaccumulation (Central Valley Regional Water Quality Control Board 2008a).

^d The recommended water column 4-day average TMDL concentration for total mercury (U.S. Environmental Protection Agency 2012b).

5
6 Fish tissue concentrations were evaluated in relation to the Delta methylmercury TMDL tissue
7 targets of 0.24 mg mercury/kg wet-weight of largemouth bass filets (muscle tissue) for fish
8 normalized to a standard 350 mm total length (Central Valley Regional Water Quality Control Board
9 2011b). The normalization is necessary because of the strong dependence of tissue mercury
10 concentrations on fish size and age; all fish tissue mercury results presented in this document are
11 length-normalized. It is assumed that impact evaluations relative to this established locally derived
12 toxicity limit will provide an appropriate surrogate for effects of bioaccumulated mercury exposure
13 to humans and wildlife from fish consumption and relative impacts on the fish. Most measured and
14 modeled (current and future) fish tissue concentrations of mercury exceed the TMDL tissue target
15 levels. Formulation of the fish tissue mercury model and comparisons between measured and
16 modeled fish tissue results are provided in Appendix 8I, *Mercury*. The Central Valley Water Board
17 TMDL water/tissue translation model as well as a model specifically developed using DSM2 water
18 outputs to predict fish tissue concentrations are compared in Appendix 8I.

19 Water quality data from the Delta and Suisun Marsh include records of mercury and methylmercury
20 waterborne concentrations as total or filtered water fractions. Water quality summary information
21 since 1999 is shown in Table 8-48 and Table 8-49. The general pattern of mercury waterborne
22 loading to the Delta shows the dominance of mercury mining sources via Cache Creek and Yolo
23 Bypass (Central Valley Regional Water Quality Control Board 2011c); however, the waterborne
24 average concentrations do not reflect the same pattern as loads (Table 8-48). Instead, the Eastside
25 tributary streams and San Joaquin River show higher mercury and methylmercury concentrations
26 than the Sacramento River inputs.

1 **Table 8-48. Historical Mercury Concentrations in the Five Delta Source Waters for the Period 1999–**
 2 **2008**

Data Parameters	Source Water									
	Sacramento River ^a		San Joaquin River ^a		San Francisco Bay ^a		East Side Tributaries ^a		Agriculture within the Delta ^b	
Mean (ng/L)	4.1	–	7.6	0.8	7.8	–	8.6	1.4	6.5	–
Minimum (ng/L)	1.2	–	3.1	0.3		–	0.3	1.4	–	–
Maximum (ng/L)	30.6	–	21.7	3.0		–	26.2	1.4	–	–
75 th Percentile (ng/L)	5.5	–	8.6	1.2		–	7.5	1.4	–	–
99 th Percentile (ng/L)	24.2	–	17.4	2.8		–	25.2	1.4	–	–
Data Source	CVRWQCB – 2008 ^a		BDAT 2010; CVRWQCB 2008 ^a	BDAT 2010; USGS 2010	SFEI – 2010		CVRWQCB – 2008 ^a	USGS 2010	CVRWQCB – 2008 ^a	
Station(s)	Sacramento River at Freeport		San Joaquin River at Vernalis		Martinez		Mokelumne and Calaveras Rivers ^{b,c}	Cosumnes River ^d	Mid-Delta locations, median	
Date Range	1999–2002 –		2000–2004	2000–2002	2007 –		2000–2001; 2003–2004	2002	2008	
ND Replaced with RL	Not applicable		Not applicable		–		Not applicable		Not applicable	
Data Omitted	None		None		–		None		None	
No. of Data Points	45	–	49	19	–	–	25	1	–	–

Sources: Bay Delta and Tributaries Project (BDAT) 2010; Central Valley Regional Water Control Board (CVRWQCB) 2008a; San Francisco Estuary Institute (SFEI) 2010; U.S. Geological Survey (USGS) 2010.

Notes: Means are geometric means. ND = non-detection; ng/L = nanograms per liter; RL = reporting limit.

^a The total recoverable concentration of the analyte is presented in first cell and the dissolved concentration of the analyte is presented in the second cell.

^b Mokelumne River at Interstate 5.

^c Calaveras River at rail road upstream of West Lane.

^d Cosumnes River at Michigan Bar.

3

1 **Table 8-49. Historical Methylmercury Concentrations in the Five Delta Source Waters for the Period**
 2 **2000–2008**

Source Water	Sacramento River ^a		San Joaquin River ^a		San Francisco Bay ^a		East Side Tributaries ^a		Agriculture within the Delta ^a	
Mean (ng/L)	0.10	0.03	0.15	0.03	0.032	-	0.22	0.08	0.25	
Minimum (ng/L)	0.05	0.03	0.09	0.01	-	-	0.02	0.02	-	-
Maximum (ng/L)	0.24	0.03	0.26	0.08	-	-	0.32	0.41	-	-
75 th Percentile (ng/L)	0.12	0.03	0.18	0.06	-	-	0.20	0.15	-	-
99 th Percentile (ng/L)	0.23	0.03	0.26	0.08	-	-	0.31	0.39	-	-
Data Source	CVRWQCB 2008a		BDAT 2010; CVRWQCB 2008a	BDAT 2010; CVRWQCB 2008a; USGS 2010	SFEI 2010	-	CVRWQCB 2008a	CVRWQCB 2008a; USGS 2010	CVRWQC B 2008a	-
Station(s)	Sacramento River at Freeport		San Joaquin River at Vernalis		Martinez	-	Mokelumne and Calaveras Rivers	Mokelumne and Cosumnes Rivers	Mid-Delta locations, median	
Date Range	2000– 2000 2003	2000– 2000 2001;	2000– 2000 2001;	2000– 2002 2003–2004	2007	-	2000–2001; 2003–2004	2000; 2002	2008	-
ND Replaced with RL	Not applicable		Not applicable	Yes	-	-	Yes	Yes	Not applicable	
Data Omitted	None		None		-	-	None	None	None	
No. of Data Points	36	1	49	25	-	-	27	9	-	-

Sources: Bay Delta and Tributaries Project (BDAT) 2010; Central Valley Regional Water Control Board (CVRWQCB) 2008a; San Francisco Estuary Institute (SFEI) 2010; U.S. Geological Survey (USGS) 2010.

Notes: Means are geometric means. ND = non-detection; ng/L = nanograms per liter RL = reporting limit.

^a The total recoverable concentration of the analyte is presented in first cell and the dissolved concentration of the analyte is presented in the second column.

3

4 Nitrate

5 Applicable nitrate objectives for the affected environment utilized in this assessment are
 6 summarized in Table 8-50. The 5 mg/L-N threshold is for irrigation water as recommended by
 7 Ayers and Westcot (1994), who recommend a value of 5 mg/L nitrate-N for sensitive crops (e.g.,
 8 sugar beets, grapes, apricot, citrus, avocado, grains). The concern for these crops is that too much
 9 nitrate may cause greater growth than desired, diluting sugars and flavors and thus lowering the
 10 value of the crop. However, at levels below 5 mg/L-N, it is assumed that nitrate is beneficial for these
 11 crops, and thus increases below the 5 mg/L-N threshold are generally not of concern for agriculture.
 12 This 5 mg/L-N Ayers and Westcot (1994) threshold has not been identified as a recommended
 13 criterion by U.S. EPA, nor has it been adopted by the state as a water quality objective.

1 **Table 8-50. Applicable Federal Criteria, State Objectives, and other Relevant Effects Thresholds for**
 2 **Nitrate (mg N/L)**

	Region 5 Basin Plan	Region 2 Basin Plan ^a	California Toxics Rule	Drinking Water MCL	USEPA Recommended Criteria	Other Relevant Thresholds ^b
Nitrate-N	–	30 100	–	10	10 ^c	5

Notes: MCL = maximum contaminant level; mg/L = milligrams per liter; USEPA = U.S. Environmental Protection Agency.

^a San Francisco Bay Water Board (2007). 30 mg/L nitrate-N criterion for irrigation water; 100 mg/L nitrate-N criterion for livestock watering.

^b Ayers and Westcot (1994). Recommended goals for sensitive crops.

^c For the consumption of water and organisms.

3
 4 Table 8-51 characterizes nitrate concentrations in source waters to the Delta. Data indicate that the
 5 San Joaquin River and agriculture within the Delta contain the highest nitrate concentrations, while
 6 concentrations in the Sacramento River, San Francisco Bay, and East Side Tributaries are
 7 considerably lower. Both the Sacramento and San Joaquin Rivers exhibit seasonal patterns in nitrate
 8 concentration.

9 Nitrate does not behave conservatively in the environment. It can be created via conversion from
 10 ammonia to nitrate and can be taken up and metabolized by organisms and sediments. However,
 11 because nitrate concentrations vary considerably between the source waters to the Delta,
 12 conservative modeling via DSM2 and the mass-balance approach described in Section 8.3.1.3, *Plan*
 13 *Area*, was employed to provide a characterization of changes in nitrate concentration anticipated as
 14 a result of changes in source water fractions throughout the Delta alone (using mean concentrations
 15 from Table 8-51). Addition and loss mechanisms are considered qualitatively in the context of the
 16 quantitative mixing results to characterize changes in nitrate concentrations under the alternatives
 17 assessed.

18 As discussed in Section 8.1.3.10, *Nitrate/Nitrite and Phosphorus*, a host of biological and physical
 19 factors affect algal species composition and abundance in the Delta. For algal species in general, and
 20 *Microcystis* in particular, the research describing the link between nutrient concentrations/ratios
 21 and toxic algal blooms is not conclusive about the type of effect small changes in nutrient levels or
 22 nutrient ratios would have on such algal blooms (see also Section 8.1.3.18, *Microcystis*). Our ability
 23 to model changes in nutrient ratios attributable to the project is limited by a lack of availability of a
 24 suitable model. Changes in nitrate levels that can be estimated using conservative mixing (i.e., no
 25 uptake, loss or transformation) models are small enough that predictions of what these changes
 26 would mean to the makeup of algal communities or to changes in the N:P ratio would be speculative.
 27 Further, since the Delta is thought to be light limited and nutrients are in excess relative to algal
 28 growth requirements, these types of changes would not be expected to measurably change the
 29 quantity or composition of algae in the Delta. While temperature can affect the rates of creation and
 30 loss of nitrate in the affected environment, as discussed above for DO, temperature is not expected
 31 to change substantially under the project alternatives, relative to the No Action Alternative.
 32 Temperature increases due to climate change, relative to Existing Conditions, are expected to be <
 33 5°F, which is not considered a great enough change to substantially affect nitrate levels.

1 **Table 8-51. Nitrate Concentrations in the Source Waters to the Delta**

Source Water	Sacramento River ^a	San Joaquin River ^a	San Francisco Bay	East Side Tributaries	Agriculture within the Delta ^{a, b}
Mean (mg/L as N)	0.068–0.209	0.791–1.839	0.07	0.17	0.059–3.833
Minimum (mg/L as N)	0.023–0.113	0.068–1.175	0.026	0.010	0.002–0.339
Maximum (mg/L as N)	0.136–0.553	2.123–3.614	0.12	1.70	0.135–54.644
75 th Percentile (mg/L as N)	0.09–0.248	1.017–2.169	0.09	0.16	0.068–4.516
99 th Percentile (mg/L as N)	0.122–0.545	1.992–3.479	0.12	0.99	0.133–34.182
Data Source	DWR	DWR	SFEI	USGS	DWR
Station(s)	Sac River at Greene’s Landing, Sac River at Hood	San Joaquin River at Vernalis	BD40 (Just west of Carquinez Straight)	Mokelumne River, Cosumnes River	See footnote ^b
Date Range	1997–2008	1990–2009	1993–2001	1961–1993	1990–2001
ND Replaced with RL	No	No	No	No	Yes
Data Omitted	Data prior to 1992 (EPA Method 353.2; poor detection limit)	Two values > 9 mg/L as N	None	Values reported as “0”	None
No. of Data Points	25–33	29–35	25	45	5–81

Notes: DWR = California Department of Water Resources; mg/L = milligrams per liter; ND = non-detection; RL = reporting limit; SFEI = San Francisco Estuary Institute; USGS = U.S. Geological Survey.

^a Values reported as range of monthly values (minimum monthly–maximum monthly). Trends in monthly average nitrate at these locations suggested a seasonality to concentration. Due to the appearance of seasonality in monthly average concentration at these locations, average monthly concentration was used. Tables of these parameters by month are show in Appendix 8J, *Nitrate*.

^b Values calculated from all agriculture drain data pooled together. All nitrate data from agricultural drains contained in the DWR Water Data Library were placed into a single database. Due to the uneven distribution of agricultural drains in the Delta, geographical trends in agricultural drain water quality were evaluated by categorizing the data based on their associated location in the Delta. Categories included western, southern, northern, eastern, and central Delta, following the geographical delineations of the State Water Resources Control Board. With data pooled and categorized by region, average concentration by region were compared. Average nitrate did not vary greatly between regions. Due to the apparent low regional variability, values were obtained by pooling all data together and obtaining summary statistics from this pooled database.

2

3 **Organic Carbon**

4 While existing goals and action threshold for organic carbon as a DBP precursor are expressed as
5 TOC, it is the dissolved fraction, expressed as DOC, which is the focus of the organic carbon
6 assessment. As previously stated, 85–90% of Delta TOC is in the DOC or “dissolved” form. Further,
7 while the relative potency of organic carbon as a DBP precursor can vary considerably across
8 samples (CALFED Bay-Delta Program 2008a:5), in the Delta it is generally believed that the
9 dissolved fraction (i.e., DOC) most frequently influences DBP formation potential (CALFED Bay-Delta
10 Program 2007b:5–22). Even within the DOC fraction, DBP formation can vary considerably,
11 indicating that the nature of the organic matter that comprises DOC in a sample is important.
12 Nevertheless, DOC is considered a more accurate surrogate for DBP formation relative to TOC or
13 POC.

1 Given the strong link between THM and HAA formation potential and organic carbon, THM and HAA
 2 formation potential will not be assessed separately, but rather the assessment of organic carbon
 3 addresses concerns regarding THM and HAA formation potential.

4 Table 8-52 provides a summary of DOC concentrations for the Sacramento and San Joaquin Rivers as
 5 utilized for DSM2 boundary conditions. As discussed in Section 8.3.1.1, *Models Used and their*
 6 *Linkages*, DSM2 was utilized directly to model and predict DOC at 11 locations across the Delta, and
 7 the degree DOC changed under the various project alternatives. Because DOC is a precursor to the
 8 formation of DBPs which represent a long-term risk to human health, and because the existing
 9 source water quality goal is based on a running annual average, the quantitative assessment focuses
 10 on the degree to which an alternative may result in change in long-term average DOC concentrations
 11 at select locations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas.
 12 For municipal intakes located in the Delta interior, assessment locations at Contra Costa Pumping
 13 Plant No.1 and Rock Slough are taken as representative of Contra Costa's intakes at Rock Slough, Old
 14 River and Victoria Canal, and the assessment location at Buckley Cove is taken as representative of
 15 the City of Stockton's intake on the San Joaquin River. Municipal intakes at Mallard Slough, City of
 16 Antioch, and the North Bay Aqueduct are represented by their respective assessment locations. For
 17 the purposes of this assessment, effects within the SWP/CVP Export Service Areas are assessed
 18 based on DOC concentrations at the primary SWP and CVP Delta export locations (i.e., Banks and
 19 Jones pumping plants). DOC in the Delta is generally considered to act conservatively; thus, the
 20 mass-balance modeling approach employed. Moreover, the POC fraction would be largely removed
 21 through conventional drinking water treatment (State Water Project Contractors Authority 2007:3–
 22 19).

23 **Table 8-52. Monthly Average Dissolved Organic Carbon Utilized in DSM2 Modeling for Sacramento**
 24 **and San Joaquin River Source Waters (mg/L)**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Sacramento at Hood	1.8	2.3	2.9	3.0	2.9	2.7	2.4	2.0	1.8	1.8	1.8	1.8
San Joaquin at Vernalis	3.4	3.5	3.6	4.7	4.8	4.7	3.9	3.4	3.4	3.4	3.4	3.4

25
 26 In establishing its source water goal for organic carbon, CALFED assumed more stringent DBP
 27 criteria for treated drinking water than are currently in place. Source water with TOC between 4 and
 28 7 mg/L is believed sufficient to meet currently established drinking water criteria for DPBs,
 29 depending on the amount of *Giardia* inactivation required (California Urban Water Agencies 1998,
 30 ES2). In light of these source water goals and EPA's TOC removal action thresholds, the assessment
 31 of alternatives evaluates how each alternative would affect the frequency with which predicted
 32 future DOC concentrations would exceed 2, 3, and 4 mg/L on a long-term average basis at the
 33 assessment locations. Because, in many cases, the existing condition is one already exceeding 2 and
 34 3 mg/L, the frequency with which DOC exceeds 4 mg/L becomes a key focus of the assessment, as
 35 well as the change in long-term average DOC concentration.

36 An important Delta assessment location is DWR's North Bay Aqueduct intake at Barker Slough.
 37 While source-water fingerprinting identifies the Sacramento River as comprising the majority of
 38 flow at the Barker Slough location, the quality of water is substantially influenced by local sources in
 39 the Barker Slough catchment. These local sources contribute a significant organic carbon load to the

1 Barker Slough location, where average TOC between 2001 and 2005 was 5.8 mg/L and as high as 20
2 mg/L in winter months (State Water Project Contractors Authority 2007: 3-19, 3-26). The DSM2
3 model does not account for these local sources and, therefore, concentrations presented in this
4 assessment generally underestimate baseline DOC conditions. Nevertheless, operations and
5 maintenance activities will not substantially affect these local sources to Barker Slough and thus
6 their contribution to annual average DOC would continue to occur regardless of project alternative
7 implementation. The modeling presented in this assessment for the Barker Slough location accounts
8 for expected changes in DOC relative to changes in Delta hydrodynamics, excluding local watershed
9 sources to Barker Slough.

10 Pathogens

11 The assessments of pathogens were conducted in a qualitative manner with consideration to
12 sources of pathogens and factors that contribute to elevated levels in surface waters, including flow
13 rate and distance from pathogen sources.

14 Pesticides

15 Assessing pesticide-related effects is substantially challenged by: 1) limited available monitoring
16 data in the Delta and other water bodies of the affected environment, and 2) a continually changing
17 pesticide use market. Due to a number of factors, including historic pesticide use patterns and
18 analytical capabilities, there is more data available for certain classes of pesticides, such as OP
19 insecticides, than that for other classes of pesticides, including herbicides, fungicides, and
20 insecticides such as pyrethroids and carbamates.

21 Likely the single most recent and comprehensive compilation of pesticide data for the Delta and
22 upstream water bodies (within 30 miles of the Delta) was compiled by Johnson et al. (2010). The
23 result of this compilation and review was the conclusion that there were few chemicals for which
24 data were of sufficient number and quality to allow a definitive conclusion regarding contaminants
25 and toxicological issues in the Delta such as the POD. The stated exception was that of the OP
26 insecticides chlorpyrifos and diazinon, where frequent toxicity to bioassay indicator organisms has
27 been associated with measurable concentrations of chlorpyrifos and diazinon (Kuivila and Foe
28 1995; Werner et al. 2000). In fact, in the comprehensive review of Johnson et al. (2010), only the
29 analysis of diazinon, chlorpyrifos, several pyrethroid insecticides and the herbicide diuron were
30 carried forward, primarily due to data quantity and quality limitation. In this compilation,
31 cumulative frequency distributions were prepared, suggesting that less than 10% of all samples for
32 chlorpyrifos, diazinon, and diuron would be expected to exceed benchmark toxicity thresholds. Data
33 for the pyrethroid insecticides were too limited, primarily due to data quality issues (i.e.,
34 insufficiently low detection limits). However, pyrethroid-related research and regulatory interest
35 has intensified with the fairly recent observation of substantial pyrethroid-associated toxicity in
36 sediments and the water column of numerous urban streams, agricultural drainage canals, and
37 municipal wastewater effluent (Weston and Lydy 2010). These pyrethroid observations are largely
38 believed to be related to their recent increased use as a suitable substitute for diazinon and
39 chlorpyrifos.

40 Perhaps more challenging than a limited monitoring effort is the dynamic state of the pesticide
41 market. Regulatory and pest resistance pressures have left the pesticide market, namely the
42 insecticide market, in a state of flux. Pesticide use varies from year to year depending on numerous
43 external factors such as climate and associated pest outbreaks, cropping patterns, and economic

1 trends in housing construction and urban development. Layered upon this year-to-year variation is
2 an overall trend of decreased OP insecticides use and increased pyrethroid use, primarily due to the
3 early regulatory phase-out of many OP insecticide uses initiated in early 2000. The market has yet to
4 balance and reach equilibrium, and what limited and relatively short-term monitoring data that is
5 available ultimately only represents a snapshot of a trend in the gradual replacement of many OP
6 uses with that of pyrethroids. Until markets stabilize, trends will inevitably continue to develop.

7 For rivers, a number of factors are necessary for pesticide-related impacts on beneficial uses to be a
8 possibility. Although a number of relevant beneficial uses exist, for the majority of pesticides aquatic
9 life beneficial uses are the greatest concern. For concentrations of pesticides in surface water to
10 reach thresholds of aquatic life concern, a number of controlling factors are typically at play. First
11 and foremost, pesticides must be used, and used in a location with hydrologic connectivity to surface
12 water, and used in amounts that are not easily diluted in the environment. Secondly, the pesticide
13 must be transportable. The ultimate transportability of a pesticide is largely determined by its
14 individual chemistry, where its chemistry determines important properties such as water solubility,
15 vaporization, and soil sorption. Factors unrelated to the pesticide are also important, such as
16 substrate erosivity, precipitation or irrigation amounts, and time elapsed from application to runoff.
17 Thirdly, the pesticide must be stable in the environment, such that residues of the applied pesticide
18 are present during runoff events. And finally, if transported to surface waters, sufficient amounts of
19 pesticide must be present that once diluted by surface water flows, the resulting concentration is of
20 a magnitude capable of eliciting a measurable effect in aquatic life. All of these factors contribute in
21 the end to the potential for adverse beneficial use effects, but of the many factors involved,
22 CVP/SWP operations only affect river flows and, thus available dilution. In an estuary environment,
23 where substantial dilution capacity typically occurs, duration of aquatic life exposure in addition to
24 pesticide concentration is important. While the capacity of the Delta to dilute pesticide inputs is
25 largely unaffected by CVP/SWP operations, the duration of exposure, or residence time, can be
26 affected by operations. Therefore, in the Delta, changes in source water fractions represent long-
27 term changes in exposure potential.

28 Similar to the assessment of Johnson et al. (2010), there is insufficient data to perform an
29 assessment of project alternatives' effects on all pesticides. Within available data, however, there is
30 sufficient evidence that the OP insecticides diazinon and chlorpyrifos, and the herbicide diuron may
31 be found in the affected environment at concentrations frequently toxic to aquatic life, and to such a
32 degree that changes in CVP/SWP operations could possibly have an effect. Furthermore, although
33 pyrethroid insecticides have not been demonstrated to have the same magnitude of concern
34 throughout the affected environment, trends in OP replacement, increased pyrethroid use, and
35 increased pyrethroid incidence in urban streams and agricultural drains suggest that pyrethroids
36 may become a broader concern in the future. Therefore, the pesticide assessment focuses on
37 potential effects of CVP/SWP operations into the future, under the various considered alternatives,
38 on diazinon, chlorpyrifos, pyrethroids, and diuron, and the possibility that the frequency or
39 magnitude of existing pesticide-related risk to beneficial uses might change.

40 The pesticide assessment utilizes recent research and monitoring related to OP, diuron and
41 pyrethroid incidence in ambient waters to qualitatively assess the effects of the alternatives on
42 those pesticides and their possible related aquatic harm. Effects of alternatives on pesticides are
43 primarily incidental and indirect, as existing and future sources of pesticide loading are largely
44 unrelated. Further, effects on pesticides would be related to the change in river flow rates and Delta
45 source water volumes. Because these changes would not directly affect pesticide source loading, but
46 could affect in-stream pesticide concentrations through dilution as well as in-water pesticide

1 dispersion and geographic distribution, changes in CVP/SWP operations could alter the long-term
2 risk of pesticide-related effects on aquatic life beneficial uses. This change in risk can be qualitatively
3 assessed through change in river flows and associated dilution, as well as change in source water
4 fraction and associated opportunity for exposure. Pesticide effect assessments based on dilution
5 flows and source water fraction is heavily burdened by assumptions regarding pesticide use into the
6 future. As well, pesticide effects assessments based on changes in potential risk are heavily
7 burdened by presumptions of real hazard relative to actual in-stream concentrations and actual
8 effect thresholds which cannot be determined. It is assumed that sources of pesticides to water
9 bodies would be similar for all alternatives.

10 In addition to the present-use pesticides described above, “legacy” pesticides, which have been
11 banned for decades and include numerous organochlorine insecticides including DDT, can still be
12 found in terrestrial soils and riverine sediments throughout the Central Valley. These were assessed
13 based on the understanding that residues of these pesticides enter rivers primarily through surface
14 runoff and erosion of terrestrial soils during storm events, and through resuspension of riverine
15 bottom sediments, the combination of which to this day may contribute to excursions above water
16 quality objectives (Central Valley Regional Water Quality Control Board 2010c). These low level
17 sources are widespread and dispersed throughout the Central Valley.

18 **Phosphorus**

19 An analysis of nutrient loads to the Delta found that phosphorus concentrations showed little inter-
20 seasonal variability between the Sacramento and San Joaquin Rivers (Tetra Tech 2006a). Data
21 gathered for this assessment confirm this finding, and also show that little variability exists between
22 these two rivers and between San Francisco Bay water at Martinez. Current estimates for in-Delta
23 contribution of nutrients from agriculture on the Delta islands are small compared to tributary
24 sources (Tetra Tech 2006a). Table 8-53 summarizes dissolved ortho-phosphate data for source
25 waters to the Delta, and Figure 8-56 shows the seasonal variation in dissolved ortho-phosphate
26 concentrations among the three major source waters. During April through December, ortho-
27 phosphate concentrations from the three major source waters are very similar. During January
28 through March, concentrations in the San Joaquin River at Vernalis are noticeably greater than from
29 the Sacramento River at Hood/Greene’s Landing or San Francisco Bay at Martinez. Phosphorus
30 levels in the Sacramento River are not expected to increase due to treatment upgrades at SRWTP
31 (which is an action completely separate from the project alternatives). This is because SRWTP will
32 implement treatment upgrades that will keep phosphorus levels in the plant’s discharge at or below
33 current levels. Therefore, phosphorus levels in the Sacramento River inflows to the Delta under the
34 No Action Alternative (early long-term [ELT] and late long-term [LLT]) and action alternatives
35 would not be affected by this action relative to Existing Conditions.

1 **Table 8-53. Summary of Dissolved Ortho-Phosphate Concentrations (mg/L-P) in Delta Source**
 2 **Waters**

Source Water	Sacramento River	San Joaquin River	San Francisco Bay	East Side Tributaries
Mean (mg/L as P)	0.068	0.106	0.092	0.018
Minimum (mg/L as P)	0.010	0.010	0.030	0.010
Maximum (mg/L as P)	0.24	0.45	0.18	0.090
75 th Percentile (mg/L as P)	0.090	0.130	0.11	0.020
99 th Percentile (mg/L as P)	0.18	0.28	0.17	0.06
Data Source	DWR, BDAT	DWR, BDAT	BDAT	USGS
Station(s)	Sac River at Greene's Landing (BDAT only), Sac River at Hood	San Joaquin River at Vernalis	Suisun Bay at Bulls Head near Martinez	Mokelumne River
Date Range	1975–2009	1975–2009	1975–2006	1977–1994
ND Replaced with RL	No	No	No	Yes
Data Omitted	None	None	None	Single value reported as "0"
No. of Data Points	523	502	203	100

Notes: BDAT = Bay Delta and Tributaries Project; DWR = California Department of Water Resources; mg/L = milligrams per liter; ND = non-detection; RL = reporting limit; USGS = U.S. Geological Survey.

3
 4 Phosphorus does not behave conservatively in the environment, e.g., it can be taken up and
 5 metabolized by organisms or lost to or supplied by sediment. While at times phosphorus in the Delta
 6 and its source waters can be bound primarily in suspended sediment, there is limited ability to
 7 predict changes in total phosphorus concentrations because there are no sediment transport models
 8 for the Delta. Because phosphorus concentrations do not vary considerably between the major
 9 source waters (as discussed above), phosphorus was assessed qualitatively. The primary way in
 10 which the project alternatives could affect phosphorus levels is by increasing the fraction of San
 11 Joaquin River water at point in the Plan Area during January through March. Thus, source water
 12 fractions for the San Joaquin River were analyzed for that period to determine if the changes would
 13 be expected to substantially affect phosphorus concentrations. As unpredictable as they may be,
 14 levels of total phosphorus could be directly influenced by changes in suspended sediment-bound
 15 phosphorus. Therefore, changes in phosphorus levels were qualitatively assessed on the basis of
 16 changes in TSS and turbidity levels.

17 As discussed in Section 8.1.3.10, *Nitrate/Nitrite and Phosphorus*, a host of biological and physical
 18 factors affect algal species composition and abundance in the Delta. For algal species in general, and
 19 *Microcystis* in particular, the research describing the link between nutrient concentrations/ratios
 20 and toxic algal blooms is not conclusive about the type of effect small changes in nutrient levels or
 21 nutrient ratios would have on such algal blooms (see also Section 8.1.3.18, *Microcystis*). Our ability
 22 to model changes in nutrient ratios attributable to the project is limited by a lack of availability of a
 23 suitable model. Changes in phosphorus levels that can be estimated using conservative mixing

models are small enough that predictions of what these changes would mean to the makeup of algal communities or to changes in the N:P ratio would be speculative. Further, since the Delta is thought to be light limited and nutrients are in excess relative to algal growth requirements, these types of changes would not be expected to measurably change the quantity or composition of algae in the Delta.

Selenium

Potential impacts may occur from project-related changes to concentrations of selenium in water as well as changes to concentrations in fish tissues (whole-body and fillets) and bird eggs.

Bioaccumulation models were developed linking selenium concentrations in water to concentrations in fish tissue and bird eggs, which were estimated for each assessment location and alternative based on the modeled selenium concentration estimates for water from DSM2 (as described in Appendix 8M, *Selenium*), and from water to whole-body sturgeon in the western Delta (as described in Appendix 8M). Because of differences in bioaccumulation among water-year types, one model was used for all water years and a modified model was developed for drought years (when bioaccumulation was higher for fish). Detailed results are presented in Appendix 8M.

Applicable selenium objectives for water in the affected environment are summarized in Table 8-54, and selected benchmarks for assessment of selenium in whole-body fish, bird eggs, and fish fillets are presented in Table 8-55.

Table 8-54. Applicable Federal Criteria, State Standards/Objectives, and Other Relevant Effects Thresholds for Selenium

	Region 5 Basin Plan ^a	Region 2 Basin Plan ^b	California Toxics Rule ^c	Drinking Water MCL ^d	USEPA Recommended Criteria ^e	Other Relevant Thresholds ^f
Selenium micrograms per liter (µg/L)	5/12	5/20	5/20	50	5/variable 1.3	2

^a Objectives apply to the lower San Joaquin River from the mouth of the Merced River to Vernalis as 5 µg/L (4-day average) and 12 µg/L (maximum concentration) total selenium concentration (Central Valley Regional Water Quality Control Board 2009a).

^b Selenium criteria were promulgated as total recoverable concentrations for all San Francisco Bay/Delta waters in the National Toxics Rule (NTR) (U.S. Environmental Protection Agency 1992; San Francisco Bay Water Board 2007).

^c Standard is Criterion Continuous Concentration as 5 µg/L total recoverable selenium; California Toxics Rule deferred to the NTR for San Francisco Bay/Delta waters and San Joaquin River (U.S. Environmental Protection Agency 2000).

^d Maximum Contaminant Level. In addition, the California Office of Environmental Health Hazard Assessment (California Office of Environmental Health Hazard Assessment 2010) has recommended a Public Health Goal of 30 µg/L.

^e Adopted Criteria for protection of freshwater aquatic life are 5 µg/L (continuous concentration, 4-day average) total recoverable selenium and they vary for the Criterion Maximum Concentration (CMC; 24-hour average) (U.S. Environmental Protection Agency 2012b). The CMC = $1/[(f1/CMC1) + (f2/CMC2)]$ where f1 and f2 are the fractions of total selenium that are treated as selenite and selenate, respectively. Draft Criterion for water concentrations in lentic systems 1.3 µg/L (U.S. Environmental Protection Agency 2014).

^f Concentration as total recoverable selenium identified as a Level of Concern for the Grassland Bypass Project (Beckon et al. 2008).

1 **Table 8-55. Selected Benchmarks for Assessment of Selenium in Whole-body Fish, Bird Eggs, and Fish**
 2 **Fillets**

	Whole-Body Fish ^a		Bird Eggs ^a		Fish Fillets ^b
	Low ^c	High ^d	Low ^e	High ^f	
Selenium	4	8.1	6	10	2.5

^a Milligrams per kilogram (mg/kg), dry-weight basis.
^b mg/kg, wet-weight basis; Advisory Tissue Level (California Office of Environmental Health Hazard Assessment 2008).
^c Level of Concern for whole-body fish (lower end of range) (Beckon et al. 2008). For sturgeon the low benchmark was 5 mg/kg, dry weight (Presser and Luoma 2013).
^d Toxicity Level for whole-body fish (U.S. Environmental Protection Agency 2014). For sturgeon the high benchmark was 8 mg/kg, dry weight (Presser and Luoma 2013).
^e Level of Concern for bird eggs (lower end of range) (Beckon et al. 2008).
^f Toxicity Level for bird eggs (Beckon et al. 2008).

3

4 The State Water Board lists the western Delta as having impaired water quality for selenium and
 5 several other constituents under Clean Water Act Section 303(d) (State Water Resources Control
 6 Board 2011). The Central Valley Water Board completed a TMDL for selenium in the lower San
 7 Joaquin River (downstream of the Merced River) in 2001, and USEPA approved this in 2002 (Central
 8 Valley Regional Water Quality Control Board 2001, 2009d). Historical selenium concentrations in
 9 source waters to the Delta are shown in Table 8-56. DSM2 modeling for other constituents
 10 considered five sources of water to the Delta, as described in Section 8.3.1.3, *Plan Area*. However, for
 11 selenium, the Sacramento River mean concentration upstream of the American River (as measured
 12 below Knights Landing, upstream of the Yolo Bypass) was somewhat higher than that at Freeport
 13 (representing the main flow of the river to the Delta). Consequently, the value for Knights Landing
 14 was used as the input through the Yolo Bypass and the value for Freeport was used to represent the
 15 main flow of the Sacramento River to the Delta.

1 **Table 8-56. Historical Selenium Concentrations in the Six Delta Source Waters for the Period 1996–**
 2 **2014**

Source Water	Sacramento River ^a	San Joaquin River ^b	San Francisco Bay ^a	East Side Tributaries ^c	Agriculture within the Delta ^a	Yolo Bypass ^d
Mean (µg/L) ^e	0.09	0.45	0.10	0.10	0.11	0.23
Minimum (µg/L)	0.04	0.07	0.06	0.10	0.11	0.19
Maximum (µg/L)	0.23	1.50	0.45	0.10	0.11	0.30
75 th percentile (µg/L)	0.11	0.76	0.12	0.10	0.11	0.29
99 th percentile (µg/L)	0.23	1.50	0.44	0.10	0.11	0.30
Data Source	USGS 2014	USGS 2014	SFEI 2014	None	Lucas and Stewart 2007	DWR 2009b
Station(s)	Sacramento River at Freeport	San Joaquin River at Vernalis	Central-West; San Joaquin River near Mallard Island (BG30)	None	Mildred Island, Center	Sacramento River below Knights Landing
Date Range	11/2007–7/2014	11/2007–8/2014	2/2000–8/2013	None	2000	2004, 2007, 2008
ND Replaced with RL	Not applicable	Not applicable	No	Not applicable	No	Yes
Data Omitted	None	None	None	Not applicable	None	None
No. of Data Points	88	93	14	None	1	5

Notes: ND = non-detection; RL = reporting limit; SFEI = San Francisco Estuary Institute; SWAMP = Surface Water Ambient Monitoring Program; µg/L = micrograms per liter.

^a Dissolved selenium concentration.

^b Not specified whether total or dissolved selenium.

^c Dissolved selenium concentration in Mokelumne, Calaveras, and Cosumnes Rivers is assumed to be 0.1 µg/L due to lack of available data and lack of sources that would be expected to result in concentrations greater than 0.1 µg/L.

^d Total selenium concentration.

^e Means are geometric means.

3

4 Largemouth bass collected from sites near the source locations or within the Delta in 2000, 2005,
 5 and 2007 were analyzed for selenium (Foe 2010). Measured selenium concentrations in those fish
 6 and modeled selenium concentrations in whole-body fish at three source water locations are
 7 presented in Table 8-57. Selenium concentrations in fish fillets, whole-body fish, and bird eggs at
 8 assessment locations in the Delta were estimated using models described in Appendix 8M, *Selenium*.

1 **Table 8-57. Measured and Modeled Selenium Concentrations (milligrams per kilogram, dry-weight**
 2 **basis) in Whole-Body Fish at or near Source Water Locations to the Delta**

Year	Sacramento River ^a		San Joaquin River ^b		Suisun Bay ^c	
	Measured	Modeled	Measured	Modeled	Measured	Modeled
2000	2.6	1.5 ^d	1.7	1.9 ^e	No Data	1.5 ^f
2005	1.5	1.5 ^d	1.9	1.9 ^e	No Data	1.6 ^f
2007	1.8	2.5 ^g	2.4	2.4 ^h	No Data	2.5 ⁱ

Notes: K_d = particulate/water ratio; TTF_{fish} = trophic transfer factor from diet to fish; $TTF_{invertebrate}$ = trophic transfer factor from particulate to invertebrate.

^a Sacramento River Mile 44.

^b Vernalis.

^c Montezuma Slough near Grizzly Bay; bass were not sampled near here, so modeled values are for the nearest location where bass were sampled (Big Break), for which the waterborne selenium concentration (0.10 µg/L) was the same as that for the San Joaquin River at Mallard Island.

^d Concentration of selenium estimated from Model 4: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 4909 to 4997 (varying by year and quarter in 2000 [4910 to 4997] and 2005 [4909 to 4910]), $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

^e Concentration of selenium estimated from Model 4: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 665 in 2000 and 651 in 2005, $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

^f Concentration of selenium estimated from Model 4: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 1683 to 4804 (varying by year and quarter in 2000 [2441 to 4593] and 2005 [1683 to 4804]), $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

^g Concentration of selenium estimated from Model 5: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 8061 to 8064 (varying by quarter), $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

^h Concentration of selenium estimated from Model 5: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 1206, $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

ⁱ Concentration of selenium estimated from Model 5: Trophic level 4 (TL-4) fish eating TL-3 fish, using K_d = 6220 to 7926 (varying by quarter), $TTF_{invertebrate}$ = 2.8, and TTF_{fish} = 1.1.

3

4 Trace Metals

5 Water quality criteria used in the assessment of trace metals are presented in Table 8-58. The CTR
 6 criteria for cadmium, chromium (III), copper, lead, nickel, silver, and zinc are promulgated as
 7 equations that contain three adjustments: 1) the water-effect ratio (WER), 2) the conversion factor
 8 (CF) from total to dissolved fraction, and 3) hardness (freshwater criteria only), which are used to
 9 adjust the criteria based on site-specific water quality conditions in order to provide the level of
 10 protection intended by U.S. EPA. Table 8-59 presents hardness adjusted CTR criteria for the primary
 11 Delta source waters, including the Sacramento and San Joaquin Rivers. Criteria were calculated
 12 based on each source waters average and 5th percentile hardness (See Appendix 8N, *Trace Metals*,
 13 for hardness data). Due to lower average and 5th percentile hardness on the Sacramento River,
 14 calculated hardness-based metals aquatic life criteria are lowest on the Sacramento River.

15 The quality of water representative of the Bay source water fraction is highly seasonal, with
 16 conditions ranging between freshwater and saltwater conditions. In such a case, CTR metals criteria
 17 guidance states that the more stringent of the freshwater or saltwater criteria is to be used.
 18 Comparing saltwater criteria listed in Table 8-58 to freshwater criteria in Table 8-59, saltwater
 19 criteria for copper and nickel are more stringent than the corresponding hardness-based freshwater
 20 criteria.

1 **Table 8-58. Water Quality Criteria and Objectives for Trace Metals (µg/L)**

Metal	Freshwater		Saltwater		Human Health		Region 5 Basin Plan	California Drinking Water MCLs ^e
	Acute ^a	Chronic ^a	Acute ^a	Chronic ^a	Water & Organisms	Organisms Only		
Aluminum	87 ^f	750 ^f	NA	NA	NA	NA	NA	200
Arsenic	340	150	69	36	NA	NA	10 ^b	10
Cadmium	4.3/3.9 ^c	2.2/1.1 ^c	42	9.3	NA	NA	0.22 ^d	5
Chromium (III)	550	180	NA	NA	NA	NA	NA	50
Copper	13	9	4.8	3.1	1,300	NA	5.6 ^d /10 ^b	1,000
Iron	NA	1,000 ^f	NA	NA	NA	NA	300 ^b	300
Lead	65	2.5	210	8.1	NA	NA	NA	15
Manganese	NA	NA	NA	NA	NA	NA	50 ^b	50
Nickel	470	52	74	8.2	610	4,600	NA	100
Silver	3.4	NA	1.9	NA	NA	NA	10 ^b	100
Zinc	120	120	90	81	NA	NA	100 ^b /16 ^d	5,000

Notes: All values in micrograms per liter (µg/L) and expressed as dissolved metal, unless otherwise noted.

NA = non-applicable.

^a Values represent both California Toxic Rule (CTR)/National Toxics Rule criteria and criteria contained within the Region 2 Basin Plan. Acute values are applicable to short periods of time, generally defined as 1-hour average concentrations. Chronic values are defined as 4-day average concentrations. For metals whose CTR criteria allow for adjustments based on water-effect ratio (WER), conversion factor (CF), and hardness, values in the table assume a default WER of 1.0, default CFs contained within the CTR, and a default hardness of 100 milligrams per liter (as CaCO₃).

^b Applies at the following locations: Sacramento River from Keswick Dam to the I Street Bridge at City of Sacramento; American River from Folsom Dam to the Sacramento River; Folsom Lake; and the Sacramento-San Joaquin Delta.

^c First value is the CTR cadmium criterion, second value is Region 2 Basin Plan criterion.

^d Applies to the Sacramento River and its tributaries above State Route 32 bridge at Hamilton City.

^e Expressed as total recoverable metal.

^f U.S. Environmental Protection Agency 304(a) national recommended criteria.

2

3 Metals differ in their physical and chemical parameters and thus in their fate, transport, and
4 bioavailability in the aquatic environments. Throughout the trace metals assessment dissolved
5 metals concentrations are utilized, because the dissolved fraction better approximates the
6 bioavailable fraction to aquatic organisms. Furthermore, drinking water treatment plants readily
7 remove particulate and suspended matter from raw water. While maximum contaminant levels for
8 treated drinking water are measured on a total recoverable basis, the dissolved fraction of these
9 metals is taken as the more accurate predictor of metals concentration post-treatment. This is
10 particularly the case with aluminum, iron, and manganese which are naturally abundant in soil.
11 Total recoverable aluminum, iron, and manganese concentrations can be very high in water carrying
12 a substantial load of suspended matter (i.e., TSS). Therefore, assessment of aquatic life and drinking
13 water effects utilizes the dissolved fraction of trace metals in the environment.

1 **Table 8-59. Hardness-Based Dissolved Freshwater Aquatic Life Criteria by Primary Source Water ($\mu\text{g/L}$)**

Metal	Criteria for Sacramento Source Water Based on 5 th Percentile Hardness		Criteria for Sacramento Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	0.81	0.128	1.19	0.168
Copper	5.53	4.006	8.04	5.623
Chromium (III)	263.50	34.276	364.71	47.441
Lead	22.86	0.891	35.52	1.384
Nickel	211.11	23.448	295.34	32.803
Silver	0.64	-	1.26	-
Zinc	52.77	53.199	73.86	74.464
Metal	Criteria for San Joaquin Source Water Based on 5 th Percentile Hardness		Criteria for San Joaquin Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	1.13	0.162	2.93	0.321
Copper	7.65	5.373	19.32	12.447
Chromium (III)	349.18	45.421	781.14	101.610
Lead	33.49	1.305	97.98	3.818
Nickel	282.37	31.362	648.66	72.046
Silver	1.15	-	6.24	-
Zinc	70.61	71.187	162.41	163.742
Metal	Criteria for Bay Source Water Based on 5 th Percentile Hardness		Criteria for Bay Source Water Based on Average Hardness	
	Acute	Chronic	Acute	Chronic
Cadmium	1.11	0.160	13.98	0.981
Copper	7.52	5.290	88.25	49.357
Chromium (III)	343.97	44.744	2925.17	380.504
Lead	32.82	1.279	518.97	20.224
Nickel	278.02	30.879	2537.13	281.796
Silver	1.11	-	99.88	-
Zinc	69.52	70.089	636.59	641.798

Notes: Criteria calculated based on each source waters average and 5th percentile hardness.
 $\mu\text{g/L}$ = micrograms per liter.

2

3 Research has shown that elevated copper levels in water bodies are of concern for disruption of
4 olfactory cues in salmonids when migrating to their natal streams to spawn, which can lead to
5 increased straying. However, the U.S. EPA-developed biotic ligand model (BLM)-based copper
6 criteria have been shown to always be protective of these concerns (Meyer and Adams 2010: 2096).
7 Because of this, BLM-based copper criteria were derived for the Sacramento and San Joaquin Rivers,
8 as shown in Table 8-60. The BLM criteria account for the aggregate effect of several different water
9 quality parameters on copper toxicity in addition to hardness (e.g., dissolved organic carbon, pH,
10 and various salt concentrations), with the protective criterion being sensitive to DOC concentrations
11 in water. When calculated based on the average of all necessary parameters and the 5th percentile
12 DOC, copper BLM-based criteria were higher (i.e., less sensitive) than the corresponding non WER-

1 adjusted copper criteria presented in Table 8-59. Therefore, the calculated hardness-based CTR
2 copper criteria are found to be adequately protective of fish olfaction.

3 **Table 8-60. Biotic Ligand Model-Based Criteria for Dissolved Copper ($\mu\text{g/L}$)**

	CMC	CCC
Sacramento		
Average of all BLM parameters	10.9299	6.7888
5 th Percentile DOC; Average of remaining parameter	6.9774	4.3338
San Joaquin		
Average of all BLM parameters	15.9659	9.9167
5 th Percentile DOC; Average of remaining parameter	10.0879	6.2658
Notes: BLM = biotic ligand model; DOC = dissolved organic carbon; $\mu\text{g/L}$ = micrograms per liter.		

4
5 There is currently no single program or effort for the coordinated and comprehensive measurement
6 of trace metals in the Delta and its primary source waters. Moreover, analytical techniques for trace
7 metals measurement have improved considerably over time, often resulting in substantially lower
8 detection limits and at time showing earlier techniques to be prone to analytical error. Nevertheless,
9 local monitoring efforts such as the San Francisco Bay RMP and the Sacramento Coordinated
10 Regional Monitoring Program have collected trace metals on the Sacramento River and the San
11 Francisco Bay for more than a decade, resulting in an adequate long-term characterization of these
12 waters. Unfortunately, there has been no equivalent effort on the San Joaquin River, eastside
13 tributaries, or within the Delta itself. This imbalance in available data limits the effects assessment
14 approach. Effects are qualitatively assessed.

15 Summaries of trace metals data compiled for this qualitative assessment are provided in Appendix
16 8N, *Trace Metals*. Data of sufficient quality were available for the Bay, Sacramento River and San
17 Joaquin River source waters, although data for the San Joaquin are very few. These data used to
18 inform the qualitative assessment on trace metal effects upstream of the Delta, within the Delta, and
19 the SWP and CVP service areas. Due to the relatively short exposure durations related to aquatic life
20 acute and chronic effects, long-term trace metals effects are evaluated on a 95th percentile
21 concentration basis. Due to the relatively long exposure durations related to drinking water effects,
22 long-term trace metals effects are evaluated on an average concentration basis.

23 **Total Suspended Solids and Turbidity**

24 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
25 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
26 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
27 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
28 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
29 other biological material in the water.

30 TSS and turbidity in Delta waters is affected by TSS concentrations and turbidity levels of the Delta
31 inflows (and associated sediment load). TSS and turbidity within Delta waters also is affected by
32 fluctuation in flows within the channels due to the tides, with sediments depositing as flow
33 velocities and turbulence are low at periods of slack tide, and sediments becoming suspended when
34 flow velocities and turbulence increase when tides are the near the maximum. TSS and turbidity

1 variations can also be attributed to phytoplankton, zooplankton and other biological material in the
2 water.

3 The TSS and turbidity assessments were conducted in a qualitative manner based on anticipated
4 changes in these factors.

5 ***Microcystis***

6 *Microcystis* has an annual life cycle characterized by two phases. The first is a benthic phase, during
7 which cysts overwinter in the sediment. In the second planktonic phase, during summer and fall,
8 *Microcystis* enters the water column and begins to grow. When environmental conditions, such as
9 sufficiently warm water temperatures, trigger *Microcystis* recruitment from the sediment, the
10 organism is resuspended into the water column through a combination of active and passive
11 processes (Verspagen et al. 2004; Mission and Latour 2012). In the Delta, there are five primary
12 environmental factors that trigger the emergence and subsequent growth of *Microcystis*.

- 13 1. Warm water temperatures (>19°C) (Lehman et al. 2013).
- 14 2. Nutrient availability (e.g., nitrogen and phosphorus) (Smith 1986; Paerl 2008 as cited in Davis et
15 al. 2009).
- 16 3. Water column irradiance and clarity (surface irradiance >100 Watts per square meter per
17 second and total suspended solid concentration <50mg/L (Lehman et al. 2013).
- 18 4. Flows and long residence times (Lehman et al. 2013).

19 *Microcystis* blooms typically develop over a period of several weeks after cells emerge from the
20 benthic state (Marmen et al. 2016). Because environmental conditions and benthic recruitment
21 drive *Microcystis* formation within the water column, it is common for many *Microcystis* cells to
22 enter the water column at the same time. Once in the water column, and when environmental
23 conditions are favorable, *Microcystis* rapidly multiplies. One study found the doubling time of
24 *Microcystis aeruginosa* strains ranged from 1.5 to 5.2 days, with an average doubling time of 2.8 days
25 (Wilson et al. 2006). This fast growth rate allows cells to form colonies which come together to form
26 a “scum” layer at the water surface. In the Delta, scums are primarily composed of the colonial form
27 of *Microcystis*, but single cells are also present (Baxa et al. 2010).

28 Like many cyanobacteria species, *Microcystis* possess specialized intracellular gas vesicles that
29 enable the organism to regulate its buoyancy (Reynolds 1981 as cited in Paerl et al. 2014). This
30 buoyancy allows *Microcystis* to take advantage of near surface areas with optimal growth conditions
31 (e.g., light). The collection of cells at the surface, primarily in calm waters, allows *Microcystis* to
32 sustain a competitive advantage over other phytoplankton species by optimizing their
33 photosynthetic needs while shading out other algal species, which they compete with for nutrients
34 and light (Huisman et al. 2004).

35 Wind and tides can enhance the aggregation of *Microcystis* cells in slow moving waters (Baxa et al.
36 2010), but in faster moving, turbulent waters, the ability of *Microcystis* to maintain its positive
37 buoyancy is reduced (Visser et al. 1996). Therefore, high flow rates make it difficult for *Microcystis*
38 to collect and form dense colonies at the water surface. Turbulence effects metabolic processes and
39 cell division (Koch 1993; Thomas et al. 1995 as cited in Li et al. 2013) and thus can be a negative
40 growth factor (Paerl et al. 2001 and articles cited within). Turbulent water mixes all algae
41 throughout the photic zone of the water column and reduces light through turbidity which allows
42 faster growing chlorophytes (green algae) and diatoms to outcompete the slower growing

1 cyanobacteria, including *Microcystis* (Wetzel et al. 2001; Huisman et al. 2004; Li et al. 2013).
2 Although the amount of flow required to disrupt a *Microcystis* bloom varies by system, in the
3 Zhongxin Lake system China, flow velocities of 0.5–1.0 feet/second shifted the dominant
4 phytoplankton species from cyanobacteria to green algae and diatoms (Li et al. 2013).

5 As described under Impact WQ-29 (Effects on TSS and Turbidity), changes in TSS and turbidity
6 levels within the Delta under the project alternatives could not be quantified, but are expected to be
7 similar under the project alternatives to Existing Conditions and the No Action Alternative. Minimal
8 changes in water clarity would result in minimal changes in light availability for *Microcystis* under
9 the project alternatives. As such, the project alternatives' influence on *Microcystis* production in the
10 Delta, as influenced by the project alternatives' effects on Delta water clarity, is considered to be
11 negligible.

12 Regarding nutrients the maintenance of *Microcystis* blooms in the Delta requires the availability of
13 the nitrogen and phosphorus. However, the body of science produced by scientists studying
14 *Microcystis* blooms in the Delta and elsewhere does not indicate that the specific levels of these
15 nutrients, or their ratio, currently control the seasonal or inter-annual variation in the bloom. A
16 large fraction of ammonia in the Sacramento River will be removed due to planned upgrades to the
17 Sacramento Regional County Sanitation District's SRWTP, which will result in >95% removal of
18 ammonia from the effluent discharge from this facility. Following the SRWTP upgrades, levels of
19 ammonia in Sacramento River are expected to be similar to background ammonia concentrations in
20 the San Joaquin River and San Francisco Bay (see Section 8.3.3.1, Impact WQ-1). The response of
21 *Microcystis* production in the Delta to the substantial reduction in river ammonia levels (from
22 removing ammonia from the SRWTP discharge) is unknown because nitrate and phosphorus levels
23 in the Delta will remain well above thresholds that would limit *Microcystis* blooms.

24 Nutrient ratios in excess of the Redfield N:P ratio of 16 have also been hypothesized to favor
25 *Microcystis* growth in the Delta (Glibert et al. 2011). However, considerable doubt has been cast on
26 this hypothesis because median N:P molar ratios in the Delta during peak bloom periods are usually
27 near or a little lower than the Redfield ratio of 16 needed for optimum phytoplankton growth, and
28 when ammonia is considered the sole N source, the N:P ratio drops substantially to a median of
29 1.31:1 (Lehman et al. 2013). Based on this information, there is no evidence as to what type of effect
30 small changes in nutrient concentrations and ratios would have on *Microcystis* blooms, given that
31 such blooms are largely influenced by a host of other physical factors, including water temperature
32 and water residence time within channels.

33 Based on the above, water clarity and nutrient effects on *Microcystis* were determined to not have
34 substantial effects on *Microcystis* abundance under the project alternatives, relative to Existing
35 Conditions and the No Action Alternative. A qualitative evaluation was performed to determine if
36 the action alternatives would result in an increase in frequency, magnitude, and geographic extent of
37 *Microcystis* blooms in the Delta based on the following two additional abiotic factors that may affect
38 *Microcystis*: 1) changes to water operations and creation of tidal and floodplain restoration areas
39 that change water residence times within Delta channels, and 2) increases in Delta water
40 temperatures.

41 The methodology used to determine residence time for Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5,
42 6A, 6B, 6C, 7, 8, and 9 is described in BDCP Appendix 5.C, Section 5C.4.4.7, *Residence Time*. Briefly,
43 residence time in different subregions of the Plan Area was assessed using the results of the DSM2
44 Particle Tracking Model for multiple neutrally buoyant particle release locations. Residence time

1 was defined as the time at which 50% of particles from a given release location exited the Plan Area
 2 (either by movement downstream past Martinez or through entrainment at the south Delta export
 3 facilities, north Delta diversion, North Bay Aqueduct, or agricultural diversions in the Delta). The
 4 data were reduced into mean residence time by subregion and season. The data do not represent the
 5 length of time that water in the various subregions spends in the Delta in total, but do provide a
 6 useful parameter with which to compare generally how long algae would have to grow in the
 7 various subregions of the Delta. Table 8-60a shows the residence time results that are used in the
 8 *Microcystis* assessments. Results for summer and fall are most relevant for the *Microcystis*
 9 assessment, but all seasons are presented for completeness.

10 **Table 8-60a. Average Residence Time for Subregions of the Plan Area by Season and Alternative**

Subregion	Season	Average Residence Time (days)										
		Ex Cond.	No Act.	Alt 1	Alt 2	Alt 3	Alt 4 Scn H3	Alt 5	Alt 6	Alt 7	Alt 8	Alt 9
North Delta	Summer	33	38	43	38	41	39	41	43	40	46	40
	Fall	49	50	61	56	60	57	55	55	57	58	55
	Winter	36	37	40	40	40	39	41	37	37	37	40
	Spring	30	33	37	35	36	35	36	34	34	29	35
	Overall	35	38	43	41	43	41	41	40	40	40	41
Cache Slough	Summer	18	21	46	40	45	39	39	49	46	59	46
	Fall	46	46	44	39	43	40	39	39	45	56	39
	Winter	29	31	33	32	33	32	33	28	29	27	31
	Spring	22	24	33	33	33	33	33	31	30	33	31
	Overall	27	29	38	36	38	35	36	36	36	42	36
West Delta	Summer	22	24	32	28	30	28	29	40	27	33	28
	Fall	25	27	34	30	33	30	30	30	31	32	27
	Winter	18	20	21	21	21	21	21	19	19	19	19
	Spring	18	20	24	22	24	22	23	20	20	17	20
	Overall	20	22	27	25	26	25	25	27	23	24	23
East Delta	Summer	22	26	40	34	35	34	31	76	32	48	21
	Fall	15	35	33	47	32	48	48	58	55	55	21
	Winter	28	32	40	42	40	42	40	50	51	50	26
	Spring	42	47	57	54	59	54	56	61	57	54	35
	Overall	29	36	45	45	44	45	44	61	49	52	27
South Delta	Summer	8	10	16	17	14	16	11	70	23	33	35
	Fall	5	11	8	42	8	43	34	79	53	52	33
	Winter	10	11	19	19	14	16	15	59	57	56	28
	Spring	25	26	24	29	20	28	27	65	60	58	31
	Overall	13	16	18	26	15	25	21	67	49	50	32
Suisun Marsh	Summer	51	58	38	35	37	35	36	37	36	39	42
	Fall	17	19	39	34	38	34	33	32	34	34	38
	Winter	9	9	28	28	29	27	29	24	24	24	32
	Spring	45	51	32	31	31	30	30	29	28	25	33
	Overall	33	37	33	32	33	31	32	30	30	30	36

11

1 The methodology used to characterize residence time changes under Alternatives 4A, 2D, and 5A
 2 relied on modeled residence times presented in the Biological Assessment for the California
 3 WaterFix (ICF International 2016) for July through November. In addition, changes in maximum
 4 daily channel velocities, as modeled by DSM2, for a number of locations in the Delta were evaluated.

5 **8.3.1.8 San Francisco Bay**

6 The western seaward boundary of the Plan Area has been delineated at Carquinez Strait. There are
 7 no actions proposed to occur in the bays seaward of the Plan Area. Nevertheless, because a
 8 substantial portion of Delta waters does flow seaward, an assessment of the effects of Delta water
 9 quality changes under the project alternatives on the San Francisco Bay water quality was
 10 conducted to identify potential effects in the Bay. The assessment addresses potential direct and
 11 indirect effects on water quality of areas seaward of the Delta, based on the best available scientific
 12 understanding. No hydrologic or hydrodynamic modeling was conducted seaward of Suisun Bay.

13 Because net Delta flows move seaward, water quality constituents present in the Delta water
 14 column could potentially be transported seaward. The Screening Analysis (see Sections 8.3.1.3,
 15 8.3.2.1, and Appendix 8C, *Screening Analysis*) identified constituents present in Delta waters
 16 warranting detailed assessment in the Plan Area based on their historical concentrations in the
 17 water column or importance to beneficial uses of Delta waters. These same constituents were
 18 addressed in the assessment of effects on San Francisco Bay. The assessment of effects in San
 19 Francisco Bay was based on projected changes in constituent concentration/levels that would occur
 20 in the Delta and changes in Delta outflow under the project alternatives. The following sections
 21 describe constituent-specific considerations and methods for calculating changes in Delta loading
 22 that are common to the assessment of all project alternatives in the San Francisco Bay for nutrients
 23 (ammonia, nitrate, and phosphorus), mercury, and selenium.

24 **Nutrients: Ammonia, Nitrate, Phosphorus**

25 **Constituent-specific Considerations**

26 Nutrients in freshwater outflows from the Delta have the potential to impact the embayments that
 27 make up the San Francisco Bay, although oceanic flows in and out of the Golden Gate mute the
 28 influence of Delta-derived freshwater flows on the Central Bay, South Bay, and Lower South Bay
 29 (Senn and Novick 2013). Thus, nutrients effects to San Francisco Bay from changes in Delta outflow
 30 would be limited almost entirely to the northern part of San Francisco Bay, namely San Pablo Bay.
 31 The assessment specifically addresses effects on San Pablo Bay, but relies on research conducted in
 32 Suisun Bay, because very little research specific to San Pablo Bay has been conducted and because
 33 San Pablo Bay and Suisun Bay experience similar nutrient loading. Existing effects from nutrients on
 34 San Pablo Bay and Suisun Bay have been hypothesized, yet widespread impairment due to nutrients
 35 in these embayments is not thought to be occurring (Senn and Novick 2013).

36 Suisun Bay is currently characterized by levels of phytoplankton biomass and a community
 37 composition insufficient to support the pelagic food web. The highly altered phytoplankton
 38 community and low biomass levels are thought to be linked primarily to the invasive clam *Corbula*
 39 *amurensis*, which was established in Suisun Bay in 1987, and grazing by other aquatic
 40 macroinvertebrates, specifically zooplankton (Kimmerer and Thompson 2014). Notwithstanding,
 41 Dugdale et al. (2007; 2012) has argued that nitrate is preferred by and fuels blooms of diatoms, and
 42 that uptake of nitrate by diatoms is impaired until ammonia levels are depleted below 0.03–0.06

1 mg/L-N. The onset of diatom blooms in Suisun Bay, and to a lesser extent San Pablo Bay, has been
 2 attributed to the drawdown of ammonia levels in these embayments. Ammonia levels are
 3 infrequently lower than this threshold. Currently, there is a lack of experimental results
 4 substantiating the ammonia-inhibition hypothesis and conflicting mechanistic interpretations of the
 5 available studies (Senn and Novick 2013; Senn and Novick 2014).

6 Other research has hypothesized that a high N:P ratio in the Delta and Suisun Bay has caused a
 7 transition away from a diatom-based food web, resulting in a cascading effect on higher trophic
 8 levels compared to conditions prior to the onset of phytoplankton biomass and community
 9 composition changes which occurred around 1986 (Glibert et al. 2011). As some have indicated, the
 10 introduction of *C. amurensis* is likely to have caused these alternations in phytoplankton biomass
 11 and composition (Senn and Novick 2014). The influence of a high N:P ratio on changes in
 12 chlorophyll levels and phytoplankton composition in Suisun Bay or downstream embayments
 13 receiving freshwater from the Delta cannot be ruled out, nor the magnitude of its effect determined.
 14 Nonetheless, these effects are likely to be small compared to the obvious and documented effects of
 15 the introductions of clams and copepods, which cannot reasonably be linked to nutrient conditions
 16 in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014).

17 Harmful algal blooms are considered a stressor of Suisun Bay. Summer-fall blooms of *Microcystis*
 18 *aeruginosa* have occurred with increasing frequency and intensity in the Delta and Suisun Bay since
 19 2000. While blooms of *Microcystis* have not been documented in embayments downstream of Suisun
 20 Bay, the toxin produced by some *Microcystis* strains, microcystin, was detected in pilot monitoring
 21 measurements throughout the low salinity zone and in the central and southern embayments of San
 22 Francisco Bay (Senn and Novick 2014). In the San Francisco Estuary, nutrient levels are not
 23 considered a primary driver *Microcystis* bloom formation (Lehman et al. 2013); however, there is
 24 evidence that *Microcystis* tends to prefer an ammonia nitrogen source compared to other forms of
 25 nitrogen (Senn and Novick 2014).

26 **Load Estimates**

27 Effects of the project alternatives on nutrient loads to Suisun Bay and San Pablo Bay were
 28 determined by estimating the percentage change in phosphorus and nitrogen loads in Delta outflow
 29 due to the alternative. Because the project alternatives would not change net outflows between the
 30 upstream entrance of Suisun Bay (Mallard Island) and San Pablo Bay (Martinez or Carquinez Strait),
 31 nor would there be substantial changes in nutrient loading within Suisun Bay, estimated changes in
 32 loading to Suisun Bay were used as an approximation for the change in nutrient loading to San Pablo
 33 Bay. Changes in Delta-related nitrogen and phosphorus loads to Suisun Bay and San Pablo Bay were
 34 thus assumed to be proportional to the estimated change in loads in Delta outflow.

35 For nitrogen loads, changes of nitrate and ammonia loads at Mallard Island were estimated
 36 differently for Existing Conditions than for the project alternatives, due to differing assumptions
 37 regarding nitrogen loads from the SRWTP, the largest point source of nitrogen to the Delta. Loadings
 38 were estimated in the following manner.

39 **Ammonia:**

- 40 • Existing Conditions: The ammonia-nitrogen load was assumed to be equivalent to the current
 41 average ammonia load discharged from SRWTP (28.7 mg/L-N at 141 mgd; Sacramento Regional
 42 County Sanitation District 2014) plus the ammonia load of the Delta tributaries unaffected by
 43 the SRWTP discharge, calculated from the long-term average ambient ammonia concentration

1 (0.04 mg/L-N; Central Valley Regional Water Quality Control Board 2010a:5) and the Delta
2 outflow (provided in Appendix 5A, Section C.7).

- 3 • Project Alternative: Ammonia-nitrogen loads at Mallard Island were calculated from the long-
4 term annual ammonia concentration downstream of the SRWTP calculated in the Impact WQ-1
5 and the long-term average net Delta outflow (provided in Appendix 5A, Section C.7).

6 **Nitrate:**

- 7 • Existing Conditions: The estimated nitrate-nitrogen load was based on the modeled long-term
8 annual average nitrate concentration at Mallard Island (as shown in Appendix 8J, *Nitrate*) and
9 the long term average net Delta outflow. The SRWTP contribution was not factored separately
10 as it was for ammonia, because nitrate levels under Existing Conditions are below analytical
11 detection levels in SRWTP effluent.
- 12 • Project Alternative: Nitrate-nitrogen loads were calculated as the sum of the nitrate load from
13 modeled long-term annual average nitrate concentration at Mallard Island (which does not
14 account for an increase in SRWTP effluent nitrate) and the average net Delta outflow, and nitrate
15 load due to an increase in nitrate discharged from SRWTP (6.7 mg/L-N at 181 mgd; Sacramento
16 Regional County Sanitation District 2014).

17 These mass-balance calculations assume that transformation and loss of nitrogen species within the
18 Delta are negligible.

19 Phosphorus loads under the project alternatives could be altered by two factors: 1) change in the
20 source water fraction, and thus phosphorus concentration, of outflows from the Delta; and 2) an
21 increase or decrease in Delta outflow. The major source waters to the Delta—San Joaquin River,
22 Sacramento River, and San Francisco Bay—have similar dissolved phosphorus concentrations for
23 the months April through October (Figure 8-56), but during December through March, higher
24 dissolved phosphorus concentrations occur in the San Joaquin River compared to the Sacramento
25 River and San Francisco Bay. Under the project alternatives, changes in the fraction of San Joaquin
26 River water in the Delta outflow during December through March are projected. Considering the
27 dissolved phosphorus concentrations of these sources, mass balance calculations show that for the
28 relative change in source water fractions at Mallard Island, the magnitude of change in the dissolved
29 phosphorus concentration of Delta outflows during these months would be negligible (<0.01 mg/L-
30 P). Therefore, the relative change in phosphorus load in Delta outflow was considered to be
31 proportional to the change in net Delta outflow.

32 **Mercury**

33 **Constituent-specific Considerations**

34 San Francisco Bay is impaired because mercury contamination is adversely affecting existing
35 beneficial uses, including sport fishing, preservation of rare and endangered species, and wildlife
36 habitat (San Francisco Bay Regional Water Quality Control Board 2013). Mercury concentrations in
37 San Francisco Bay fish are high enough to threaten the health of humans who consume them, while
38 concentrations in some bird eggs harvested from the shores of San Francisco Bay are high enough to
39 account for abnormally high rates of eggs failing to hatch (San Francisco Bay Regional Water Quality
40 Control Board 2013). Because of these concerns, a mercury TMDL was approved for San Francisco
41 Bay in 2007. Beneficial uses of the Delta are similarly impaired due to methylmercury, and the
42 Central Valley Water Board adopted the Delta Methylmercury TMDL in 2011 to address the

1 impairment. The geographic scope of the San Francisco Bay TMDL includes Suisun Bay, San Pablo
2 Bay, Central Bay, South Bay, and Lower South Bay. The assessment addresses the effects of the
3 project alternatives on mercury and methylmercury loads from the Delta to San Francisco Bay
4 downstream of Suisun Bay.

5 The bioavailability and toxicity of elemental mercury (from whatever primary source) are greatly
6 enhanced through the natural, bacterial conversion of mercury to methylmercury in marshlands,
7 wetlands or bottom sediments. The dominant source of methylmercury that enters the aquatic food
8 web of San Francisco Bay is the internal net production of methylmercury bay sediments (Davis et
9 al. 2012). Historically, millions of pounds of inorganic mercury were used in gold mining operations
10 within the San Francisco Bay watershed, and a large fraction of this mercury was washed
11 downstream and accumulated in Bay sediment. The large pool of inorganic mercury currently
12 contained in Bay sediments dominates the fraction converted to methylmercury and that
13 accumulating the Bay's aquatic food web.

14 Exports from the Delta represent a sizable source of the overall mercury load to San Francisco Bay.
15 The San Francisco Bay Mercury TMDL estimated that the Delta exported mercury at a rate of 440
16 kg/year to the Bay based on data from 2003 (San Francisco Bay Regional Water Quality Control
17 Board 2006). David et al. (2009) estimated the Delta's mercury export as 260 kg/year based on
18 sediment, flow, and mercury data from 1995 through 2006. The later estimation is recognized as the
19 most reliable calculation of mercury exported from the Delta to date (San Francisco Bay Regional
20 Water Quality Control Board 2006). Other sources contribute approximately 782 kg/year of
21 mercury to San Francisco Bay, and include bed erosion, urban stormwater runoff, wastewater
22 discharges, runoff from the Guadalupe River watershed and direct deposition (San Francisco Bay
23 Regional Water Quality Control Board 2006).

24 Methylmercury loading to the waters of San Francisco Bay is estimated to be approximately
25 25 kg/year and is dominated by internal loading of methylmercury from Bay sediments
26 (16 kg/year). External inputs account for approximately 8 kg/year of methylmercury loaded to the
27 Bay, of which the Delta accounts for 3.6 kg/year (Yee et al. 2011).

28 The San Francisco Bay Water Board assigned a total mercury waste load allocation (WLA) for the
29 Delta of 330 kg/year or a load reduction of 110 kg/year. The Central Valley Water Board has
30 targeted the 110 kg/year total mercury load reduction in its planned implementation of the Delta
31 Methylmercury TMDL (San Francisco Bay Regional Water Quality Control Board 2006). Waste load
32 allocations for methylmercury were not established in the San Francisco Bay Mercury TMDL.

33 **Load Estimates**

34 Mercury and methylmercury loads were estimated by taking into account the change in existing load
35 due to modifications in Delta outflow and changes in the fraction of source waters of Delta outflows
36 to San Francisco Bay that would occur under the project alternatives. The existing loads of mercury
37 and methylmercury from the Delta to San Francisco Bay of 260 kg/year and 3.6 kg/year,
38 respectively, were obtained from the published literature (David et al. 2009; Yee et al. 2011). These
39 loads were calculated using historical water quality and flow data from Mallard Island, and as such,
40 they account for the many sources of mercury and methylmercury to Delta waters. In assessing the
41 effects on mercury and methylmercury loads in Delta outflows due to the project alternatives, the
42 approach taken assumes that the multiple other sources of mercury and methylmercury to net Delta
43 outflow, besides changes in source water fraction and net outflow, would remain constant. This
44 assumption was made because data was only available to quantitatively estimate the change in

1 mercury and methylmercury loads due to changes in the magnitude of Delta outflow and changes in
2 mercury and methylmercury concentrations at Mallard Island due to changes in source water
3 fractions at that location. The project alternatives effects of floodplain and tidal restoration on
4 methylmercury concentrations in the Delta, and thus, the San Francisco Bay were not quantifiable,
5 and so were considered qualitatively in this analysis.

6 The long-term average mercury and methylmercury loads under the project alternatives were
7 calculated as the sum of 1) the existing mercury and methylmercury loads from existing literature,
8 and 2) the net change in the mercury and methylmercury load associated with changes in the source
9 water fraction/net outflow variables. The change in the mercury and methylmercury load in Delta
10 outflow was calculated as follows. Long-term average concentrations of mercury and
11 methylmercury in water were modeled quantitatively for the Delta using a mass-balance approach
12 (as described in Appendix 8I, *Nitrate*). Concentration data represent the concentration expected at a
13 given location due to conservative mixing (i.e., no uptake, loss or transformation) of the various
14 source water fractions under the project alternatives. Thus, the estimated concentrations do not
15 account for other sources of mercury and methylmercury to Delta waters, including mobilization of
16 sediment, flux from sediment, and in-Delta mercury methylation. Given its seaward location, the
17 modeled long-term average concentration data for Mallard Island (Appendix 8I, Table I-5 and Table
18 I-6) were assumed to represent the concentration of mercury and methylmercury in Delta outflow
19 due to changes in various source water fractions under the project alternatives. Modeled Mallard
20 Island concentrations were converted to loads using the long-term annual average Delta outflow (as
21 shown in Appendix 5A, Section C.7) at Mallard Island projected for Existing Conditions and the
22 project alternative. The difference between the load estimate for the alternative and Existing
23 Conditions is equivalent to the net change in the mercury and methylmercury load associated with
24 changes in the source water fraction/net outflow variables (item 2, above).

25 Long-term average mercury and methylmercury loads in Delta exports to San Francisco Bay were
26 then estimated by summing 1) the existing load (260 kg/year mercury; and 3.6 kg/year
27 methylmercury) and 2) the net change in the mercury and methylmercury load associated with
28 changes in the source water fraction/net outflow variables.

29 **Selenium**

30 **Constituent-specific Considerations**

31 Selenium is an essential trace element for human and other animal nutrition that occurs naturally in
32 the environment. It is also highly bioaccumulative and is of concern because at high levels it can
33 cause chronic toxicity (especially impaired reproduction) in fish and aquatic birds (Ohlendorf 2003).
34 Examples of those effects include reduced hatchability of fertile eggs and the development of severe,
35 often lethal, embryo deformities in fish and birds (US Department of Interior 1998; Ohlendorf 2003).
36 Because of the known effects of selenium bioaccumulation from aquatic organisms to higher trophic
37 levels in the food chain, the wildlife habitat and rare, threatened, or endangered species beneficial
38 uses are the most sensitive receptors to selenium exposure. Selenium also affects other aquatic life
39 beneficial uses, including warm freshwater habitat; cold freshwater habitat; migration of aquatic
40 organisms; spawning, reproduction, and/or early development; and estuarine habitat. Additional
41 non-habitat beneficial uses that may be affected include freshwater replenishment, municipal and
42 domestic supply, and agricultural supply.

1 Selenium is a constituent of concern in San Francisco Bay for potential effects on aquatic and
2 terrestrial resources, and (indirectly) human health. The State Water Board listed San Francisco Bay
3 as having impaired water quality for selenium under CWA Section 303(d) in 1998 (State Water
4 Resources Control Board 2011). Currently, North, Lower, and South San Francisco Bay are Section
5 303(d) listed for impairments from selenium due to reduced hatchability in nesting diving birds.
6 Historical monitoring of selenium in ducks, fish, and invertebrates in the northern part of San
7 Francisco Bay revealed concentrations that could cause health risks to people and wildlife. More
8 recent monitoring has shown that selenium tissue concentrations of diving ducks have declined to
9 be within the normal background range and white sturgeon muscle concentrations are substantially
10 lower than observed before the North Bay was Section 303(d) listed (San Francisco Bay Regional
11 Water Quality Control Board 2011; San Francisco Estuary Institute 2014). Selenium levels in the
12 North Bay have declined gradually since the early 1990s before the North Bay was first Section
13 303(d) listed (Tetra Tech 2008). This was due in part to the fact that petroleum refineries, which
14 were a major source of dissolved selenium to the North Bay at that time, implemented controls by
15 1999 that decreased selenium in their discharges by up to 66% (Tetra Tech 2008).

16 Although the entire San Francisco Bay is listed as impaired by selenium, separate TMDLs for
17 selenium will be developed for the North Bay and South Bay, as the primary selenium loading to the
18 North Bay and the Suisun Bay area is from the Delta, while the South Bay is affected by local and
19 watershed sources not associated with the Delta (Lucas and Stewart 2007). The San Francisco Bay
20 Water Board is conducting a new TMDL project to address selenium toxicity in the North Bay,
21 defined to include a portion of the Delta, Suisun Bay, Carquinez Strait, San Pablo Bay, and the Central
22 Bay (San Francisco Bay Regional Water Quality Control Board 2011). The North Bay selenium TMDL
23 will identify and characterize selenium sources to the North Bay and the processes that control the
24 uptake of selenium by wildlife. The TMDL also will quantify selenium loads, develop and assign
25 waste load allocations among sources, and include an implementation plan designed to achieve the
26 TMDL and protect beneficial uses.

27 Of the major watersheds that contribute to outflow from the Delta to the North Bay, selenium is
28 most enriched in marine sedimentary rocks of the Coast Ranges on the western side of the San
29 Joaquin Valley (Presser and Piper 1998). Erosion of the selenium-enriched sedimentary rock and
30 irrigation practices used in the Central Valley contribute to selenium concentrations in this
31 watershed.

32 The San Francisco Bay RMP collects samples throughout San Francisco Bay annually for
33 measurement of total and dissolved selenium. The San Francisco Bay Water Board (2011)
34 recommends averaging selenium concentrations from samples collected across the North Bay on an
35 annual basis to compare with water column selenium numeric thresholds. Total and dissolved
36 selenium data generated by the RMP during the period 2002–2013 for samples collected north of
37 the Bay Bridge and downstream of Mallard Island were averaged for each calendar year (San
38 Francisco Estuary Institute 2015). For dissolved selenium, annual average concentrations in the
39 North Bay ranged from 0.05–0.17 µg/L, averaging 0.11 µg/L over the entire period. For total
40 selenium, annual average concentrations in the North Bay ranged from 0.07–0.22 µg/L, averaging
41 0.13 µg/L over the entire period. The ratio of dissolved to total selenium over this period was 90%.

42 Selenium criteria were promulgated for all San Francisco Bay and Delta waters in the NTR (San
43 Francisco Bay Regional Water Quality Control Board 2013). The NTR criteria specifically apply to
44 San Francisco Bay upstream to and including Suisun Bay and the Delta. The NTR values are 5.0 µg/L
45 (4-day average) and 20 µg/L (1-hour average). By comparison, the available data show that the

1 maximum concentration in the North Bay has not exceeded 0.44 µg/L since 2002. However, the NTR
2 criteria are not considered protective of aquatic life in the San Francisco Bay because the current
3 scientific information shows that selenium toxicity is driven by dietary exposures that are amplified
4 through biomagnification of selenium through the aquatic food chain (U.S. Environmental Protection
5 Agency 2014). The USEPA has published draft aquatic life ambient water quality criteria for
6 selenium (U.S. Environmental Protection Agency 2014) that account for dietary exposure that
7 recommend fish and fish egg/ovary tissue concentrations that are protective of aquatic life. The
8 USEPA draft criterion for selenium is 15.2 mg/kg (dry weight) in fish eggs or ovaries, and 8.1 mg/kg
9 (dry weight) in fish whole-body (or 11.8 mg/kg in fish muscle). Selenium concentrations in white
10 sturgeon muscle throughout the entire San Francisco Bay, including fish from the North Bay, have
11 mostly been below 10 mg/kg (dry weight) in the most recent fish surveys conducted by the RMP
12 (San Francisco Estuary Institute 2014). Because obtaining fish tissues is challenging, USEPA (2014)
13 also recommends water column dissolved selenium criteria of 1.3 µg/L for lentic aquatic systems
14 and 4.8 µg/L for lotic aquatic systems. Water column dissolved selenium concentrations in the North
15 Bay have been substantially below the draft lentic or lotic recommended criteria.

16 Because the North Bay TMDL is currently in development, a final fish-tissue concentration target
17 and method for translating this target to a dissolved selenium water column concentration for the
18 North Bay has not yet been determined. Presser and Luoma (2013) translated a whole-body fish
19 tissue target of 8 mg/kg to a dissolved selenium water column concentration using ecosystem
20 modeling and data/assumptions specific to the North Bay. In the North Bay, white sturgeon are
21 considered representative of the most sensitive aquatic species because its exposure to selenium is
22 high due to its long lifecycle, its benthic feeding habits, and its diet consisting of selenium-rich
23 benthic macroinvertebrates (i.e., *Corbula amurensis*) (San Francisco Bay Regional Water Quality
24 Control Board 2011). A dissolved selenium concentration of 0.202 µg/L, applicable to the North Bay
25 as a whole, was predicted by Presser and Luoma (2013) to coincide with a whole-fish tissue
26 concentration in white sturgeon of 8 mg/kg under long-term average annual flow conditions
27 (trophic transfer factors for predator and prey were 1.3 and 9.2, respectively; partitioning
28 coefficient (Kd) was 3,317 L/g).

29 Annual average dissolved selenium concentrations in the North Bay as measured by the RMP (0.05–
30 0.17 µg/L) have been below the 0.202 µg/L dissolved selenium water column target since 2002. The
31 low long-term average dissolved selenium concentration of the North Bay (0.11 µg/L) and data from
32 recent fish tissue surveys have led to the suggestion that the North Bay may not currently be
33 impaired with respect to selenium, and this suggestion has led to continued efforts as part of the
34 North Bay TMDL development to determine the current effects to aquatic life from selenium in the
35 North Bay (San Francisco Bay Regional Water Quality Control Board 2011).

36 Existing annual average selenium loads for the entire North Bay have been calculated based on
37 measured concentrations of the major source waters to the North Bay, with concentrations
38 measured in samples from Mallard Island used to estimate the load of total selenium exported from
39 the Delta (San Francisco Bay Regional Water Quality Control Board 2011). The Preliminary Project
40 Report for the North Bay selenium TMDL has reported the existing load of total selenium to the
41 North Bay is 5,605 kg/year (assuming an average urban and non-urban runoff load of 595 kg/year).
42 The existing total selenium load to the North Bay from the Delta is 3,940 kg/year, which comprises
43 70.3% of the entire North Bay load (San Francisco Bay Regional Water Quality Control Board 2011).
44 While the entire North Bay load of dissolved selenium was not determined, the dissolved selenium
45 load to the North Bay from the Delta has been estimated as 2,700 kg/year (S San Francisco Bay
46 Regional Water Quality Control Board 2011; Tetra Tech 2014).

1 Load Estimates

2 The project alternatives would primarily influence selenium loads to the North Bay through
3 diversion of Sacramento River water at the proposed north Delta intakes, with the diverted fraction
4 being replaced by flows from the San Joaquin River, which are naturally enriched with selenium.
5 Because relatively minimal changes (<10%) in long-term average net Delta outflow relative to the
6 project alternatives are expected (Appendix 5A, Section C.7), tidal velocities, and thus sedimentation
7 rates, in the Plan Area and North Bay are expected to remain unchanged. Thus, increased
8 sedimentation of particulates, and associated selenium enrichment of North Bay sediments, due to
9 changes in net Delta outflow is not expected. Any changes in sediment selenium levels that would
10 occur in the North Bay would track the relative changes in selenium water column concentrations
11 due to the alternative. Changes in North Bay water column selenium concentrations and loads due to
12 the project alternatives were determined as follows.

13 The long-term average total and dissolved selenium concentrations in the North Bay under the
14 project alternatives were estimated assuming that the current long-term average selenium
15 concentrations of the North Bay (0.11 and 0.13 µg/L for dissolved and total selenium) would change
16 in proportion to the change in the long-term average total selenium load of the North Bay. North Bay
17 selenium loads were estimated by taking into account the change in existing load due to
18 modifications in net outflow and source water fractions of Delta exports to the North Bay expected
19 for the alternative. Specifically, the long-term average selenium load of the North Bay under the
20 alternative was calculated as the summation of 1) the existing North Bay selenium load (5,605
21 kg/year), and 2) the incremental change in selenium load of net Delta outflow expected under the
22 alternative.

23 The incremental change in selenium load in net Delta outflow under the project alternatives (item 2,
24 above) was estimated as follows, assuming that loads to the North Bay besides those from the Delta
25 would remain unchanged. First, the percentage change in selenium load in net Delta outflow was
26 calculated using modeling results. Long-term average concentrations of dissolved selenium in water
27 were modeled for the Delta using a quantitative mass-balance approach (as described in Appendix
28 8M, *Selenium*). Concentration data represent the concentration expected at a given location due to
29 conservative mixing (i.e., no uptake, loss or transformation) of the various source water fractions
30 under the alternative. Thus, the estimated concentrations do not account for other sources or sinks
31 of selenium to Delta waters, including mobilization of sediment, flux from sediment, and sediment
32 deposition. Given its seaward location, the modeled long-term average concentration data for the
33 Mallard Island station (Appendix 8M, Tables M-9a and M-9b) were assumed to represent the
34 concentration of dissolved selenium in Delta outflow due to conservative mixing of the various
35 source waters under the alternative. Mallard Island concentration data were converted to selenium
36 loads using the long-term annual average flow (as shown in Appendix 5A, Section C.7) at Mallard
37 Island. The percentage change of the modeled selenium load (modeled percentage change”) under
38 the alternative relative to the modeled selenium load in Delta outflow under Existing Conditions was
39 then calculated. The incremental change in total selenium load of net Delta outflow under the
40 alternative (item 2, above) was calculated as the product of 1) the modeled percentage change in
41 selenium load, and 2) the current estimate for existing long-term average total selenium loads from
42 the Delta to the North Bay (3,940 kg/year).

1 **8.3.2 Determination of Effects**

2 The water quality effects of the action alternatives and the No Project Alternative, relative to
 3 Existing Conditions for CEQA, and of the action alternatives relative to the No Action Alternative for
 4 NEPA were determined consistent with the Methods for Analysis presented in the previous section,
 5 and are presented below. Additional discussion beyond that presented herein pertaining to the
 6 potential for water quality-related effects on fish and aquatic resources, human health, and
 7 agriculture are addressed in Chapter 11, *Fish and Aquatic Resources*; Chapter 25, *Public Health*; and
 8 Chapter 14, *Agricultural Resources*, respectively.

9 As discussed in greater detail in Chapter 5, *Water Supply*, Section 5.3.2, the NEPA No Action
 10 Alternative (LLT), which reflects an anticipated future condition in 2060 and 2025 (ELT), includes
 11 both sea level rise and climate change (changed precipitation patterns), and also assumes, among
 12 many other programs, projects, and policies, implementation of most of the required actions under
 13 both the December 2008 USFWS BiOp and the June 2009 NMFS BiOp. The NEPA effects analyses in
 14 this chapter reflect these No Action assumptions.

15 **8.3.2.1 Screening Analysis and Results**

16 This water quality analysis assessed the potential effects of implementing the various alternatives
 17 on 182 constituents (or classes of constituents). The initial analysis of water quality effects, referred
 18 to as the “screening analysis” in the introduction to Section 8.3.1, *Methods of Analysis*, resulted in
 19 the following findings. Of the 182 constituents, 110 were determined to have no potential to be
 20 adversely affected by the alternatives to an extent to which adverse environmental effects would be
 21 expected. Historical data for these constituents showed no exceedances of water quality
 22 objectives/criteria in the major Delta source waters, were not on the State’s 303(d) list in the
 23 affected environment, were not of concern based on professional judgment or scoping comments,
 24 and had no potential for substantial long-term water quality degradation. Consequently, no further
 25 analyses were performed for these 110 constituents. Conversely, further analysis was determined to
 26 be necessary for 72 constituents. Of these, 15 are addressed further in the Screening Analysis itself
 27 in Appendix 8C because they did not warrant alternative-specific analyses, and 1—temperature—is
 28 addressed in Chapter 11, *Fish and Aquatic Resources*. The remaining 56 constituents are addressed
 29 in the Environmental Consequences section, and are contained in the sections noted in Table 8-61.

30 In addition, *Microcystis aeruginosa*, a species of freshwater cyanobacteria, is addressed in the water
 31 quality assessment, due to potential adverse effects to beneficial uses of Delta waters, including
 32 water supply and aquatic life uses, as further described in Section 8.1.3.18.

33 As discussed in Section 8.3.1, *Methods for Analysis*, constituents that require analysis beyond that of
 34 the initial screening analysis, and that do not behave conservatively (e.g., degrade or are consumed
 35 in biochemical processes) within the system were further assessed qualitatively. Conversely,
 36 constituents that are primarily conserved (i.e., do not change) as they move through the system (e.g.,
 37 dissolved salts) were candidates for further quantitative assessments, via comparisons of modeled
 38 scenarios that depict the Existing Conditions, No Action Alternative, and the action alternatives
 39 (Table 8-61).

1 **Table 8-61. Water Quality Constituents for which Detailed Assessments are Performed**

Constituents Carried Forward for Further Analysis	Quantitative ^a	Qualitative	Section of Environmental Consequences
Ammonia		X	Ammonia
Boron	DSM2+MB		Boron
Bromide	DSM2+MB/EC Ratios		Bromide
Chloride	DSM2+MB/EC Ratios		Chloride
Oxygen		X	Dissolved Oxygen
Conductance (EC)	DSM2-QUAL		Electrical Conductivity (EC)/TDS
Total Dissolved Solids		X	Electrical Conductivity (EC)/TDS
Mercury	DSM2+MB		Mercury
<i>Microcystis</i>		X	<i>Microcystis</i>
Nitrate	DSM2+MB	X	Nitrate
Nitrite		X	Nitrate
Nitrite + Nitrate		X	Nitrate
Organic Carbon	DSM2-QUAL		Organic Carbon (DOC/TOC)
Haloacetic acids ^b		X	Organic Carbon (DOC/TOC)
Trihalomethanes ^c		X	Organic Carbon (DOC/TOC)
Cryptosporidium		X	Pathogens
Escherichia coli		X	Pathogens
Organochlorine, Organophosphate, and Pyrethroid Pesticides ^d		X	Pesticides and Herbicides
Phosphorus		X	Phosphorus
Selenium	DSM2+MB		Selenium
Other Trace Metals ^e		X	Trace Metals
Total Suspended Solids		X	Turbidity and TSS
Volatile Suspended Solids		X	Turbidity and TSS
Turbidity		X	Turbidity and TSS

^a DSM2+MB = Constituent was modeled via mass balance approach described in Section 8.3.1.3, *Plan Area* (i.e., DSM2 fingerprinting results coupled with historical source water quality data); EC Ratios = Constituent was modeled via EC to chloride and/or chloride to bromide ratios described in Section 8.3.1.3; DSM2-QUAL = Constituent was modeled directly using DSM2-QUAL.

^b Dibromoacetic Acid (DBAA), dichloroacetic Acid (DCAA), trichloroacetic Acid (TCAA), total haloacetic acids

^c Bromodichloromethane, bromoform, dibromochloromethane, total THMs

^d Aldrin, BHC, BHC-alpha, BHC-beta, BHC-delta, BHC-gamma (lindane), chlordane, chlorpyrifos, diazinon, dieldrin, endosulfan (mixed isomers), endosulfan-I, endosulfan-II, endrin, heptachlor, p,p'-DDD, p,p'-DDE, p,p'-DDT, toxaphene, pyrethroids

^e Aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, nickel, zinc, aluminum, silver

2

1 8.3.2.2 Comparisons

2 For hydrologic (i.e., CALSIM) modeling purposes, which depicts CVP and SWP system-wide
 3 operations and thus how water would be routed through the Delta, Existing Conditions, the No
 4 Action Alternative and the action alternatives were partly defined according to the key inputs shown
 5 in Table 8-62. For the quantitative and qualitative assessments performed, comparisons of the
 6 assessment scenarios were made consistent with Table 8-63 and are presented in Section 8.3.3,
 7 *Effects and Mitigation Approaches*. The CEQA baseline, “Existing Conditions”, is defined in Appendix
 8 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact*
 9 *Conditions*, and for the purposes of the quantitative water quality assessments is represented by
 10 Existing Conditions modeling runs, not historical water quality monitoring data as presented in
 11 Section 8.1.3, *Existing Surface Water Quality*. The No Action Alternative is defined by the future
 12 surface water demands at the 2025 level of development, and specific future planned and approved
 13 facilities and operations described in Appendix 3D. In addition, two planning horizons for projected
 14 climate change and sea level rise are provided, one at 2025 (ELT) and the other at 2060 (LLT). The
 15 longer planning horizon to 2060 for climate change is assumed for the No Action Alternative (LLT)
 16 compared to system water supply and demands to be commensurate with the 50-year
 17 implementation timeframe for the action alternatives that include HCP/NCCP components (i.e.,
 18 Alternatives 1A-1C, 2A-2C, 3, 4, 5, 6A-C, 7, 8, and 9). The shorter planning horizon to 2025 – the ELT
 19 scenario -- is assumed for the alternatives that do not include HCP/NCCP components (i.e.,
 20 Alternatives 2D, 4A, and 5A).

21 **Table 8-62. Water Quality Assessment Scenarios**

Input Parameters	Existing Conditions	No Action Alternative	Project Alternatives
Surface Water Demands ^a	2005/Recent Historical	2025/Full Water Rights	2025/Full Water Rights
Conveyance	Through Delta	Through Delta	Various
CVP/SWP Operational Criteria	Per USFWS and NMFS BiOps RPAs ^b	Per USFWS and NMFS BiOps RPAs ^b	Various
Fall X2	No	Yes	Some Yes, Some No
Climate Change/Sea Level Rise	None	Year 2060 (LLT) Year 2025 (ELT)	Year 2060 (BDCP alternatives) Year 2025 (non-HCP alternatives)

^a This is a simplified characterization of the water demands to illustrate the differences between the scenarios. Water demands for some purveyors under the No Action and action alternatives are the same as those under Existing Conditions, while others are increased to a full contract amount or 2030 level. See CALSIM II modeling assumptions for specific differences (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*).

^b U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Biological Opinions (BiOps) Reasonable and Prudent Alternatives (RPAs) are described in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*, and Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*.

22

1 **Table 8-63. Scenario Comparisons Performed for Impact Assessment Purposes**

Comparison	Purpose of Comparison
1 Existing Conditions versus Alternatives (including No Action Alternative)	A required comparison to current conditions for CEQA purposes. Shows effects due not only to changes in conveyance facilities and operational criteria defined by the alternative, including meeting Fall X2, but also the effects of future surface water demands and climate change/sea level rise. ^a
2 No Action Alternative versus Project Alternatives	Identifies potential alternative-specific effects caused by changes in conveyance facilities and operating criteria.

^a The CEQA baseline, “Existing Conditions”, is defined in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*, and for the purposes of quantitative water quality assessments, is represented by Existing Conditions modeling runs, not historical water quality monitoring data as presented in Section 8.1.3, *Existing Surface Water Quality*.

2

3 **8.3.2.3 Effects Determinations**

4 Both qualitative and quantitative water quality assessments have been conducted to determine the
5 anticipated changes in water quality that may occur throughout the affected environment from
6 implementing an alternative, relative to the water quality conditions that would occur under the
7 Existing Conditions or the No Action Alternative. The water quality effects of the action or
8 alternative would be adverse (under NEPA) and significant (under CEQA) if implementation of an
9 alternative would result in one of the numbered conditions below. As defined and used for
10 assessment purposes, these conditions serve as both effects criteria under NEPA and thresholds of
11 significance under CEQA. As is explained in more detail below, the thresholds build on, and add
12 detail to, general questions posed in the sample Initial Study checklist found in Appendix G to the
13 CEQA Guidelines. The refinements to the language set forth in that document reflects the application
14 of professional judgment and experience to the more general language found in the original.

- 15 1. Cause exceedance of applicable state or federal numeric or narrative water quality
16 objectives/criteria, or other relevant water quality effects thresholds identified for this
17 assessment (applicable objectives/criteria are identified in Appendix 8A, *Water Quality Criteria*
18 *and Objectives*, and the constituent-specific assessments in Section 8.3.1.7, *Constitute-Specific*
19 *Considerations Used in the Assessment*), by frequency, magnitude, and geographic extent that
20 would result in adverse effects to one or more beneficial uses within affected water bodies.
- 21 2. Increase levels of a bioaccumulative pollutant by frequency, magnitude, and geographic extent
22 such that the affected water body (or portion of a water body) would be expected to have
23 measurably higher body burdens of the bioaccumulative pollutant in aquatic organisms, thereby
24 substantially increasing the health risks to wildlife (including fish) or humans consuming those
25 organisms.
- 26 3. Cause long-term degradation of water quality in one or more water body of the affected
27 environment, resulting in sufficient use of available assimilative capacity such that occasionally
28 exceeding water quality objectives/criteria would be likely and would result in substantially
29 increased risk for adverse effects to one or more beneficial uses.
- 30 4. Further degrade water quality by measurable levels, on a long-term basis, for one or more
31 parameters that are already impaired and, thus, included on the State’s Clean Water Act

1 Section 303(d) list for the water body, such that beneficial use impairment would be made
2 discernibly worse.

3 5. Substantially alter the existing drainage pattern of the site or area, including through the
4 alteration of the course of a stream or river, in a manner which would result in substantial
5 erosion or siltation on- or off-site.

6 The third effect assessment criterion/threshold listed above is triggered not by increased
7 exceedances of water quality standards or adverse impacts on beneficial uses, but rather by the
8 more sensitive threshold of demonstrated water quality degradation, on a long-term basis, that
9 eliminates a substantial amount of the receiving water body's available assimilative capacity,
10 thereby resulting in water quality conditions that substantially increase the likelihood of water
11 quality objectives/criteria exceedances and adverse effects to beneficial uses. This effects
12 assessment criterion/threshold would not be met if a substantial amount of available assimilative
13 capacity is used under the alternative assessed, yet substantial assimilative capacity remains such
14 that exceeding water quality objectives/criteria would be rare, if it were to occur at all and,
15 therefore, resulting water quality poses negligible risk for adverse effects to beneficial uses.

16 Similarly, the fourth effect assessment criterion/threshold above is met not by demonstrated or
17 potential adverse effects to beneficial uses, but rather the more sensitive criteria/threshold of
18 "measurable degradation," on a long-term basis, under already impaired conditions. This effect
19 assessment criterion/threshold is included in recognition that an adverse effects determination
20 should be more sensitive when water quality conditions are already impaired in a water body and,
21 therefore, any measurable worsening, on a long-term basis, may be considered substantial and
22 adverse. This fourth effects assessment criterion/threshold provides meaningful sensitivity for
23 already impaired conditions by requiring measurable changes, on a long-term basis, rather than
24 "any" change at any time (i.e., a change that could be calculated, but may not be measureable in the
25 actual environment, or may not occur frequently enough to measurably alter water quality on a
26 long-term basis).

27 The fifth effect assessment criterion/threshold listed above applies to alteration of drainage
28 patterns, which occurs through construction of various components of the project. Consequently,
29 effects of the project were assessed relative to this criterion/threshold fully in the sections relating
30 to effects of construction only.

31 As indicated above, these thresholds/criteria set forth above were derived from questions relating
32 to hydrology and water quality in Appendix G (Section IX) of the CEQA Guidelines. Without
33 refinements, thresholds derived literally from that source would read as follows:

- 34 • Violate any water quality standards (criterion 1);
- 35 • Substantially alter the existing drainage pattern of the site or area, including through the
36 alteration of the course of a stream or river, in a manner which would result in substantial
37 erosion or siltation on- or off-site (criterion 5);
- 38 • Otherwise substantially degrade water quality (criteria 3 and 4).

39 Appendix G thresholds of significance relating specifically to hydrology and flooding, and whether
40 the project would substantially increase the rate or amount of surface runoff in a manner which
41 would result in flooding on- or off-site, are addressed in Chapter 6, *Surface Water*. The above-listed
42 Appendix G thresholds have been integrated into the five numbered effects criteria/thresholds
43 listed above and the applicable water quality objectives/criteria are identified in Appendix 8A,

1 *Water Quality Criteria and Objectives, and in Section 8.3.1.7, Constitute-Specific Considerations Used*
2 *in the Assessment.*

3 The first bulleted Appendix G threshold, “violate any water quality standard,” was refined for
4 application in effects criterion/threshold #1. This is because a “water quality standard” contains
5 three components: 1) the beneficial uses of the water body to be protected, 2) the criteria/objectives
6 that, when met, result in water quality protective of the designated beneficial uses, and 3) an
7 antidegradation policy. Therefore, effects criterion/threshold #1 started with the basic concept
8 behind this first Appendix G threshold, and was further refined to account for the frequency,
9 magnitude, and geographic extent with which a water quality criterion or objective could be
10 exceeded, thereby giving the assessor the ability to relate such exceedances to adverse effects on
11 beneficial uses (i.e., actual adverse environmental effects). As such, effects criterion/threshold #1
12 will identify significant impacts under CEQA when water quality under an alternative is anticipated
13 to change substantially, thereby causing adverse effects to beneficial uses, and will avoid making
14 such determinations when the violation of a water quality standard is too infrequent, low in
15 magnitude, and/or isolated geographically to actually cause any adverse effects on beneficial uses of
16 the water body or water body segment.

17 Similarly, the third bulleted Appendix G threshold of “... substantially degrade water quality,” is
18 vague as written and thus not sufficiently specific to allow meaningful or precise application as a
19 threshold of significance. Therefore, it too has been refined and expanded into effects
20 criteria/thresholds #3 and #4 enumerated above.

21 Finally, the second bulleted CEQA Appendix G threshold has been included directly as effects
22 criterion/threshold #5. Consequently, the applicable water quality thresholds of significance
23 identified in Section IX of Appendix G of the CEQA Guidelines have been fully incorporated into the
24 five numbered effects criteria/thresholds used to assess the identified water quality changes under
25 the alternatives for the purposes of making impact determinations for CEQA purposes.

26 **8.3.3 Effects and Mitigation Approaches**

27 **8.3.3.1 No Action Alternative**

28 Pursuant to the description of comparisons made in this chapter, which are discussed in Section
29 8.3.2.2, this section contains the comparison of the No Action Alternative vs. Existing Conditions for
30 CEQA purposes.

31 Under the No Action Alternative, the facilities and operations of the SWP and CVP would continue to
32 be similar to Existing Conditions with the following changes.

- 33 ● Effects of sea level rise and climate change on system operations.
- 34 ● An increase in demands and the buildout of facilities associated with water rights and CVP and
35 SWP contracts of about 443 thousand acre-feet per year (TAF/year), north of Delta at the future
36 level of development. This is an increase in CVP municipal and industrial (M&I) service contracts
37 (253 TAF/year) and water rights (184 TAF/year) related primarily to urban M&I use, especially
38 in the communities in El Dorado, Placer, and Sacramento Counties.
- 39 ● An increase in demands associated with SWP contracts, up to full contract amounts, south of
40 Delta at the future level of development. SWP M&I demands, which under the existing level of
41 development vary on hydrologic conditions between 3.0 and 4.1 MAF per year, under the future

1 condition are at maximum contract amounts in all hydrologic conditions. This represents a
 2 potential 25% increase on average in south of Delta demands under SWP M&I contracts
 3 between existing and future levels of development due to assumed additional development and
 4 demographics.

5 • New urban intake/Delta export facilities:

- 6 ○ Freeport Regional Water Project (see Appendix 5A, *BDCP/California WaterFix FEIR/FEIS*
 7 *Modeling Technical Appendix*, for information on additional East Bay Municipal Utility
 8 District (EBMUD) demand of about 26 TAF/year on the average with increased demand in
 9 dry years)
- 10 ○ 30 million-gallon-per-day City of Stockton Delta Water Supply Project
- 11 ○ Delta-Mendota Canal–California Aqueduct Intertie
- 12 ○ Contra Costa Water District Alternative Intake and 55 TAF/year increased demand
- 13 ○ South Bay Aqueduct rehabilitation, to 430 cubic feet per seconds (cfs) capacity, from the
 14 junction with California Aqueduct to Alameda County Flood Control and Water Conservation
 15 District Zone 7.
- 16 • An increase in supplies for wildlife refuges including Firm Level 2 supplies of about 8 TAF/year
 17 at the future level of development. In addition, there is a shift in refuge demands from south to
 18 north (24 TAF/year reduction in south of Delta and 32 TAF/year increase in north of Delta).
- 19 • Implementation of the Fall X2 Reasonable and Prudent Alternative (RPA) action (see Appendix
 20 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*), which requires
 21 maintenance of X2 at specific locations in wet and above normal years in September and
 22 October, plus releases in November to augment Delta outflow dependent on hydrology.

23 A detailed description of the modeling assumptions associated with the No Action Alternative is
 24 included in Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*.

25 Note that the numbering of water quality impacts for the No Action Alternative, presented below, is
 26 consistent with the numbering of impacts for the action alternatives. For the action alternatives, two
 27 numbered impacts are provided for each constituent or constituent class, one for impacts due to
 28 water conveyance facilities operations and maintenance, and the other for impacts due to
 29 implementation of conservation measures under BDCP alternatives or Environmental Commitments
 30 under HCP alternatives. For the No Action Alternative, only discussion of impacts due to water
 31 conveyance facilities operations and maintenance is applicable. Therefore, only one numbered
 32 impact for each constituent or constituent-class is provided for the No Action Alternative, consistent
 33 with the numbering for the action alternatives' water conveyance facilities operations and
 34 maintenance impacts.

35 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and**
 36 **Maintenance**

37 ***Upstream of the Delta***

38 Substantial point sources of ammonia-N do not exist upstream of the SRWTP in the Sacramento
 39 River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras
 40 Rivers), or upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of ammonia-
 41 N within the watersheds are also relatively low, thus resulting in generally low ammonia-N

1 concentrations in the reservoirs and rivers of the watersheds. Consequently, any modified reservoir
 2 operations and subsequent changes in river flows under the No Action Alternative, relative to
 3 Existing Conditions, are expected to have negligible, if any, effects on reservoir and river ammonia-N
 4 concentrations upstream of Freeport in the Sacramento River watershed and upstream of the Delta
 5 in the San Joaquin River watershed. Any negligible changes in ammonia-N concentrations that may
 6 occur in the water bodies of the affected environment located upstream of the Delta would not be of
 7 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 8 substantially degrade the quality of these water bodies, with regards to ammonia.

9 **Delta**

10 As summarized in Table 8-40, under the No Action Alternative, it is assumed that SRWTP upgrades
 11 would be in place, and thus that the average monthly effluent ammonia concentration would not
 12 exceed 1.5 mg/L-N in April through October and 2.4 mg/L-N in November through March. In
 13 comparison, the permitted average monthly effluent ammonia concentration under the Existing
 14 Conditions is 33 mg/L-N, with actual monthly average ammonia concentration in the effluent being
 15 approximately 24 mg/L-N (Central Valley Regional Water Quality Control Board 2010e). Because of
 16 this, ammonia concentrations in the Sacramento River downstream of the SRWTP would be
 17 substantially lower under the No Action Alternative, relative to Existing Conditions. As shown in
 18 Figure 8-52, Sacramento River ammonia concentrations currently are of the same magnitude as San
 19 Joaquin River and San Francisco Bay concentrations of ammonia during the January through March
 20 period of the year, and much greater than these two sources for the remainder of the year.
 21 Consequently, a substantial decrease in Sacramento River ammonia concentrations is expected to
 22 decrease ammonia concentrations for all areas of the Delta that are influenced by Sacramento River
 23 water. Additionally, San Joaquin River and San Francisco Bay concentrations are similar to each
 24 other throughout the year (Figure 8-52), indicating that any change in source water fraction from
 25 BAY to SJR or from SJR to BAY at locations in the Delta would not substantially alter concentrations
 26 at these locations. Therefore, at locations which are not influenced notably by Sacramento River
 27 water, concentrations are expected to remain relatively unchanged. Any negligible increases in
 28 ammonia-N concentrations that may occur at certain locations in the Delta would not be of
 29 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 30 substantially degrade the water quality at these locations, with regards to ammonia.

31 **SWP/CVP Export Service Areas**

32 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 33 of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source waters
 34 influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers (see
 35 Appendix 8D, *Source Water Fingerprinting Results*). As discussed above for the Plan Area, for areas of
 36 the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants,
 37 ammonia concentrations are expected to decrease under the No Action Alternative, relative to
 38 Existing Conditions. This decrease in ammonia-N concentrations for water exported via the south
 39 Delta pumps is not expected to result in adverse effects on beneficial uses or substantially degrade
 40 water quality of exported water, with regards to ammonia.

41 In summary, based on the discussion above, effects on ammonia of facilities operations and
 42 maintenance are considered to be not adverse.

43 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 44 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,

1 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 2 constituent. For additional details on the effects assessment findings that support this CEQA impact
 3 determination, see the effects assessment discussion that immediately precedes this conclusion.

4 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 5 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 6 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 7 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 8 any modified reservoir operations and subsequent changes in river flows under the No Action
 9 Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects on
 10 reservoir and river ammonia-N concentrations upstream of Freeport in the Sacramento River
 11 watershed and upstream of the Delta in the San Joaquin River watershed.

12 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 13 substantially lower under the No Action Alternative, relative to Existing Conditions, due to upgrades
 14 to the SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the
 15 Delta that are influenced by Sacramento River water are expected to decrease. At locations which
 16 are not influenced notably by Sacramento River water, concentrations are expected to remain
 17 relatively unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected
 18 changes in either of these concentrations.

19 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 20 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 21 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 22 Jones pumping plants, ammonia-N concentrations are expected to decrease under the No Action
 23 Alternative, relative to Existing Conditions.

24 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 25 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 26 SWP/CVP Export Service Areas under the No Action Alternative relative to Existing Conditions. As
 27 such, this alternative is not expected to cause additional exceedance of applicable water quality
 28 objectives/criteria by frequency, magnitude, and geographic extent from ammonia that would cause
 29 adverse effects on any beneficial uses of waters in the affected environment. Because ammonia
 30 concentrations would not be expected to increase substantially, no long-term water quality
 31 degradation is expected to occur and, thus, no adverse effects on beneficial uses would occur.
 32 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
 33 may occur in some areas would not make any existing ammonia-related impairment measurably
 34 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,
 35 minor increases that may occur in some areas would not bioaccumulate to greater levels in aquatic
 36 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 37 is considered to be less than significant.

38 **Impact WQ-3: Effects on Boron Concentrations Resulting from Existing Facilities Operations** 39 **and Maintenance**

40 ***Upstream of the Delta***

41 Under the No Action Alternative, greater water demands and climate change would alter the
 42 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
 43 River watershed and eastside tributaries, relative to Existing Conditions. Because substantial

1 sources of boron do not exist upstream of the Delta in the watersheds of the Sacramento River and
 2 eastside tributaries, concentrations of boron in surface water are low and often below detection
 3 limits (see Section 8.1, *Environmental Setting/Affected Environment*). Consequently, changes in the
 4 magnitude and timing of reservoir releases and river flows upstream of the Delta would have
 5 negligible, if any, effect on boron sources, and ultimately the concentration of boron in the
 6 Sacramento River, the eastside tributaries, and the various reservoirs of the related watersheds.
 7 Consequently, the No Action Alternative would not be expected to cause exceedance of boron
 8 objectives or substantially degrade water quality with respect to boron and thus, would not
 9 adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, or their
 10 associated reservoirs upstream of the Delta.

11 South of the Delta, the San Joaquin River is a substantial source of boron. While tributaries and
 12 associated reservoirs of the lower San Joaquin are likely negligible sources of boron, loading in the
 13 lower San Joaquin watershed contributes to relatively high concentrations which can be sourced to
 14 agricultural irrigation of soils containing boron and use of water imported from the south Delta.
 15 Average boron concentrations in the lower San Joaquin River at Vernalis are inversely correlated to
 16 net river flow and the dilution provided by this flow. Under the No Action Alternative, long-term
 17 average flows at Vernalis would decrease 6% relative to Existing Conditions (as a result of climate
 18 change and increased water demands) (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 19 *Technical Appendix*). Based on best-fit regressions of annual average San Joaquin River flow and
 20 boron, these decreases in flow would correspond to a potential increase in long-term average boron
 21 of about 2% relative to Existing Conditions (Appendix 8F, Table Bo-32). The relatively small
 22 increase would not cause boron concentrations to exceed applicable objectives relative to Existing
 23 Conditions and would not cause substantial long-term water quality degradation with regards to
 24 boron. Accordingly, with respect to the 303(d) listing of the lower San Joaquin River impairment for
 25 boron would not be made discernibly worse. The No Action Alternative also would not be expected
 26 to adversely affect necessary TMDL actions implemented to reduce boron loading in the lower San
 27 Joaquin River because the modeled increases are associated with less dilution of the existing load
 28 and boron loading would not be anticipated to change measurably. Consequently, the small
 29 increases in lower San Joaquin River boron levels that may occur under the No Action Alternative,
 30 relative to Existing Conditions, would not be expected to adversely affect any beneficial uses of the
 31 lower San Joaquin River.

32 **Delta**

33 Relative to Existing Conditions, the No Action Alternative would result in generally similar long-term
 34 annual average boron concentrations, or decreased average concentrations, at ten of the eleven
 35 Delta assessment locations for the 16-year period modeled (i.e., 1976–1991), and would increase
 36 only at the Jones Pumping Plant location by about 3% (Appendix 8F, Table Bo-2). Increased monthly
 37 average concentrations would occur under the No Action Alternative at nine of the assessment
 38 locations during the months of December through June, with decreased or similar concentrations
 39 occurring only at two interior Delta locations (i.e., SF Mokelumne River at Staten Island and San
 40 Joaquin River at Buckley Cove). For the drought year period modeled (i.e., 1987–1991), the No
 41 Action Alternative would result in increased annual average concentrations at six locations (up to a
 42 maximum 4% increase at the Jones Pumping Plant) relative to Existing Conditions.

43 With respect to the 2,000 µg/L EPA drinking water human health advisory objective (i.e., for
 44 children), the long-term annual average and monthly average boron concentrations, for either the
 45 16-year period or drought period modeled, are low and would never exceed this objective at any of

1 the eleven Delta assessment locations under the No Action Alternative (i.e., maximum long-term
2 average concentration of about 417 µg/L at the Sacramento River at Mallard Island), which
3 represents a slight decrease from the Existing Conditions (Appendix 8F, Table Bo-3A). Long-term
4 average boron concentrations would be similar or slightly lower at most Delta assessment locations,
5 and no changes would result in measureable long-term use of assimilative capacity (i.e., less than
6 3% reduction) or further degradation of water quality conditions with respect to the 2,000 µg/L
7 objective (Appendix 8F, Table Bo-4). Consequently, boron levels that may occur under the No Action
8 Alternative, relative to Existing Conditions, would not be expected to adversely affect municipal
9 water supply beneficial uses of the Delta.

10 Similarly, under the No Action Alternative, the long-term annual average and monthly average
11 boron concentrations for either the 16-year period or drought period modeled would never exceed
12 the lowest agricultural objective of 500 µg/L contained in the San Francisco Bay RWQCB (Region 2)
13 Basin Plan at any Delta assessment location except at the Sacramento River at Mallard Island and
14 San Joaquin River at Antioch locations (Appendix 8F, Table Bo-3A). However, the agricultural
15 beneficial use is not an existing designated use at Mallard Island within the Region 2 Basin Plan, and
16 the Antioch location is in the far western Delta and not a location of agricultural diversions
17 (California Department of Water Resources 1995). Small reductions in the modeled long-term
18 average assimilative capacity would occur only at the Jones and Banks pumping plants, Old River at
19 Rock Slough, and Sacramento River at Emmaton locations (e.g., maximum reduction of 3% at Jones
20 Pumping Plant for both the 16-year and 4% for the modeled drought period) (Appendix 8F, *Boron*,
21 Table Bo-5). Moreover, the reduced assimilative capacity would not lead to an increased frequency
22 of exceedances of objectives because the absolute concentrations would be well below the lowest
23 500 µg/L objective for the protection of agricultural beneficial uses, as indicated in plots of monthly
24 average boron concentrations for representative interior and south Delta locations (i.e., Franks
25 Tract, Old River at Rock Slough, Jones Pumping Plant, and Old River at Tracy Road) (Appendix 8F,
26 Figure Bo-2). Consequently, the small increases in average boron concentrations that may occur
27 under the No Action Alternative, relative to Existing Conditions, would not be expected to adversely
28 affect municipal or agricultural water supply beneficial uses of the Delta, or substantially degrade
29 water quality with respect to boron.

30 ***SWP/CVP Export Service Areas***

31 Under the No Action Alternative, relatively small increases would occur in long-term average boron
32 concentrations at the Jones and Banks pumping plants relative to the Existing Conditions (i.e., up to
33 4% at Jones pumping plant for both the 16-year and drought period modeled) (Appendix 8F, Table
34 Bo-2). With respect to the 303(d) listing of the lower San Joaquin River impairment for boron,
35 increased boron concentrations in exported water to the San Joaquin River basin could lead to
36 increased loading in the lower San Joaquin River since boron is principally related to irrigation
37 water deliveries. However, the absolute average boron concentrations at Jones Pumping Plant
38 would be low relative to applicable objectives (Appendix 8F, Figure Bo-2), and the reduction in
39 assimilative capacity would be minor (i.e., 4% reduction for the drought period modeled) compared
40 to the Existing Conditions (Appendix 8F, Table Bo-5). Thus, the long-term increased boron
41 concentrations would not be expected to cause further measurable degradation in the lower San
42 Joaquin River that would make the existing impairment discernibly worse or adversely affect
43 necessary TMDL actions implemented to reduce boron loading. Consequently, the small increases in
44 average boron concentrations that may occur under the No Action Alternative, relative to Existing
45 Conditions, would not be expected to adversely affect municipal or agricultural water supply

1 beneficial uses in the SWP and CVP service area, or substantially degrade water quality with respect
2 to boron.

3 In summary, the effects of additional future climate change/sea level rise under the No Action
4 Alternative conditions would result in relatively small increases in long-term average boron
5 concentrations in the lower San Joaquin River and several Delta locations. However, the predicted
6 changes would not be expected to cause exceedances of applicable objectives or further measurable
7 water quality degradation, and thus would not constitute an adverse effect on water quality.

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
10 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
11 constituent. For additional details on the effects assessment findings that support this CEQA impact
12 determination, see the effects assessment discussion that immediately precedes this conclusion.

13 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
14 river flow rate and reservoir storage reductions that would occur under the No Action Alternative,
15 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
16 boron levels. Additionally, relative to Existing Conditions, the No Action Alternative would not result
17 in reductions in river flow rates (i.e., less dilution) or increased boron loading such that there would
18 be any substantial increase in boron concentrations upstream of the Delta in the San Joaquin River
19 watershed.

20 It is expected there would be no substantial change in Delta boron levels (i.e., <4% increase at any
21 assessment location) in response to a shift in the Delta source water percentages under this
22 alternative or substantial degradation of these water bodies. With respect to the 303(d) listing of
23 boron in the lower San Joaquin River for the agricultural water supply beneficial use, the potential
24 small increase in long-term average boron concentration associated with reduced flows and
25 exported water at the Jones Pumping Plant would not be expected to cause substantial additional
26 boron loading, or further degradation at measurable levels in the lower San Joaquin River, and thus
27 would not cause the existing impairment to be discernibly worse.

28 Boron is not a bioaccumulative constituent, thus any increased concentrations under the No Action
29 Alternative would not result in adverse boron bioaccumulation effects to aquatic life or humans.
30 Relative to Existing Conditions, the No Action Alternative would not result in substantially increased
31 boron concentrations such that frequency of exceedances of municipal and agricultural water supply
32 objectives would increase. The levels of boron degradation that may occur under the No Action
33 Alternative would not be of sufficient magnitude to cause substantially increased risk of exceeding
34 objectives or adverse effects to municipal or agricultural beneficial uses, or any other beneficial
35 uses, within the affected environment. Based on these findings, this impact is determined to be less
36 than significant.

37 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 38 **Maintenance**

39 ***Upstream of the Delta***

40 Under the No Action Alternative, greater water demands will alter the magnitude and timing of
41 reservoir releases upstream of the Delta, relative to Existing Conditions. As shown in Table 8-43, the
42 Sacramento River watershed and eastside tributaries are negligible sources of bromide to the Delta.

1 While greater water demands under the No Action Alternative would alter the magnitude and
 2 timing of reservoir releases north and east of the Delta, these activities would have negligible, if any,
 3 effect on the sources, and ultimately the concentration of bromide in the Sacramento River, the
 4 eastside tributaries, and the various reservoirs of the related watersheds. Consequently, the No
 5 Action Alternative would not be expected to adversely affect the MUN beneficial use, or any other
 6 beneficial uses, of the Sacramento River, the eastside tributaries, or their associated reservoirs
 7 upstream of the Delta.

8 South of the Delta, the San Joaquin River is a substantial source of bromide. While tributaries and
 9 associated reservoirs of the lower San Joaquin are likely negligible sources of bromide, bromide on
 10 the lower San Joaquin is relatively high and can be sourced to agriculture irrigation water imported
 11 from the southern Delta. Agricultural irrigation drainage is the primary source of bromide on the
 12 lower San Joaquin River, where concentrations at Vernalis are inversely correlated to net river flow
 13 and the dilution provided by this flow. Under the No Action Alternative, long-term average flows at
 14 Vernalis would decrease 6% relative to Existing Conditions (Appendix 5A, *BDCP/California WaterFix*
 15 *FEIR/FEIS Modeling Technical Appendix*). Based on best-fit regressions of annual average San
 16 Joaquin River flow and bromide, these decreases in flow would correspond to a possible increase in
 17 long-term average bromide of about 3% relative to Existing Conditions (Appendix 8E, *Bromide*,
 18 Table 24). The relatively small magnitude of this increase is considered to be less than substantial.
 19 Moreover, there are no existing municipal intakes on the lower San Joaquin River. Consequently, the
 20 small increases in lower San Joaquin River bromide levels that may occur under the No Action
 21 Alternative, relative to Existing Conditions, would not be expected to adversely affect the MUN
 22 beneficial use, or any other beneficial uses, of the lower San Joaquin River.

23 **Delta**

24 Relative to Existing Conditions, the No Action Alternative would result in small decreases in long-
 25 term average bromide concentrations at all modeled Delta assessment locations with the exception
 26 being the Sacramento River at Emmaton for the drought period (Appendix 8E, *Bromide*, Table 2).
 27 Long-term average concentrations of seawater-derived constituents decrease under the No Action
 28 Alternative relative to Existing Conditions because the No Action Alternative includes Fall X2
 29 operations, while Existing Conditions does not (Appendix 3D, *Defining Existing Conditions, No Action*
 30 *Alternative, No Project Alternative, and Cumulative Impact Conditions*, and Appendix 5A,
 31 *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). Therefore, even though sea level
 32 rise is included in the No Action Alternative, and not in Existing Conditions, the effect of Fall X2 on
 33 bromide is generally greater than sea level rise. For the modeled drought period, long-term bromide
 34 concentrations at Emmaton are predicted to increase by about 8%.

35 The modeled frequency with which bromide concentration exceeds 50 and 100 µg/L would change
 36 only slightly at all 11 assessment locations, with some Delta assessment locations experiencing
 37 improved water quality relative to bromide (Appendix 8E, *Bromide*, Table 2). However, small
 38 increases in modeled concentration threshold exceedances would occur at some Delta interior and
 39 western Delta assessment locations. In the Delta interior at Rock Slough and Franks Tract, the
 40 frequency of exceeding 100 µg/L would increase by a maximum of about 3 percentage points (4
 41 percentage points for modeled drought period). Larger increases would occur in the western Delta,
 42 however, where the frequency of exceeding 100 µg/L would increase by as much as 7 percentage
 43 points at Emmaton (2 percentage points for modeled drought period). The greater frequencies of
 44 exceedance can be sourced primarily to the assumptions of sea level rise in the late long-term. While
 45 the greater influence of sea water would result in slightly more frequent bromide conditions

1 exceeding 50 and 100 µg/L in these select interior and western Delta locations, the resulting
2 conditions would not be expected to adversely affect MUN beneficial uses, or any other beneficial
3 use, particularly when considering the relatively small change in long-term annual average
4 concentration.

5 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
6 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
7 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
8 µg/L. Given these seasonal constraints on use, mass balance modeling predicts that use of these
9 intakes would most frequently occur during the months of February, March, and April of wet and
10 above normal water year types when water quality suitable for diversion would be most typically
11 available. Focusing on this period of most likely seasonal use (February–April of wet and above
12 normal water years), under the No Action Alternative average bromide concentrations would
13 increase about 5% at the City of Antioch intake and would decrease about 4% at the Mallard Slough
14 intake relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25). Such a relatively small
15 predicted increase in bromide concentrations at the City of Antioch intake would not be expected to
16 adversely affect MUN beneficial uses, or any other beneficial use, while decreases at Mallard Slough
17 would be considered beneficial.

18 The discussion above is based on results of the mass-balance modeling approach. Results of the
19 modeling approach which used relationships between EC and chloride and between chloride and
20 bromide (see Section 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment
21 of bromide using these data results in the same conclusions as are presented above for the mass-
22 balance approach (see Appendix 8E, *Bromide*, Tables 3 and 26).

23 ***SWP/CVP Export Service Areas***

24 Under the No Action Alternative, long-term average bromide concentrations at the Banks and Jones
25 pumping plants would decrease by as much as 13% relative to Existing Conditions (Appendix 8E,
26 *Bromide*, Table 2). As explained above for the Delta, long-term average concentrations of seawater-
27 derived constituents decrease under the No Action Alternative relative to Existing Conditions
28 because the No Action Alternative includes Fall X2, while Existing Conditions does not (Appendix
29 3D, 5A). Therefore, even though sea level rise is included in the No Action Alternative, and not in
30 Existing Conditions, the effect of Fall X2 on bromide is generally greater than sea level rise. The
31 frequency with which bromide would exceed bromide concentration thresholds at the Banks and
32 Jones pumping plants, relative to Existing Conditions, would remain unchanged or would improve
33 slightly, including years of drought (Appendix 8E, *Bromide*, Table 2). Consequently water exported
34 into the SWP/CVP Export Service Areas through these south Delta pumps would be of similar or
35 slightly better quality with regards to bromide under the No Action Alternative, relative to Existing
36 Conditions.

37 The discussion above is based on results of the mass-balance modeling approach. Results of the
38 modeling approach which used relationships between EC and chloride and between chloride and
39 bromide (see Section 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment
40 of bromide using these data results in the same conclusions as are presented above for the mass-
41 balance approach (see Appendix 8E, *Bromide*, Table 3).

42 Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to
43 create new sources of bromide or contribute towards a substantial change in existing sources of
44 bromide in the affected environment. Maintenance activities would not be expected to cause any

1 substantial change in bromide such that MUN beneficial uses, or any other beneficial use, would be
2 adversely affected anywhere in the affected environment.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
5 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
6 constituent. For additional details on the effects assessment findings that support this CEQA impact
7 determination, see the effects assessment discussion that immediately precedes this conclusion.

8 While greater water demands under the No Action Alternative would alter the magnitude and
9 timing of reservoir releases north and east of the Delta, these activities would have negligible, if any,
10 effect on the sources of bromide, and ultimately the concentration of bromide in the Sacramento
11 River, the eastside tributaries, and the various reservoirs of the related watersheds. However, south
12 of the Delta, the San Joaquin River is a substantial source of bromide, primarily due to the use of
13 irrigation water imported from the southern Delta. Concentrations of bromide at Vernalis are
14 inversely correlated to net river flow. Under the No Action Alternative, long-term average flows at
15 Vernalis would decrease only slightly, resulting in less than substantial predicted increases in long-
16 term average bromide of about 3% relative to Existing Conditions.

17 Relative to Existing Conditions, the No Action Alternative would result in small decreases in long-
18 term average bromide concentrations at all modeled Delta assessment locations with the exception
19 being the Sacramento River at Emmaton for the drought period. For the modeled drought period,
20 long-term bromide concentrations at Emmaton are predicted to increase by about 8%. Small
21 increases in modeled concentration threshold exceedances would occur at some Delta interior and
22 western Delta assessment locations, including Rock Slough, Franks Tract, and Emmaton, but the
23 resulting conditions would not be expected to adversely affect MUN beneficial uses, or any other
24 beneficial use. Moreover, the small (i.e., $\leq 5\%$) predicted increase in long-term average bromide
25 concentrations at the City of Antioch intake would not be expected to adversely affect MUN
26 beneficial uses while decreases at Mallard Slough would be considered beneficial.

27 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
28 of changes in bromide concentrations at Banks and Jones pumping plants. Long-term average
29 bromide concentrations at the Banks and Jones pumping plants are predicted to decrease by as
30 much as 13% relative to Existing Conditions while exceedance of bromide concentration thresholds
31 at the Banks and Jones pumping plants, would remain largely unchanged.

32 Based on the above, the No Action Alternative would not cause exceedance of applicable state or
33 federal numeric or narrative water quality objectives/criteria because none exist for bromide. The
34 No Action Alternative would not result in any substantial change in long-term average bromide
35 concentration or exceed 50 and 100 $\mu\text{g}/\text{L}$ assessment threshold concentrations by frequency,
36 magnitude, and geographic extent that would result in adverse effects on any beneficial uses within
37 affected water bodies. Bromide is not a bioaccumulative constituent and thus concentrations under
38 this alternative would not result in bromide bioaccumulating in aquatic organisms. Increases in
39 exceedances of the 100 $\mu\text{g}/\text{L}$ assessment threshold concentration would be 7 percentage points or
40 less at all locations assessed, which is considered to be less-than substantial long-term degradation
41 of water quality. The levels of bromide degradation that may occur under the No Action Alternative
42 would not be of sufficient magnitude to cause substantially increased risk for adverse effects on any
43 beneficial uses of water bodies within the affected environment. Bromide is not 303(d) listed and
44 thus the minor increases in long-term average bromide concentrations would not affect an existing

1 beneficial use impairment because no such use impairment currently exists for bromide. Based on
 2 these findings, this impact is less than significant.

3 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 4 **Maintenance**

5 ***Upstream of the Delta***

6 Under the No Action Alternative, greater water demands and climate change would alter the
 7 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
 8 River watershed and eastside tributaries, relative to Existing Conditions. Because substantial
 9 sources of chloride do not exist upstream of the Delta, concentrations of chloride in surface water
 10 are low and often below detection limits (see “Section 8.1, *Environmental Setting/Affected*
 11 *Environment*). Consequently, changes in the magnitude and timing of reservoir releases and river
 12 flows upstream of the Delta would have negligible, if any, effect on chloride sources, and ultimately
 13 the concentration of chloride in the Sacramento River, the eastside tributaries, and the various
 14 reservoirs of the related watersheds. Consequently, the No Action Alternative would not be expected
 15 to cause exceedance of chloride objectives/criteria or substantially degrade water quality with
 16 respect to chloride and thus would not adversely affect any beneficial uses of the Sacramento River,
 17 the eastside tributaries, or their associated reservoirs upstream of the Delta.

18 South of the Delta, the San Joaquin River has generally elevated chloride concentrations compared
 19 to the Sacramento River and east side tributaries; however, average monthly and maximum
 20 concentrations are below the applicable drinking water MCL of 250 mg/L and the EPA chronic
 21 aquatic life criterion of 230 mg/L (Appendix 8G, *Chloride*, Table Cl-2). The chloride in the lower San
 22 Joaquin River can be sourced to accumulation of salts in agricultural drainage from irrigation water
 23 imported from the southern Delta. Chloride concentrations at Vernalis are inversely correlated to
 24 net river flow and the dilution provided by the flow. Under the No Action Alternative, long-term
 25 average flows at Vernalis would decrease by an estimated 6% relative to Existing Conditions (as a
 26 result of climate change and increased water demands). Based on best-fit regressions of annual
 27 average San Joaquin River flow and chloride, these decreases in flow would correspond to a
 28 potential increase in long-term average chloride concentrations of about 2% relative to Existing
 29 Conditions (Appendix 8G, Table Cl-62). The relatively small increase would not cause chloride
 30 concentrations to exceed applicable objectives relative to existing concentrations and would not
 31 cause substantial long-term water quality degradation with regards to chloride. Moreover, there are
 32 no existing municipal supply intakes on the lower San Joaquin River. Consequently, the small
 33 increases in lower San Joaquin River chloride levels that may occur under the No Action Alternative,
 34 relative to Existing Conditions, would not be expected to adversely affect any beneficial uses of the
 35 lower San Joaquin River.

36 ***Delta***

37 Relative to Existing Conditions, modeling predicts that the No Action Alternative would result
 38 primarily in small decreases in long-term average chloride concentrations for the 16-year period
 39 modeled (i.e., 1976–1991) at all Delta assessment locations (Appendix 8G, Table Cl-1 and Table Cl-
 40 2). Long-term average concentrations of seawater-derived constituents decrease under the No
 41 Action Alternative relative to Existing Conditions because the No Action Alternative includes Fall X2,
 42 while Existing Conditions does not (Appendix 3D, *Defining Existing Conditions, No Action Alternative,*
 43 *No Project Alternative, and Cumulative Impact Conditions*, and Appendix 5A, *BDCP/California*

1 *WaterFix FEIR/FEIS Modeling Technical Appendix*). Therefore, even though sea level rise is included
2 in the No Action Alternative, and not in Existing Conditions, the effect of Fall X2 on chloride is
3 generally greater than sea level rise. In the months of February through June, monthly average
4 chloride concentrations would increase at all of the assessment locations except two interior Delta
5 locations (i.e., SF Mokelumne River at Staten Island and San Joaquin River at Buckley Cove). For the
6 other months of the year (i.e., July through January), the changes in chloride concentrations would
7 be variable with increases and decreases occurring at all eleven assessment locations. The
8 Sacramento River at Emmaton location in the western Delta would exhibit the largest seasonal
9 increases compared to Existing Conditions, ranging from 11% to 48% during the months of
10 December through June. For the drought year period modeled (i.e., 1987–1991), the annual average
11 chloride concentration would remain unchanged or decrease at ten of the assessment locations, but
12 increase by about 12% compared to Existing Conditions at the Sacramento River at Emmaton
13 location (Appendix 8G, Table CI-1 and Table CI-2). The comparison to Existing Conditions reflects
14 changes in chloride due to both increased demands and changed hydrology and Delta hydrodynamic
15 conditions associated with climate change and sea level rise. The following outlines the modeled
16 chloride changes relative to the applicable objectives and effects on beneficial uses in Delta waters.

17 Municipal and Industrial Beneficial Uses—Relative to Existing Conditions

18 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
19 (see Section 8.3.1.3, *Plan Area*) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for
20 municipal and industrial beneficial uses on a basis of the percentage of years the chloride objective
21 is exceeded for the modeled 16-year period. The objective is exceeded if chloride concentrations
22 exceed 150 mg/L for a specified number of days in a given water year at both the Antioch and
23 Contra Costa Pumping Plant #1 locations. For No Action Alternative, the modeled frequency of
24 objective exceedance would decrease relative to Existing Conditions. The modeled frequency of
25 exceedance is predicted to be 7% under Existing Conditions and 0% under the No Action Alternative
26 (Appendix 8G, Table CI-64). Similarly, estimates of chloride concentrations generated using EC-
27 chloride relationships and DSM2 EC output (see Section 8.3.1.3) were also used to evaluate the 250
28 mg/L Bay-Delta WQCP objective for chloride at Contra Costa Pumping Plant #1, where daily average
29 objectives apply. The basis for the evaluation was the predicted number of days the objective was
30 exceeded for the modeled 16-year period. For the No Action Alternative, the modeled frequency of
31 objective exceedance would decrease slightly, from 6% of modeled days under Existing Conditions,
32 to 4% of modeled days under the No Action Alternative (Appendix 8G, Table CI-63).

33 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3, *Plan*
34 *Area*), estimation of chloride concentrations through both amass balance approach and an EC-
35 chloride relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in
36 terms of both frequency of exceedance and use of assimilative capacity. When utilizing the mass
37 balance approach, modeled monthly average chloride concentrations at the Barker Slough at North
38 Bay Aqueduct for the 16-year period would not exceed the objective, which represents no change
39 from the Existing Conditions (Appendix 8G, *Chloride*, Table CI-3). The modeled frequency of
40 exceedances at the Banks pumping plant would decrease slightly from 4% under Existing Conditions
41 to 2%. At the Contra Costa Canal at Pumping Plant #1, the modeled frequency of exceedances of this
42 objective would decrease about 10% from 24% to 14%. Chloride concentrations in the western
43 Delta can exceed the applicable 250 mg/L objective frequently in the low-flow fall and early winter
44 months under Existing Conditions. Consequently, water is diverted from the San Joaquin River at
45 Antioch and Mallard Slough municipal intakes only when salinity conditions are acceptable. The
46 frequency of exceedances of the objective at the San Joaquin at Antioch location for the 16-year

1 period modeled would increase from 66% under Existing Conditions to 73% for a net increase of
 2 about 7% and would increase 1% (i.e., from 85% under Existing Conditions to 86%) at the
 3 Sacramento River at Mallard Island location. Moreover, the increased chloride concentrations would
 4 occur during the months of January through June, thus reducing water quality during the period of
 5 seasonal municipal diversions (Appendix 8G, Figure Cl-1). The available assimilative capacity would
 6 decrease substantially at the Antioch location in the months of March and April (i.e., maximum
 7 reduction of 39% for the 16-year period modeled and 97% for the drought period only) when
 8 chloride concentrations would be near, or exceed, the objectives, thus increasing the risk of
 9 exceeding objectives (Appendix 8G, Table Cl-5).

10 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
 11 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
 12 capacity are similar to those discussed when utilizing the mass balance modeling approach
 13 (Appendix 8G, *Chloride*, Table Cl-4). Based on the additional predicted seasonal and annual
 14 exceedances of one or both Bay Delta WQCP objectives for chloride, and the associated long-term
 15 water quality degradation and use of assimilative capacity, the potential exists for adverse effects on
 16 the municipal and industrial beneficial uses in the western Delta, particularly at the Antioch
 17 location, through reduced opportunity for diversion of water with acceptable chloride levels.

18 *303(d) Listed Water Bodies—Relative to Existing Conditions*

19 Tom Paine Slough in the southern Delta is on the 303(d) list for chloride with respect to the
 20 secondary MCL of 250 mg/L. The plot of monthly average chloride concentrations at the Old River at
 21 Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled location
 22 to Tom Paine Slough in the south Delta, would be well below the MCL and generally would be
 23 similar, or reduced slightly, compared to Existing Conditions (Appendix 8G, Figure Cl-2).

24 Suisun Marsh is on the 303(d) list for chloride in association with the Bay-Delta WQCP objectives for
 25 maximum allowable salinity during the months of October through May, which establish
 26 appropriate seasonal salinity conditions for fish and wildlife beneficial uses. The Sacramento River
 27 at Mallard Island, Sacramento River at Collinsville, and Montezuma Slough at Beldon's Landing
 28 within the marsh, are DSM2-modeled locations representative of source water quality conditions for
 29 the marsh that is supported by inflowing flood tide waters from the west, and ebb tide flows of
 30 Sacramento River water into Montezuma Slough through the SMSCG located near the Collinsville
 31 location. Long-term average chloride concentrations at the Sacramento River at the Mallard Island
 32 location for the 16-year period modeled would decrease slightly by 140 mg/L (-5%) compared to
 33 Existing Conditions (Appendix 8G, Table Cl-1). The plots of monthly average chloride concentrations
 34 for the Sacramento River at Collinsville (Appendix 8G, Figure Cl-3) and Montezuma Slough at
 35 Beldon's Landing (Appendix 8G, Figure Cl-4) for the 16-year period modeled indicate that, compared
 36 to Existing Conditions, chloride concentrations would be similar or lower during the months of
 37 October through May. Consequently, chloride concentrations at Tom Paine Slough and Suisun Marsh
 38 would not be further degraded on a long-term basis or adversely affect necessary actions to reduce
 39 chloride loading for any TMDLs developed.

40 ***SWP/CVP Export Service Areas***

41 Under the No Action Alternative, long-term average chloride concentrations at the Banks and Jones
 42 pumping plants would decrease by as much as 12% relative to Existing Conditions for the 16-year
 43 period modeled (Appendix 8G, *Chloride*, Table Cl-1). The modeled frequency of exceedances of
 44 applicable water quality objectives/criteria would decrease at the Banks and Jones pumping plants,

1 relative to Existing Conditions for both the 16-year period modeled and the drought period
2 (Appendix 8G, *Chloride*, Table Cl-3). As explained above for the Delta, long-term average
3 concentrations of seawater-derived constituents decrease under the No Action Alternative relative
4 to Existing Conditions because the No Action Alternative includes Fall X2, while Existing Conditions
5 does not (Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative,*
6 *and Cumulative Impact Conditions*, and Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
7 *Technical Appendix*). Therefore, even though sea level rise is included in the No Action Alternative,
8 and not in Existing Conditions, the effect of Fall X2 on chloride is generally greater than sea level
9 rise. Consequently, water exported into the SWP and CVP service area would generally be of similar
10 or slightly better quality with regards to chloride under the No Action Alternative relative to
11 Existing Conditions.

12 Results of the modeling approach which used relationships between EC and chloride (see Section
13 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment of chloride using
14 these data results in the same conclusions as are presented above for the mass-balance approach
15 (Appendix 8G, Table Cl-2 and Table Cl-4).

16 Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to
17 create new sources of chloride or contribute towards a substantial change in existing sources of
18 chloride in the affected environment. Maintenance activities would not be expected to cause any
19 substantial change in chloride such that any beneficial uses would be adversely affected anywhere in
20 the affected environment.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
23 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
24 constituent. For additional details on the effects assessment findings that support this CEQA impact
25 determination, see the effects assessment discussion that immediately precedes this conclusion.

26 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
27 thus river flow rate and reservoir storage reductions that would occur under the No Action
28 Alternative, relative to Existing Conditions, would not be expected to result in a substantial adverse
29 change in chloride levels. Additionally, relative to Existing Conditions, the No Action Alternative
30 would not result in reductions in river flow rates (i.e., less dilution) or increased chloride loading
31 such that there would be any substantial increase in chloride concentrations upstream of the Delta
32 in the San Joaquin River watershed.

33 It is expected there would be substantial changes in Delta chloride levels in response to a shift in the
34 Delta source water percentages under this alternative or substantial degradation of these water
35 bodies. Relative to Existing Conditions, the No Action Alternative would result in substantially
36 increased chloride concentrations such that frequency of exceedances of the 250 mg/L Bay-Delta
37 WQCP objective would increase at the San Joaquin River at Antioch (by 7%) and at Mallard Slough
38 (by 1%), and long-term degradation may occur, that may result in adverse effects on the municipal
39 and industrial water supply beneficial use. With respect to the 303(d) listings, the small increases in
40 average chloride concentrations would not cause further degradation on a long-term basis that
41 would adversely affect necessary actions to reduce chloride loading for any TMDLs developed for
42 Tom Paine Slough and Suisun Marsh wetlands.

1 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
 2 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
 3 River.

4 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the No
 5 Action Alternative would not result in adverse chloride bioaccumulation effects to aquatic life or
 6 humans. However, based on these findings, this impact is determined to be significant due to
 7 increased chloride concentrations and objective exceedances, and additional long-term degradation,
 8 in the western Delta and associated effects on the municipal and industrial water supply beneficial
 9 uses.

10 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 11 **Maintenance**

12 ***Upstream of the Delta***

13 DO levels in the reservoirs and rivers are primarily affected by water temperature, flow velocity,
 14 turbulence, amounts of oxygen demanding substances present (e.g., ammonia, organics), and rates
 15 of photosynthesis (which is influenced by nutrient levels), respiration, and decomposition. Water
 16 temperature and salinity affect the maximum DO saturation level (i.e., the highest amount of oxygen
 17 the water can dissolve). Flow velocity affects the turbulence and re-aeration of the water (i.e., the
 18 rate at which oxygen from the atmosphere can be dissolved in water). High nutrient content can
 19 support aquatic plant and algae growth, which in turn generates oxygen through photosynthesis and
 20 consumes oxygen through respiration and decomposition.

21 A reservoir can exhibit seasonal changes in the DO profile from the water surface to the sediments
 22 that is affected by its degree of thermal stratification, where oxygenated inflows enter and mix with
 23 the reservoir, its level of productivity that contributes DO through photosynthesis and consumes DO
 24 through respiration and decomposition, as well as the prevailing winds that cause mixing within the
 25 reservoir. Water temperature also is a factor in that it affects the level (between the surface and the
 26 bottom) at which oxygenated river inflows enter the reservoir, the DO saturation level, and
 27 photosynthesis and respiration rates. Cold inflows tend to move deep into the reservoir due to the
 28 lower density of cold water, whereas warm water inflows tend to mix with the surface waters,
 29 particularly when the reservoir is thermally stratified. Under the No Action Alternative, the primary
 30 factor that would change relative to Existing Conditions is that end-of-September carryover storage
 31 would be lower in all years (see Chapter 5, *Water Supply*, Section 5.3.3.1), which would affect the
 32 temperature profile of the reservoirs at the end of summer. Nevertheless, the reservoirs would
 33 continue to thermally stratify seasonally, as they do under Existing Conditions. Given the size of the
 34 reservoirs—Lake Oroville, Trinity Lake, Shasta Lake, and Folsom Lake—and their significant surface
 35 area, inflows and wind fetch that would still contribute to oxygenating these water bodies, the lower
 36 carryover storage that would occur under the No Action Alternative is not expected to cause DO
 37 depletions or substantial changes in DO that would adversely affect the beneficial uses of these
 38 water bodies.

39 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
 40 upstream of the Delta relative to Existing Conditions, altering downstream river flows. There would
 41 be some increases and decreases in the mean monthly river flows, depending on month and year.
 42 Mean monthly flows would remain within the range historically seen under Existing Conditions.
 43 Moreover, these are large, turbulent rivers with velocities typically in the range of 0.5 fps to 2.0 fps

1 or higher. Consequently, flow changes that would occur under the No Action Alternative would not
2 be expected to have substantial effects on river DO levels; likely, the changes would be
3 immeasurable. This is because sufficient turbulence and interaction of river water with the
4 atmosphere would continue to occur under this alternative to maintain water saturation levels (due
5 to these factors) at levels similar to that of Existing Conditions.

6 The changes in the magnitude and timing of water releases from reservoirs upstream of the Delta,
7 relative to Existing Conditions, could affect downstream river temperatures, depending on month
8 and year. Water temperature affects the maximum DO saturation level; as temperature increases,
9 the DO saturation level decreases. When holding constant for barometric pressure (e.g., 760 mm
10 mercury), the DO saturation level ranges from 7.5 mg/L at 30°C (86°F) to 11 mg/L at 10°C (50°F)
11 (Tchobanoglous and Schroeder 1987:735). As described in the affected environment section, DO in
12 the Sacramento River at Keswick, Feather River at Oroville, and lower American River ranged from
13 7.3 to 15.6 mg/L, 7.4 to 12.5 mg/L, and 6.5 to 13.0 mg/L, respectively. Thus, these rivers are well
14 oxygenated and experience periods of supersaturation (i.e., when DO level exceeds the saturation
15 concentration). Because these are large, turbulent rivers, any reduced DO saturation level that
16 would be caused by an increase in temperature under the No Action Alternative would not be
17 expected to cause DO levels to be outside of the range seen historically. This is because sufficient
18 turbulence and interaction of river water with the atmosphere would continue to occur under this
19 alternative to maintain saturation levels.

20 Amounts of oxygen demanding substances present (e.g., ammonia, organics) in the reservoirs and
21 rivers upstream of the Delta, rates of photosynthesis (which is influenced by nutrient
22 levels/loading), and respiration and decomposition of aquatic life is not expected to change
23 sufficiently under the No Action Alternative to substantially alter DO levels relative to Existing
24 Conditions. Any minor reductions in DO levels that may occur under this alternative would not be
25 expected to be of sufficient frequency, magnitude and geographic extent to adversely affect
26 beneficial uses, or substantially degrade the quality of these water bodies, with regard to DO.

27 An effect on salinity (expressed as EC) would not be expected in the rivers and reservoirs upstream
28 of the Delta. Thus, these parameters would not be expected to measurably change DO levels under
29 the No Action Alternative, relative to Existing Conditions.

30 ***Delta***

31 Similar to the reservoirs and rivers upstream of the Delta, DO levels in the Delta are primarily
32 affected by water temperature, salinity, Delta channel flow velocities, nutrients (i.e., phosphorus and
33 nitrogen) and aquatic organisms (i.e., photosynthesis, respiration, and decomposition). Sediment
34 oxygen demand of organic material deposited in the low velocity channels also affects Plan Area DO
35 levels.

36 Under the No Action Alternative, minor DO level changes could occur due to nutrient loading to the
37 Delta relative to Existing Conditions (see WQ-1, WQ-15, WQ-23). The state has begun to aggressively
38 regulate point-source discharge effects on Delta nutrients, and is expected to further regulate
39 nutrients upstream of and in the Delta in the future. Although population increased in the affected
40 environment between 1983 and 2001, average monthly DO levels during this period of record show
41 no trend in decline in the presence of presumed increases in anthropogenic sources of nutrients
42 (Table 8-11). Based on these considerations, excessive nutrients that would cause low DO levels
43 would not be expected to occur under the No Action Alternative.

1 Various areas of the Delta could experience salinity increases due to change in quantity of Delta
2 inflows (see WQ-11). For a 5 ppt salinity increase at 68°Fahrenheit, the saturation level of oxygen
3 dissolved in the water is reduced by only about 0.25 mg/L. Thus, increased salinity under the No
4 Action Alternative would generally have relatively minor effects on Delta DO levels where salinity is
5 increased on the order of 5 ppt or less.

6 The relative degree of tidal exchange of flows and turbulence, which contributes to exposure of
7 Delta waters to the atmosphere for reaeration, would not be expected to substantially change
8 relative to Existing Conditions, such that these factors would reduce Delta DO levels below
9 objectives or levels that protect beneficial uses.

10 As discussed in the section on DO in section 8.3.1.7, *Constitute-Specific Considerations Used in the*
11 *Assessment, Constitute-Specific Considerations Used in the Assessment* effects of climate change on air
12 and Delta water temperatures are discussed in Appendix 29C, *Climate Change and the Effects of*
13 *Reservoir Operations on Water Temperatures in the Study Area*. In general, waters of the Delta would
14 be expected to warm less than 5 degrees F under the No Action Alternative, relative to Existing
15 Conditions, due to climate change, which translates into a < 0.5 mg/L decrease in DO saturation.
16 Thus, increased temperature under the No Action Alternative due to climate change would generally
17 have relatively minor effects on Delta DO levels.

18 Some waterways in the eastern, southern, and western Delta are listed on the state's Clean Water
19 Act Section 303(d) list as impaired due to low oxygen levels. A TMDL for the Deep Water Ship
20 channel in the eastern Delta has been approved and identifies the factors contributing to low DO in
21 the Deep Water Ship Channel as oxygen demanding substances from upstream sources, Deep Water
22 Ship Channel geometry, and reduced flow through the Deep Water Ship Channel (Central Valley
23 Regional Water Quality Control Board 2005:28). The TMDL takes a phased approach to allow more
24 time to gather additional informational on source and linkages to the DO impairment, while at the
25 same time moving forward on making improvements to DO conditions. One component of the TMDL
26 implementation activities is an aeration device demonstration project.

27 In the Deep Water Ship Channel, low DO events have historically occurred in May–October, and
28 typically in drier years and when flows in the San Joaquin River at Stockton are less than 1,000 cfs
29 (Central Valley Regional Water Quality Control Board 2014, ICF International 2010). Concerns have
30 been raised that flows on the San Joaquin River at Stockton may increase, causing the location of the
31 minimum DO point to shift downstream.

32 Figure 8-65a shows a box-and-whisker plot of the monthly average flows in the San Joaquin River at
33 Stockton for the months of May–October for Dry and Critical water year types. The figure shows that
34 while flows do change somewhat, they are generally within the range of flows seen under Existing
35 Conditions. Reports indicate that the aeration facility performs adequately under the range of flows
36 from 250–1,000 cfs (ICF International 2010). Based on the above, the expected changes in flows in
37 the San Joaquin River at Stockton are not expected to substantially move the point of minimum DO,
38 and therefore the aeration facility will likely still be located appropriately to keep DO levels above
39 Basin Plan objectives.

40 Overall, assuming continued operation of the aerators, the alternative is not expected to have a
41 substantial impact on DO in the Deep Water Ship Channel. It is expected that under the No Action
42 Alternative that DO levels in the Deep Water Ship Channel would remain similar to those under
43 Existing Conditions or improve as the TMDL-required studies are completed and actions are
44 implemented to improve DO levels. DO levels in other Clean Water Act Section 303(d)-listed

1 waterways would not be expected to change relative to Existing Conditions, as the circulation of
2 flows, tidal flow exchange, and re-aeration would continue to occur similar to Existing Conditions.

3 **SWP/CVP Export Service Areas**

4 The primary factor that would affect DO in the conveyance channels and ultimately the receiving
5 reservoirs in the SWP/CVP Export Service Areas would be changes in the levels of nutrients and
6 oxygen-demanding substances and DO levels in the exported water. For reasons provided above, the
7 Delta waters exported to the SWP/CVP Export Service Areas would not be expected to be
8 substantially lower in DO compared to Existing Conditions. Exported water could potentially be
9 warmer and have higher salinity relative to Existing Conditions, due to climate change. Because the
10 biochemical oxygen demand of the exported water would not be expected to substantially differ
11 from that under Existing Conditions (due to ever increasing water quality regulations), canal
12 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
13 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
14 downstream reservoirs. Consequently, substantial adverse effects on DO levels in the SWP/CVP
15 Export Service Areas would not be expected to occur under the No Action Alternative relative to
16 Existing Conditions.

17 The effects on DO from implementing the No Action Alternative would not be adverse.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
20 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
21 constituent. For additional details on the effects assessment findings that support this CEQA impact
22 determination, see the effects assessment discussion that immediately precedes this conclusion.

23 Reservoir storage reductions that would occur under the No Action Alternative, relative to Existing
24 Conditions, would not be expected to result in a substantial adverse change in DO levels in the
25 reservoirs, because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would
26 remain. Similarly, river flow rate reductions that would occur would not be expected to result in a
27 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
28 flows would remain within the ranges historically seen under Existing Conditions and the affected
29 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
30 water temperature would not be expected to cause DO levels to be outside of the range seen
31 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
32 change sufficiently to affect DO levels.

33 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
34 Delta source water percentages under this alternative or substantial degradation of these water
35 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
36 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
37 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
38 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
39 the reaeration of Delta waters would not be expected to change substantially.

40 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
41 Export Service Areas waters under the No Action Alternative, relative to Existing Conditions,
42 because the biochemical oxygen demand of the exported water would not be expected to
43 substantially differ from that under Existing Conditions (due to ever increasing water quality

1 regulations), canal turbulence and exposure of the water to the atmosphere and the algal
 2 communities that exist within the canals would establish an equilibrium for DO levels within the
 3 canals. The same would occur in downstream reservoirs.

4 There would be no substantial, and likely no measurable, long-term change in DO levels Upstream of
 5 the Delta, in the Plan Area, or the SWP/CVP Export Service Areas under the No Action Alternative
 6 relative to Existing Conditions. As such, this alternative is not expected to cause additional
 7 exceedance of applicable water quality objectives by frequency, magnitude, and geographic extent
 8 that would adversely affect beneficial uses. Because no substantial changes in DO levels are
 9 expected, long-term water quality degradation would not be expected, and, thus, beneficial uses
 10 would not be expected to be adversely affected. Various Delta waterways are Clean Water Act
 11 Section 303(d)-listed for low DO, but because no substantial decreases in DO levels are expected,
 12 greater degradation and impairment of these areas is not expected to occur. This impact is
 13 considered to be less than significant.

14 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 15 **Operations and Maintenance**

16 ***Upstream of the Delta***

17 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
 18 upstream of the Delta relative to Existing Conditions, altering downstream river flows relative to
 19 Existing Conditions. With respect to EC, an increase or decrease in river flow alone is not of concern.
 20 Measureable changes in the quality of the watershed runoff and reservoir inflows would not be
 21 expected to occur in the future; therefore, the EC levels in these reservoirs would not be expected to
 22 change relative to Existing Conditions. There could be increased discharges of EC-elevating
 23 parameters in the future in water bodies upstream of the Delta as a result of urban growth and
 24 increased runoff and wastewater discharges. The state has begun to aggressively regulate point-
 25 source discharge effects on Delta salinity-elevating parameters, capping dischargers at existing
 26 levels, and is expected to further regulate EC and related parameters upstream of and within the
 27 Delta in the future as salt management plans are developed. Based on these considerations, EC levels
 28 (highs, lows, typical conditions) in the Sacramento River and its tributaries, the eastside tributaries,
 29 or their associated reservoirs upstream of the Delta would not be expected to be outside the ranges
 30 occurring under Existing Conditions.

31 The effects on lower San Joaquin River EC would be somewhat different. Elevated EC in the San
 32 Joaquin River can be sourced to agricultural use of irrigation water imported from the southern
 33 Delta and applied on soils high in salts. This accumulation of salts is a primary contributor of
 34 elevated EC on the lower San Joaquin River. Tributary flows generally provide dilution of the high
 35 EC agricultural drainage waters. Under the No Action Alternative, long-term average flows at
 36 Vernalis would decrease 6% (as a result of climate change and increased water demands) relative to
 37 Existing Conditions (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical*
 38 *Appendix*). These decreases in flow, alone, would correspond to a possible increase in long-term
 39 average EC levels relative to Existing Conditions. The level of EC increase cannot be readily
 40 quantified but, based on estimated increase in bromide and chloride concentrations, to which EC is
 41 correlated, would be relatively small and on the order of about 3%. However, with the
 42 implementation of the adopted TMDL for the San Joaquin River at Vernalis and the ongoing
 43 development of the TMDL for the San Joaquin River upstream of Vernalis and its implementation, it
 44 is expected that EC levels would be improved under the No Action Alternative relative to Existing

1 Conditions. Based on these considerations, substantial changes in EC levels in the San Joaquin River
 2 relative to Existing Conditions would not be expected of sufficient magnitude and geographic extent
 3 that would result in adverse effects on any beneficial uses, or substantially degrade the quality of
 4 these water bodies, with regard to EC.

5 **Delta**

6 Relative to Existing Conditions, the No Action Alternative would result in a fewer number of days
 7 when Bay-Delta WQCP compliance locations in the western, interior, and southern Delta would
 8 exceed EC objectives or be out of compliance with the EC objectives, with the exception of the
 9 Sacramento River at Emmaton (Appendix 8H, *Electrical Conductivity*, Table EC-1). Long-term
 10 average levels of seawater-derived constituents decrease under the No Action Alternative relative to
 11 Existing Conditions because the No Action Alternative includes Fall X2, while Existing Conditions
 12 does not (Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative,*
 13 *and Cumulative Impact Conditions*, and Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 14 *Technical Appendix*). Therefore, even though sea level rise is included in the No Action Alternative,
 15 and not in Existing Conditions, the effect of Fall X2 is generally greater than sea level rise. For
 16 electrical conductivity, the Sacramento River at Emmaton is an exception, where sea level rise and
 17 increased water demands (see Table 8-62) combine to cause increases in electrical conductivity. The
 18 percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
 19 (1976–1991) would increase from 6% under Existing Conditions to 14% under the No Action
 20 Alternative. Further, the percentage of days out of compliance with the EC objective would increase
 21 from 11% under Existing Conditions to 25% under the No Action Alternative. Average EC levels at
 22 the western, interior, and southern Delta compliance locations, other than the Sacramento River at
 23 Emmaton, would decrease from 1–14% for the entire period modeled and 0–7% during the drought
 24 period modeled (1987–1991) (Appendix 8H, Table EC-11). Average EC in the Sacramento River at
 25 Emmaton would increase 1% for the entire period modeled and 10% during the drought period
 26 modeled. On average, EC would increase at Emmaton during all months, except October and
 27 November (Appendix 8H, Table EC-11).

28 In Suisun Marsh, average EC for the entire period modeled would increase under the No Action
 29 Alternative, relative to Existing Conditions, during the months of January through May by 0.1–0.7
 30 mS/cm, depending on the location and month (Appendix 8H, Table EC-21 through Table EC-25). The
 31 degree to which the average EC increases would cause exceedance of Bay-Delta WQCP objectives is
 32 unknown, because objectives are expressed as a monthly average of daily high tide EC, which does
 33 not have to be met if it can be demonstrated “equivalent or better protection will be provided at the
 34 location” (State Water Resources Control Board 2006:14). The described long-term average EC
 35 increase may, or may not, contribute to adverse effects on beneficial uses, depending on how and
 36 when wetlands are flooded, soil leaching cycles, how agricultural use of water is managed, and
 37 future actions taken with respect to the Marsh. Given the Bay-Delta WQCP narrative objective
 38 regarding “equivalent or better protection” in lieu of meeting specific numeric objectives, the small
 39 increase in EC relative to Existing Conditions would not be expected to adversely affect beneficial
 40 uses of Suisun Marsh under the No Action Alternative.

41 Given that the western Delta is Clean Water Act Section 303(d) listed as impaired due to elevated EC,
 42 the increase in the incidence of exceedance of EC objectives and average EC levels at western Delta
 43 locations under the No Action Alternative, relative to Existing Conditions, has the potential to
 44 contribute to additional impairment and adversely affect beneficial uses. While Suisun Marsh also is
 45 Section 303(d) listed as impaired because of elevated EC, the potential increases in long-term

1 average EC concentrations, relative to Existing Conditions, would not be expected to contribute to
2 additional impairment, because the increase would be so small (<1 mS/cm) as to not be measurable
3 and beneficial uses would not be adversely affected.

4 ***SWP/CVP Export Service Areas***

5 At the Banks pumping plant, relative to Existing Conditions, the No Action Alternative would result
6 in no additional exceedances of the Bay-Delta WQCP's 1,000 µmhos/cm EC objective during the
7 drought period modeled; the frequency of exceedance for both conditions would be 2% (Appendix
8 8H, Table EC-10). When the entire period modeled is considered, the frequency of exceedances of
9 the EC objective would increase slightly, from 1% under Existing Conditions to 2% under the No
10 Action Alternative (Appendix 8H, Table EC-10). Because the EC objective is for agricultural
11 beneficial use protection, for which longer-term crop exposure to elevated EC waters is a concern,
12 this minimal increase in frequency of exceedance of the EC objective would not adversely affect this
13 beneficial use.

14 For the entire period modeled, there would be no exceedance of the 1,000 µmhos/cm EC objective at
15 the Jones pumping plant under Existing Conditions and the No Action Alternative (Appendix 8H,
16 Table EC-10). Thus, there would be no adverse effect on the agricultural beneficial uses in the
17 SWP/CVP Export Service Areas using water pumped at this location under the No Action
18 Alternative.

19 Average EC levels for the entire period modeled would decrease at the Banks pumping plant by 7%
20 and at the Jones pumping plant by 5% under the No Action Alternative, relative to Existing
21 Conditions. As explained above for the Delta, long-term average levels of seawater-derived
22 constituents decrease under the No Action Alternative relative to Existing Conditions because the
23 No Action Alternative includes Fall X2, while Existing Conditions does not (Appendix 3D, *Defining*
24 *Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions,*
25 *and Appendix 5A, BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). Therefore,
26 even though sea level rise is included in the No Action Alternative, and not in Existing Conditions,
27 the effect of Fall X2 is generally greater than sea level rise. During the drought period modeled,
28 average EC levels would decrease at the Banks pumping plant by 6% and at the Jones pumping plant
29 by 5% under the No Action Alternative, relative to Existing Conditions. Consequently, in the long-
30 term, water delivered to the SWP/CVP Export Service Areas through these south Delta pumps would
31 be of similar or slightly better quality with regard to EC under the No Action Alternative, relative to
32 Existing Conditions. (Appendix 8H, Table EC-11) Based on the long-term decreases in EC levels that
33 would occur at the Banks and Jones pumping plants, the No Action Alternative would not cause long-
34 term degradation of EC levels in the SWP/CVP Export Service Areas, relative to Existing Conditions.

35 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
36 River EC levels would be expected since EC in the lower San Joaquin River is, in part, related to
37 irrigation water deliveries from the Delta. While the magnitude of this expected lower San Joaquin
38 River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
39 elevating constituents to the SWP/CVP Export Service Areas would likely alleviate or lessen any
40 expected increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see
41 discussion of Upstream of the Delta).

42 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
43 elevated EC. The No Action Alternative would result in lower average EC levels relative to Existing

1 Conditions and, thus, would not contribute to additional impairment related to elevated EC in the
2 SWP/CVP Export Service Areas waters.

3 In summary, the increased frequency of exceedance of EC objectives and increased long-term and
4 drought period average EC levels that would occur at western Delta compliance locations under the
5 No Action Alternative would contribute to adverse effects on the agricultural beneficial uses. Given
6 that the western Delta is Clean Water Act Section 303(d) listed as impaired due to elevated EC, the
7 increase in the incidence of exceedance of EC objectives and increases in long-term and drought
8 period average EC in the western Delta under the No Action Alternative has the potential to
9 contribute to additional beneficial use impairment. These increases in EC constitute an adverse
10 effect on water quality.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
13 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
14 constituent. For additional details on the effects assessment findings that support this CEQA impact
15 determination, see the effects assessment discussion that immediately precedes this conclusion.

16 River flow rate and reservoir storage reductions that would occur under the No Action Alternative,
17 relative to Existing Conditions, would not be expected to result in a substantial adverse change in EC
18 levels in the reservoirs and rivers upstream of the Delta, given that: changes in the quality of
19 watershed runoff and reservoir inflows would not be expected to occur in the future; the state's
20 aggressive regulation of point-source discharge effects on Delta salinity-elevating parameters and
21 the expected further regulation as salt management plans are developed; the salt-related TMDLs
22 adopted and being developed for the San Joaquin River; and the expected improvement in lower San
23 Joaquin River average EC levels commensurate with the lower EC of the irrigation water deliveries
24 from the Delta.

25 Relative to Existing Conditions, the No Action Alternative would not result in any substantial
26 increases in long-term average EC levels in the SWP/CVP Export Service Areas. There would be no
27 exceedance of the EC objective at the Jones pumping plant. At the Banks pumping plant there would
28 be only a 1% increase in exceedance of the EC objective when the entire period modeled is
29 considered, and no increase in the frequency of exceedance during the drought period. Average EC
30 levels for the entire period modeled would decrease at both plants. Because the EC objective is for
31 agricultural beneficial use protection, for which longer-term crop exposure to elevated EC waters is
32 a concern, the minimal increase in the frequency of exceedance of the EC objective at the Banks
33 pumping plant for the entire period modeled coupled with the long-term average decrease in EC
34 levels at the pumping plants would not adversely affect this beneficial use.

35 In the Plan Area, the No Action Alternative would result in an increase in the frequency with which
36 Bay-Delta WQCP EC objectives are exceeded in the Sacramento River at Emmaton for the entire
37 period modeled (1976–1991) and during the drought period modeled (1987–1991). Further, long-
38 term average EC levels would increase by 1% for the entire period modeled and 10% during the
39 drought period modeled at Emmaton. The increases in drought period average EC levels that would
40 occur in the Sacramento River at Emmaton would further degrade existing EC levels and thus
41 contribute additionally to adverse effects on the agricultural beneficial use. Because EC is not
42 bioaccumulative, the increases in long-term average EC levels would not directly cause
43 bioaccumulative problems in aquatic life or humans. The western Delta is Clean Water Act Section
44 303(d) listed for elevated EC and the increases in long-term average EC and increased frequency of

1 exceedance of EC objectives that would occur in the Sacramento River at Emmaton could make
2 beneficial use impairment measurably worse. This impact is considered to be significant.

3 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 4 **Maintenance**

5 ***Upstream of the Delta***

6 Under the No Action Alternative, greater water demands and climate change would alter the
7 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
8 River watershed and eastside tributaries, relative to Existing Conditions.

9 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
10 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
11 relationships for mercury and methylmercury. No significant, predictive regression relationships
12 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
13 (monthly or annual)(Appendix 8I, *Mercury*, Figures I-10 through I-13). Such a positive relationship
14 between total mercury and flow is to be expected based on the association of mercury with
15 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
16 flow in the Sacramento River under the No Action Alternative relative to Existing Conditions are not
17 of the magnitude of storm flows, in which substantial sediment-associated mercury is mobilized.
18 Therefore mercury loading should not be substantially different due to changes in flow. In addition,
19 even though it may be flow-affected, total mercury concentrations remain well below criteria at
20 upstream locations. Any negligible changes in mercury concentrations that may occur in the water
21 bodies of the affected environment located upstream of the Delta would not be of frequency,
22 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
23 degrade the quality of these water bodies as related to mercury. Both waterborne methylmercury
24 concentrations and largemouth bass fillet mercury concentrations are expected to remain above
25 guidance levels at upstream of Delta locations, but will not change substantially relative to Existing
26 Conditions due to changes in flows under the No Action Alternative.

27 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
28 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs (Central Valley Regional Water Quality
29 Control Board 2011c, State Water Resources Control Board 2003) as well as the State Water Board's
30 Statewide Mercury Control Program. The TMDL for the American River was in process for CEQA
31 scoping (Central Valley Regional Water Quality Control Board 2011d), but now will be incorporated
32 into a statewide mercury TMDL under development by the State Water Board. These projects will
33 target specific sources of mercury and methylation upstream of the Delta and could result in net
34 improvement to Delta mercury loading in the future. The implementation of these projects could
35 help to ensure that upstream of Delta environments will not be substantially degraded for water
36 quality with respect to mercury or methylmercury.

37 ***Delta***

38 As shown in Figures 8-53a, 8-53b, 8-54a, and 8-54b, comparisons in percentage change of
39 assimilative capacity of waterborne mercury concentrations relative to the 25 ng/L ecological risk
40 benchmark under the No Action Alternative compared to the Existing Condition would vary only
41 slightly among stations. Peak losses of assimilative capacity for mercury would be less than 0.1% for
42 all sites comparing Existing Conditions to the No Action Alternative. These changes are not expected
43 to result in adverse effects to beneficial uses. Peak annual average methylmercury concentrations

1 for drought conditions occurred at the San Joaquin River at Buckley Cove: 0.161 ng/L for Existing
 2 Conditions and 0.167 ng/L for the No Action Alternative (Appendix 8I, *Mercury*, Table I-6). These
 3 differences are less than 5%. Methylmercury concentrations exceed criteria at all locations and no
 4 assimilative capacity exists. Monthly average waterborne concentrations of total and
 5 methylmercury, over the period of record, are shown in Appendix 8I, Figures I-2 and I-3. Note that
 6 concentrations under Existing Conditions and the No Action Alternative are all very similar to each
 7 other (Appendix 8I, Figures I-2 and I-3, Tables I-5 and I-6).

8 Similarly, estimates of fish tissue mercury concentrations and exceedance quotients show almost no
 9 differences would occur among sites for the No Action Alternative as compared to Existing
 10 Conditions for the Delta sites (Figures 8-55a and 8-55b; Appendix 8I, *Mercury*, Tables I-7a, b). Peak
 11 exceedance quotients for drought conditions are all at the San Joaquin River at Buckley Cove (4.3 for
 12 Existing Conditions; 4.5 for the No Action Alternative; Eq2 model, Table I-7b). These small
 13 differences of less than 10% are not expected to further degrade water quality, with regards to
 14 mercury, by measurable levels, and thus beneficial use impairment would not be made discernibly
 15 worse. Similar to waterborne concentrations of methylmercury, the fish tissue concentrations and
 16 exceedance quotients would be highest at the San Joaquin River, Buckley Cove site during drought
 17 years (Appendix 8I, Tables I-7a, b). All modeled fish tissue mercury concentrations exceed tissue
 18 guidelines, with exceedance quotients greater than 1 (Appendix 8I, Tables I-7a, b).

19 ***SWP/CVP Export Service Areas***

20 The Banks and Jones pumping plants are expected to show only very small losses of assimilative
 21 capacity or changes in fish tissue concentration of mercury for the No Action Alternative in relation
 22 to Existing Conditions [less than 1% for assimilative capacity decreases; greatest decrease was at
 23 Jones Pumping Plant of 0.6% relative to Existing Conditions] (Figures 8-53a through 8-54b;
 24 Appendix 8I, *Mercury*, Tables I-7a, b). Any increases in mercury concentrations that may occur in
 25 water exported via Banks and Jones pumping plants are not expected to result in adverse effects to
 26 beneficial uses or substantially degrade the quality of exported water, with regards to mercury.

27 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 29 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 30 constituent. For additional details on the effects assessment findings that support this CEQA impact
 31 determination, see the effects assessment discussion that immediately precedes this conclusion.

32 Under the No Action Alternative, greater water demands and climate change would alter the
 33 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
 34 River watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury
 35 and methylmercury upstream of the Delta will not be substantially different relative to Existing
 36 Conditions due to the lack of important relationships between mercury/methylmercury
 37 concentrations and flow for the major rivers.

38 Methylmercury concentrations exceed criteria at all locations in the Delta for Existing Conditions
 39 and no assimilative capacity exists. However, monthly average waterborne concentrations of total
 40 and methylmercury, over the period of record, are very similar to each other among alternatives.
 41 Similarly, estimates of fish tissue mercury concentrations show almost no differences would occur
 42 among sites for the No Action Alternative as compared to Existing Conditions for Delta sites.

1 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
 2 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
 3 plants. The Banks and Jones pumping plants are expected to show only very small losses of
 4 assimilative capacity or changes in fish tissue concentration of mercury for the No Action
 5 Alternative as compared to Existing Conditions.

6 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 7 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 8 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
 9 not expected to increase substantially, no long-term water quality degradation is expected to occur
 10 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
 11 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
 12 or fish tissue mercury concentrations would not make any existing mercury-related impairment
 13 measurably worse. In comparison to Existing Conditions, the No Action Alternative would not
 14 increase levels of mercury by frequency, magnitude, and geographic extent such that the affected
 15 environment would be expected to have measurably higher body burdens of mercury in aquatic
 16 organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans
 17 consuming those organisms. This impact is considered to be less than significant.

18 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 19 **Maintenance**

20 ***Upstream of the Delta***

21 Although point sources of nitrate do exist upstream of the Delta in the Sacramento River watershed,
 22 nitrate levels in the major rivers (Sacramento, Feather, American) are low, generally due to ample
 23 dilution available in the rivers relative to the magnitude of the discharges. Furthermore, while many
 24 dischargers have already improved facilities to remove more nitrate, many others are likely to do so
 25 over the next few decades. Non-point sources of nitrate within the Sacramento watersheds are also
 26 relatively low, thus resulting in generally low nitrate-N concentrations in the reservoirs and rivers
 27 of the watershed. Furthermore, there is no correlation between historical water year average nitrate
 28 concentrations and water year average flow in the Sacramento River at Freeport (Appendix 8J,
 29 *Nitrate*, Figure 1). Consequently, any modified reservoir operations and subsequent changes in river
 30 flows under the No Action Alternative, relative to Existing Conditions, are expected to have
 31 negligible, if any, effects on average reservoir and river nitrate-N concentrations in the Sacramento
 32 River watershed upstream of the Delta.

33 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento
 34 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
 35 between historical water year average nitrate concentrations and water year average flow in the San
 36 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
 37 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
 38 regression $r^2=0.49$, Appendix 8J, *Nitrate*, Figure 2). Under the No Action Alternative, long-term
 39 average flows at Vernalis would decrease an estimated 6% relative to Existing Conditions (Appendix
 40 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). Given these relatively small
 41 decreases in flows and the weak correlation between nitrate and flows in the San Joaquin River, it is
 42 expected that nitrate concentrations in the San Joaquin River would be minimally affected, if at all,
 43 by anticipated changes in flow rates under the No Action Alternative.

1 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 2 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 3 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 4 water bodies, with regards to nitrate.

5 **Delta**

6 Results of the mixing calculations indicate that under the No Action Alternative, relative to Existing
 7 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
 8 N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 4 and 5). Although changes at specific
 9 Delta locations and for specific months may be substantial on a relative basis, the absolute
 10 concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking
 11 water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term average
 12 nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment locations
 13 except the San Joaquin River at Buckley Cove, where long-term average concentrations would be
 14 somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate concentration
 15 would be somewhat reduced under the no Action Alternative, relative to Existing Conditions. No
 16 additional exceedances of the MCL are anticipated at any location (Appendix 8J, Table 4). On a
 17 monthly average basis and on a long term annual average basis, for all modeled years and for the
 18 drought period (1987–1991) only, use of assimilative capacity available under Existing Conditions,
 19 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <3%) for all locations
 20 and months (Appendix 8J, Table 6).

21 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 22 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 23 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 24 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 25 the modeling.

- 26 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 27 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 28 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 29 the increase becoming greater with increasing distance downstream. However, the increase in
 30 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 31 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 32 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Regional
 33 Water Quality Control Board 2010a:32).
- 34 • Under the No Action Alternative, the planned upgrades to the SRWTP, which include
 35 nitrification/partial denitrification, would substantially decrease ammonia concentrations in the
 36 discharge, but would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is
 37 substantially higher than under Existing Conditions.
- 38 • Overall, under the No Action Alternative, the nitrogen load from the SRWTP discharge is
 39 expected to decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 40 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
 41 of the facility are expected to be higher than modeling results indicate for both Existing
 42 Conditions and the No Action Alternative, the increase is expected to be greater under Existing
 43 Conditions than for the No Action Alternative due to the upgrades that are assumed under the
 44 No Action Alternative.

1 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
2 immediately downstream of other wastewater treatment plants that practice nitrification, but not
3 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
4 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
5 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
6 State has determined that no beneficial uses are adversely affected by the discharge, and that the
7 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
8 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
9 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
10 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
11 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
12 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
13 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

14 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
15 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
16 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

17 ***SWP/CVP Export Service Areas***

18 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
19 nitrate-N at the Banks and Jones pumping plants.

20 Results of the mixing calculations indicate that under the No Action Alternative, relative to Existing
21 Conditions, long-term average nitrate concentrations at Banks and Jones pumping plants are
22 anticipated to change negligibly (Appendix 8J, *Nitrate*, Table 4 and 5). No additional exceedances of
23 the MCL are anticipated (Appendix 8J, Table 4). On a monthly average basis and on a long term
24 annual average basis, for all modeled years and for the drought period (1987–1991) only, use of
25 assimilative capacity available under Existing Conditions relative to the MCL was negligible (i.e.,
26 <3%) for both Banks and Jones pumping plants (Appendix 8J, Table 6). As discussed above in the
27 Delta region, nitrate-N concentrations would be higher than indicated in the mixing modeling
28 results for areas receiving Sacramento River water, including Banks and Jones pumping plants,
29 downstream of the SRWTP discharge at Freeport in the Existing Conditions (by < 1 mg/L-N), due to
30 conversion of ammonia to nitrate within the Delta. For the No Action Alternative, nitrate levels
31 would also be slightly higher than the mixing modeling results suggests because full
32 nitrification/partial denitrification of the SRWTP discharge was not accounted for. Nonetheless, the
33 total nitrogen load from the SRWTP is expected to decrease substantially due the facility's upgrades.
34 Hence, long-term average nitrate-N concentrations would be expected to decrease under the No
35 Action Alternative, relative to Existing Conditions.

36 Any short-term, negligible increases in nitrate-N concentrations that may occur in water exported
37 via Banks and Jones pumping plants are not expected to result in adverse effects to beneficial uses of
38 exported water or substantially degrade the quality of exported water, with regards to nitrate.

39 In summary, based on the discussion above, effects on nitrate of facilities operation and
40 maintenance are considered to be not adverse.

41 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
43 *Determination of Effects*) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
4 substantial dilution available for point sources and the lack of substantial nonpoint sources of
5 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
6 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
7 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
8 Consequently, any modified reservoir operations and subsequent changes in river flows under the
9 No Action Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects
10 on reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
11 watershed and upstream of the Delta in the San Joaquin River watershed.

12 In the Delta, results of the mixing calculations indicate that under the No Action Alternative, relative
13 to Existing Conditions, nitrate concentrations throughout the Delta are anticipated to remain low
14 (<1.4 mg/L-N) relative to adopted objectives. No additional exceedances of the MCL are anticipated
15 at any location, and use of assimilative capacity available under Existing Conditions, relative to the
16 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <3%) for all locations and months.

17 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
18 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
19 indicate that under the No Action Alternative, relative to Existing Conditions, long-term average
20 nitrate concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
21 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
22 Existing Conditions, relative to the MCL was negligible (i.e., <3%) for both Banks and Jones pumping
23 plants for all months.

24 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
25 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
26 CVP and SWP service areas under the No Action Alternative relative to Existing Conditions. As such,
27 this alternative is not expected to cause additional exceedance of applicable water quality
28 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
29 on any beneficial uses of waters in the affected environment from nitrate. Because nitrate
30 concentrations are not expected to increase substantially, no long-term water quality degradation is
31 expected to occur and, thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d)
32 listed within the affected environment and thus any minor increases that may occur in some areas
33 would not make any existing nitrate-related impairment measurably worse because no such
34 impairments currently exist. Because nitrate is not bioaccumulative, minor increases that may occur
35 in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn,
36 pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
37 significant.

38 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 39 **Operations and Maintenance**

40 ***Upstream of the Delta***

41 Under the No Action Alternative, greater water demands will alter the magnitude and timing of
42 reservoir releases upstream of the Delta, relative to Existing Conditions. While greater water
43 demands under the No Action Alternative would alter the magnitude and timing of reservoir

1 releases north, south and east of the Delta, these activities would have no substantial effect on the
 2 various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento River
 3 at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows
 4 would not be expected to cause a substantial long-term change in DOC concentrations upstream of
 5 the Delta. Consequently, long-term average DOC concentrations under the No Action Alternative
 6 would not be expected to change by frequency, magnitude and geographic extent, relative to
 7 Existing Conditions and, and thus, would not adversely affect the MUN beneficial use, or any other
 8 beneficial uses, in water bodies of the affected environment located upstream of the Delta.

9 **Delta**

10 Relative to Existing Conditions, the No Action Alternative would result in mostly minor changes (i.e.,
 11 up to 4% increases and 6% decreases) in long-term average DOC concentrations at all Delta
 12 assessment locations. Increases in long-term average DOC concentrations for the 16-year (1976–
 13 1991) hydrologic period modeled would not be greater than 0.1 mg/L, with the largest predicted
 14 change occurring at Rock Slough during the 1987–1991 drought period modeled, where average
 15 DOC concentration would be predicted to increase by approximately 4% (Appendix 8K, *Organic*
 16 *Carbon*, DOC Table 1). At all 11 assessment locations, modeled long-term average DOC
 17 concentrations under the No Action Alternative would exceed 2 mg/L 94–100% of the time. The
 18 frequency with which average DOC concentration exceeds the 3 mg/L threshold would change only
 19 slightly, with exception to predicted changes at both the Banks and Jones pumping plants.

20 At the Banks pumping plant, the frequency with which average DOC concentration would exceed 3
 21 mg/L would increase from 64% under Existing Conditions to 71% under the No Action Alternative
 22 (an increase from 57% to 75% during the drought year period of 1987–1991) (Appendix 8K,
 23 *Organic Carbon*, DOC Table 1). At the Jones pumping plant, the frequency that long-term average
 24 DOC concentration would exceed 3 mg/L would increase from 71% under Existing Conditions to
 25 80% under the No Action Alternative (an increase from 72% to 90% for the drought period
 26 modeled). In contrast, however, the relative frequency long-term average DOC concentrations would
 27 exceed 4 mg/L at the Banks and Jones pumping plants would be small. At the Banks pumping plant,
 28 the frequency long-term average DOC concentrations would exceed 4 mg/L would increase from
 29 33% under Existing Conditions to 35% under the No Action Alternative (an increase from 42% to
 30 43% for the drought period), while at the Jones pumping plant the modeled exceedance frequency
 31 would rise from 26% to 28% (with no predicted change in frequency of exceedance for the drought
 32 period). Trends in concentration threshold exceedances at the other assessment locations would
 33 follow that described for the Banks and Jones pumping plants, but the overall magnitude of
 34 threshold exceedance change would be less. While the No Action Alternative would generally lead to
 35 slightly higher long-term average DOC concentration in the western and southern Delta, the
 36 predicted change would not be expected to be of magnitude that would adversely affect MUN
 37 beneficial uses, or any other beneficial use, particularly when considering the relatively small
 38 change in long-term annual average concentration (i.e., ≤ 0.1 mg/L).

39 **SWP/CVP Export Service Areas**

40 With respect to the potential for effects resulting from No Action Alternative induced changes on
 41 long-term average DOC concentrations in the water exported via the Banks and Jones pumping
 42 plants, long-term average DOC concentrations would increase only slightly. Under the No Action
 43 Alternative, long-term average DOC concentrations at the Banks and Jones pumping plants would
 44 increase by as much as 3% relative to Existing Conditions (Appendix 8K, *Organic Carbon*, DOC Table

1) A greater frequency of exports greater than 3 and 4 mg/L would be predicted to occur at both Banks and Jones pumping plants, as previously discussed for the Delta, although the increased frequency of 4 mg/L would be comparatively small (see Delta discussion above). As previously stated, the predicted change in long-term average DOC concentrations relative to existing conditions would not be expected to be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial use, within the SWP and CVP Service Area.

Maintenance of SWP and CVP facilities under the No Action Alternative would not be expected to create new sources of DOC or contribute towards a substantial change in existing sources of DOC in the affected environment. Maintenance activities would not be expected to cause any substantial change in long-term average DOC concentrations such that the MUN beneficial use, or any other beneficial use, would be adversely affected anywhere in the affected environment.

CEQA Conclusion: Key findings discussed in the effects assessment provided above are summarized here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact determination for this constituent. For additional details on the effects assessment findings that support this CEQA impact determination, see the effects assessment discussion that immediately precedes this conclusion.

While greater water demands under the No Action Alternative would alter the magnitude and timing of reservoir releases north, south and east of the Delta, these activities would have no substantial effect on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows would not be expected to cause a substantial long-term change in DOC concentrations upstream of the Delta.

Relative to Existing Conditions, the No Action Alternative would result in mostly minor changes (i.e., up to 4% increases and 6% decreases) in long-term average DOC concentrations at all Delta assessment locations, with the largest increase (i.e., 4%) occurring at Rock Slough during the modeled drought period. While the No Action Alternative would generally lead to slightly higher long-term average DOC concentration (i.e., ≤ 0.1 mg/L) in the western and southern Delta, the predicted change would not be expected to be of magnitude that would adversely affect MUN beneficial uses, or any other beneficial use.

The assessment of No Action Alternative effects on DOC in the SWP/CVP Export Service Areas is based on assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to existing condition, long-term average DOC concentrations would increase only slightly at Banks and Jones pumping plants. The predicted change in long-term average DOC concentrations relative to Existing Conditions would not be expected to be of sufficient magnitude to adversely affect MUN beneficial uses, or any other beneficial use, within the SWP and CVP Service Area.

Based on the above, the No Action Alternative would not result in any substantial change in long-term average DOC concentration upstream of the Delta or result in substantial increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC concentrations would increase by no more than 0.1 mg/L at any single Delta assessment location (i.e., $\leq 4\%$ relative increase). The increases in long-term average DOC concentration that could occur within the Delta would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters or waters of the SWP and CVP Service Area. Because DOC is not bioaccumulative, the increases in long-term average DOC concentrations would not directly cause

1 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use
2 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
3 the increases in long-term average DOC that could occur at various locations would not make any
4 beneficial use impairment measurably worse. Because long-term average DOC concentrations would
5 not be expected to increase substantially, no long-term water quality degradation with respect to
6 DOC would be expected to occur and, thus, no significant impacts on beneficial uses would occur.
7 This impact would be less than significant.

8 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

9 ***Upstream of the Delta***

10 Under the No Action Alternative, the only pathogen sources expected to change in the watersheds
11 upstream of the Delta relative to Existing Conditions would be associated with population growth,
12 i.e., increased municipal wastewater discharges and development contributing to increased urban
13 runoff.

14 Increased municipal wastewater discharges resulting from future population growth would not be
15 expected to measurably increase pathogen concentrations in receiving waters due to state and
16 federal water quality regulations requiring disinfection of effluent discharges and the state's
17 implementation of Title 22 filtration requirements for many wastewater dischargers in the
18 Sacramento River and San Joaquin River watersheds.

19 Pathogen loading from urban areas would generally occur in association with both dry and wet
20 weather runoff from urban landscapes. Municipal stormwater regulations and permits have become
21 increasingly stringent in recent years, and such further regulation of urban stormwater runoff is
22 expected to continue in the future. Municipalities may implement BMPs for reducing pollutant
23 loadings from urban runoff, particularly in response to NPDES stormwater-related regulations
24 requiring reduction of pollutant loading in urban runoff. The ability of these BMPs to consistently
25 reduce pathogen loadings and the extent of future implementation is uncertain, but would be
26 expected to improve as new technologies are continually tested and implemented. Also, some of the
27 urbanization may occur on lands used by other pathogens sources, such as grazing lands, resulting
28 in a change in pathogen source, but not necessarily an increase (and possibly a decrease) in
29 pathogen loading.

30 Pathogen concentrations in the Sacramento and San Joaquin Rivers have a minimal relationship to
31 flow rate in these rivers, although most of the high concentrations observed have been during the
32 wet months (Tetra Tech 2007). Further, urban runoff contributions during the dry season would be
33 expected to be a relatively small fraction of the rivers' total flow rates. During wet weather events,
34 when urban runoff contributions would be higher, the flows in the rivers also would be higher.
35 Given the small magnitude of urban runoff contributions relative to the magnitude of river flows,
36 that pathogen concentrations in the rivers have a minimal relationship to river flow rate, and the
37 expected reduced pollutant loadings in response to NPDES stormwater-related regulations, river
38 flow rate and reservoir storage reductions that would occur under the No Action Alternative,
39 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
40 pathogen concentrations in the reservoirs and rivers upstream of the Delta. As such, the No Action
41 Alternative would not be expected to substantially increase the frequency with which applicable
42 Basin Plan objectives or U.S. EPA-recommended pathogen criteria would be exceeded in water

1 bodies of the affected environment located upstream of the Delta or substantially degrade the
2 quality of these water bodies, with regard to pathogens.

3 **Delta**

4 The *Conceptual Model for Pathogens and Pathogen Indicators in the Central Valley and Sacramento-*
5 *San Joaquin Delta* (Tetra Tech 2007) provides a comprehensive evaluation of factors affecting
6 pathogen levels in the Delta. The Pathogens Conceptual Model characterizes relative pathogen
7 contributions to the Delta from the Sacramento and San Joaquin Rivers and various pathogen
8 sources, including wastewater discharges and urban runoff. Contributions from the San Francisco
9 Bay to the Delta are not addressed. The Pathogens Conceptual Model is based on a database
10 compiled by the Central Valley Drinking Water Policy Group in 2004–2005, supplemented with data
11 from Natomas East Main Drainage Canal Studies, North Bay Aqueduct sampling, and the USGS. Data
12 for multiple sites in the Sacramento River and San Joaquin River watersheds, and in the Delta were
13 compiled. Indicator species evaluated include fecal coliforms, total coliforms, and *E. coli*. Because of
14 its availability, *Cryptosporidium* and *Giardia* data for the Sacramento River also were evaluated. Key
15 results of the data evaluation are:

16 **Total Coliform**

- 17 ● In the Sacramento Valley, the highest total coliform concentrations (>10,000 MPN/100 ml) were
18 located near urban areas.
- 19 ● Similarly high total coliform concentrations were not observed in the San Joaquin Valley,
20 because reported results were capped at about 2,400 MPN/100 ml, though a large number of
21 results were reported as being greater than this value.
- 22 ● The data should not to be interpreted to conclude that Sacramento River has higher total
23 coliform concentrations; rather, the “appearance” of the lower total coliform concentrations in
24 the San Joaquin Valley is attributed to a lower upper limit of reporting (2,400 MPN/100 ml
25 versus 10,000 MPN/100 ml).

26 ***E. coli***

- 27 ● Comparably high concentrations observed in the Sacramento River and San Joaquin River
28 watersheds for waters affected by urban environments and intensive agriculture.
- 29 ● The highest concentrations in the San Joaquin River were not at the most downstream location
30 monitored, but rather at an intermediate location near Hills Ferry.
- 31 ● *E. coli* concentrations in the Delta were somewhat higher than in the San Joaquin River and
32 Sacramento River, indicating the importance of in-Delta sources and influence of distance of
33 pathogen source on concentrations at a particular location in the receiving waters.
- 34 ● Temporal (seasonal) trends were weak, however, the highest concentrations in the Sacramento
35 River were observed during the wet months and the lowest concentrations were observed in
36 July and August.

37 **Fecal Coliform**

- 38 ● There was limited data from which to make comparisons/observations.

1 **Cryptosporidium and Giardia**

- 2 • Data were available only for the Sacramento River, limiting the ability to make comparisons
- 3 between sources.
- 4 • Often not detected and when detected, concentrations typically less than 1 organism per liter.
- 5 • There may be natural/artificial barriers/processes that limit *Cryptosporidium* transport to
- 6 water. Significant die off of those that reach the water may contribute to the low frequency of
- 7 detection.

8 The Pathogens Conceptual Model found that coliform indicators vary by orders of magnitudes over
 9 small distances and short time-scales. Concentrations appear to be more closely related to what
 10 happens in the proximity of a sampling station, rather than what happens in the larger watershed
 11 where significant travel time and concomitant pathogen die-off can occur. Sites in the Delta close to
 12 urban discharges had elevated concentrations of coliform organisms. The highest total coliform and
 13 *E. coli* concentrations were observed in the discharge from the Natomas East Main Drainage Canal
 14 and several stations near sloughs, indicating the relative influence of urban and wildlife pathogen
 15 sources on receiving water concentrations.

16 The effects of the No Action Alternative relative to Existing Conditions would be changes in the
 17 relative percentage of water throughout the Delta being comprised of various source waters (i.e.,
 18 water from the Sacramento River, San Joaquin River, Bay water, eastside tributaries, and
 19 agricultural return flow), due to potential changes in inflows particularly from the Sacramento River
 20 watershed due to increased water demands and somewhat modified SWP and CVP operations.
 21 However, it is expected there would be no substantial change in Delta pathogen concentrations in
 22 response to a shift in the Delta source water percentages under this alternative or substantial
 23 degradation of these water bodies, with regard to pathogens. This conclusion is based on the
 24 Pathogens Conceptual Model, which found that pathogen sources in close proximity to a Delta site
 25 appear to have the greatest influence on pathogen levels at the site, rather than the primary
 26 source(s) of water to the site. In-Delta potential pathogen sources, including water-based recreation,
 27 tidal habitat, wildlife, and livestock-related uses, would continue under this alternative.

28 ***SWP/CVP Export Service Areas***

29 The No Action Alternative is not expected to result in substantial changes in pathogen levels in Delta
 30 waters, relative to Existing Conditions. As such, there is not expected to be substantial, if even
 31 measurable, changes in pathogen concentrations in the SWP/CVP Export Service Areas waters
 32 under the No Action Alternative relative to Existing Conditions.

33 The effects on pathogens from implementing the No Action Alternative is determined to not be
 34 adverse.

35 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 36 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 37 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 38 constituent. For additional details on the effects assessment findings that support this CEQA impact
 39 determination, see the effects assessment discussion that immediately precedes this conclusion.

40 River flow rate and reservoir storage reductions that would occur under the No Action Alternative,
 41 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
 42 pathogen concentrations in the reservoirs and rivers upstream of the Delta, given the small

1 magnitude of urban runoff contributions relative to the magnitude of river flows, that pathogen
 2 concentrations in the rivers have a minimal relationship to river flow rate, and the expected reduced
 3 pollutant loadings in response to NPDES stormwater-related regulations.

4 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 5 a shift in the Delta source water percentages under this alternative or substantial degradation of
 6 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
 7 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 8 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 9 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 10 and livestock-related uses, would continue under this alternative.

11 There is not expected to be substantial, if even measurable, changes in pathogen concentrations in
 12 the SWP/CVP Export Service Areas waters under the No Action Alternative, relative to Existing
 13 Conditions, because the No Action Alternative is not expected to result in substantial changes in
 14 pathogen levels in Delta waters relative to Existing Conditions.

15 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 16 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 17 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 18 expected to increase substantially, no long-term water quality degradation for pathogens is
 19 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 20 River in the Stockton Deep Water Ship Channel is Clean Water Act Section 303(d) listed for
 21 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 22 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 23 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 24 considered to be less than significant.

25 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 26 **Maintenance**

27 Residues of “legacy” organochlorine (OC) pesticides enter rivers primarily through surface runoff
 28 and erosion of terrestrial soils during storm events, and through resuspension of riverine bottom
 29 sediments, the combination of which to this day may contribute to excursions above water quality
 30 objectives (Central Valley Regional Water Quality Control Board 2010c). Operation of the CVP/SWP
 31 does not affect terrestrial sources, but may result in geomorphic changes to the affected
 32 environment that ultimately could result in changes to sediment suspension and deposition.
 33 However, as discussed in greater detail for Turbidity/TSS, operations under any alternative would
 34 not be expected to change TSS or turbidity levels (highs, lows, typical conditions) to any substantial
 35 degree. Changes in the magnitude, frequency, and geographic distribution of legacy pesticides in
 36 water bodies of the affected environment that would result in new or more severe adverse effects on
 37 aquatic life or other beneficial uses, relative to Existing Conditions or the No Action Alternative,
 38 would not be expected to occur. Therefore, the pesticide assessment focuses on the present use
 39 pesticides for which substantial information is available, namely diazinon, chlorpyrifos, pyrethroids,
 40 and diuron.

41 ***Upstream of the Delta***

42 Pyrethroid and OP insecticides are applied to agricultural fields, orchards, row crops, and confined
 43 animal facilities on an annual basis, with peaks in agricultural application during the winter

1 dormant season (January–February) and during field cropping in the spring and summer.
2 Applications of diuron occur year-round, but the majority of diuron is applied to road rights-of-way
3 as a pre-emergent and early post emergent weed treatment during the late fall and early winter
4 (Green and Young 2006). Pyrethroid insecticides and urban use herbicides are additionally applied
5 around urban and residential structures and landscapes on an annual basis. These applications
6 throughout the upstream watershed represent the source and potential pool of these pesticides that
7 may enter the rivers upstream of the Delta by way of surface runoff and/or drift. Principal factors
8 contributing to pesticide loading in the Sacramento River watershed include the amount of pesticide
9 used and amount of precipitation (Guo et al. 2004). Although urban dry weather runoff occurs, this
10 is generally believed to be less significant source of pesticides to main stem receiving waters, but for
11 pyrethroids a recent study concluded that municipal wastewater treatment plants in Sacramento
12 and Stockton represent a continuous year-round source of pyrethroids to the lower Sacramento and
13 San Joaquin River’s (Weston and Lydy 2010).

14 Pesticide-related toxicity has historically been observed throughout the affected environment
15 regardless of season or water year type; however, toxicity is generally observed with increased
16 incidence during spring and summer months of April to June, coincident with the peak in irrigated
17 agriculture in the Sacramento and San Joaquin Valleys, as well as the winter rainy season,
18 particularly December through February, coincident with urban and agricultural storm-water runoff
19 and the orchard dormant spraying season (Fox and Archibald 1997). Although OP insecticide
20 incidence and related toxicity can be observed throughout the year, diazinon is most frequently
21 observed during the winter months and chlorpyrifos is most frequently observed in the summer
22 irrigation months (Central Valley Regional Water Quality Control Board 2007). These seasonal
23 trends coincide with their use, where diazinon is principally used as an orchard dormant season
24 spray, and chlorpyrifos is primarily used on crops during the summer.

25 Application of diuron peaks in the late fall and early winter. Coincidentally, diuron is found most
26 frequently in surface waters during the winter precipitation and runoff months of January through
27 March (Green and Young 2006), although diuron can be found much less frequently in surface
28 waters throughout the year (Johnson et al. 2010).

29 Monitoring for pyrethroid insecticides in mainstem rivers is limited and detections are rather few.
30 With the replacement of many traditionally OP related uses, however, it is conservatively assumed
31 that pyrethroid incidence and associated toxicity could ultimately take a pattern of seasonality
32 similar to that of the chlorpyrifos or diazinon.

33 In comparison to the Valley floor, relatively small amounts of pesticides are used in watersheds
34 upstream of project reservoirs. Water released from reservoirs flow through urban and agricultural
35 areas at which point these waters may acquire a burden of pesticide from agricultural or urban
36 sourced discharges. These discharges with their potential burden of pesticides are effectively
37 diluted by reservoir water. Under the No Action Alternative, no activity of the SWP or CVP would
38 substantially drive a change in pesticide use, and thus pesticide sources would remain unaffected.
39 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
40 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
41 Joaquin Rivers.

42 Under the No Action Alternative, winter (November–March) and summer (April–October) season
43 average flow rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at
44 Thermalito, and the San Joaquin River at Vernalis would change relative to Existing Conditions.

1 Averaged over the entire period of record, seasonal mean flow rates would largely remain
2 unchanged on the Sacramento River and Feather Rivers (Appendix 8L, *Pesticides*, Tables 1–4).
3 Summer average flow rates on the American River would decrease by 16% relative to Existing
4 Conditions. During the winter months, however, average flow rates would increase by as much as
5 9% on the American River. Similarly, summer average flow rates on the San Joaquin River would
6 decrease by 12% relative to Existing Conditions, while winter average flow rates would increase
7 slightly.

8 As previously stated, historically chlorpyrifos is used in greater amounts in agriculture in the
9 summer, and consequently observed in surface waters with greater frequency in the summer, while
10 diazinon and diuron are used and observed in surface water with greater frequency in the winter.
11 While flow reductions in the summer on the American River would not coincide with urban
12 stormwater discharges, summer flow reductions on the San Joaquin River would correspond to the
13 agricultural irrigation season. However, summer average flow reductions of up to 12%, relative to
14 Existing Conditions, are not considered of sufficient magnitude to substantially increase in-river
15 concentrations or alter the long-term risk of pesticide-related effects on aquatic life beneficial uses.
16 Greater long-term average flow reductions, and corresponding reductions in dilution/assimilative
17 capacity, would be necessary before long-term risk of pesticide related effects on aquatic life
18 beneficial uses would be adversely altered.

19 **Delta**

20 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
21 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
22 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

23 Studies documenting pesticide associated toxicity in the Delta demonstrate the dynamic nature of
24 pesticide input. Pesticide loads entering the Delta, but originating outside of the Delta, do so
25 typically in pulses and particularly after significant precipitation induced surface runoff events
26 (Kuivila and Foe 1995). Through the greater hydraulic capacity of the Delta, and through tidal
27 mixing, these pulses become diluted and spread about the Delta. Although it is difficult to
28 definitively conclude that either the Sacramento River or San Joaquin River is a consistently
29 dominant source of pesticide, a compilation of Delta diazinon and chlorpyrifos data suggest that
30 these two OP insecticides have both been more frequently observed in the San Joaquin River, and at
31 concentrations more frequently exceeding OP specific aquatic life criteria (Central Valley Regional
32 Water Quality Control Board 2006).

33 No similar observation as to incidence frequency can be made regarding pyrethroid insecticides,
34 primarily owing to a dearth of monitoring data. Pyrethroid insecticides have been observed in Delta
35 waterways, but there is little evidence supporting any particular geographic or seasonal trend
36 (Werner et al. 2010). Unlike that for chlorpyrifos and diazinon, data for pyrethroids are insufficient
37 to determine the relative loading from particular source waters.

38 Diuron has been detected in the Delta throughout the year, but with greater magnitude and
39 frequency during the winter storm season. Unlike that for chlorpyrifos and diazinon, data for diuron
40 are insufficient to determine the relative loading from particular source waters.

41 Granting the assessment challenges imposed by data limitations, there does appear sufficient
42 information to suggest that the San Joaquin River, in comparison to the Sacramento River, is a
43 greater contributor of OP insecticides in terms of greater frequency of incidence and presence at

1 concentrations exceeding water quality benchmarks. Although data is insufficient to make similar
2 observations pertaining to diuron, trends in pyrethroid use suggest that pyrethroid insecticides may
3 in the near future reflect the historic trends of OP insecticides, namely that of relative frequency,
4 magnitude, seasonality and geographic distribution. Based on these general observations, this
5 assessment utilizes source water fingerprinting to make qualitative judgments as to increased risk
6 of pesticide related aquatic life toxicity and judgments as to the possibility of associated long-term
7 degradation to water quality.

8 Percentage change in monthly average source water fraction were evaluated for the modeled 16-
9 year (1976–1991) hydrologic period and a representative drought period (1987–1991), with special
10 attention given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources
11 water fractions. For the No Action Alternative, San Joaquin River fractions would not increase more
12 than 10% at any of the 11 modeled assessment locations, with exception to Jones pumping plant
13 during the modeled drought period, where San Joaquin River fraction would increase 12–14% in
14 October and November relative to Existing Conditions, yet would continue to represent less than
15 43% of the total source water volume (Appendix 8D, *Source Water Fingerprinting Results*). Similarly,
16 Sacramento River fractions would not increase more than 10% at any of the 11 modeled assessment
17 locations. However, these large fractional increases in Sacramento River occur through near equal
18 replacement of San Joaquin River water and, as such, would likely represent an overall decrease in
19 risk of pesticide-related toxicity to aquatic life. There would be no modeled increases in Delta
20 agricultural fractions greater than 2%.

21 These modeled changes in the source water fractions of Sacramento, San Joaquin and Delta
22 agriculture water are not of sufficient magnitude to substantially alter the long-term risk of
23 pesticide-related toxicity to aquatic life within the Delta, nor would such changes result in adverse
24 pesticide-related effects on any other beneficial uses of Delta waters.

25 ***SWP/CVP Export Service Areas***

26 Assessment of effects in SWP and CVP Export Service Areas is based on effects seen in the Delta at
27 the Banks and Jones pumping plants. Under the No Action Alternative, Sacramento, San Joaquin and
28 in-Delta Agricultural source water fractions at Banks would not increase more than 5% in any
29 month relative to Existing Conditions (Appendix 8D, *Source Water Fingerprinting Results*). At Jones
30 during the modeled drought period, San Joaquin River source water fractions would increase by as
31 much as 12–14% in October and November relative to Existing Conditions, yet would continue to
32 represent less than 43% of the total source water volume. These modeled changes in the source
33 water fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient
34 magnitude to substantially alter the long-term risk of pesticide-related toxicity to aquatic life
35 beneficial uses, or any other beneficial uses, in water bodies of the SWP and CVP service area.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
37 provided above are summarized here, and are then compared to the CEQA thresholds of significance
38 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
39 determination for this constituent. For additional details on the effects assessment findings that
40 support this CEQA impact determination, see the effects assessment discussion that immediately
41 precedes this conclusion.

42 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
43 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
44 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average

1 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
2 substantially increase the long-term risk of pesticide-related water quality degradation and related
3 toxicity to aquatic life in these water bodies upstream of the Delta.

4 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
5 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
6 and maintenance activities would not affect these sources, changes in Delta source water fraction
7 could change the relative risk associated with pesticide related toxicity to aquatic life. Under the No
8 Action Alternative, however, modeled changes in source water fractions relative to Existing
9 Conditions are of insufficient magnitude to substantially alter the long-term risk of pesticide-related
10 toxicity to aquatic life within the Delta, nor would such changes result in adverse pesticide-related
11 effects on any other beneficial uses of Delta waters.

12 The assessment of the No Action Alternative effects on pesticides in the SWP/CVP Export Service
13 Areas is based on assessment of changes predicted at Banks and Jones pumping plants. As just
14 discussed regarding effects to pesticides in the Delta, modeled changes in source water fractions at
15 the Banks and Jones pumping plants are of insufficient magnitude to substantially alter the long-
16 term risk of pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in
17 water bodies of the SWP and CVP export service area.

18 Based on the above, the No Action Alternative would not result in any substantial change in long-
19 term average pesticide concentration or result in substantial increase in the anticipated frequency
20 with which long-term average pesticide concentrations would exceed aquatic life toxicity thresholds
21 or other beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations
22 analyzed for the Delta, or the SWP and CVP service area. Numerous pesticides are currently used
23 throughout the affected environment, and while some of these pesticides may be bioaccumulative,
24 those present-use pesticides for which there is sufficient evidence for their presence in waters
25 affected by SWP and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not
26 considered bioaccumulative, and thus changes in their concentrations would not directly cause
27 bioaccumulative problems in aquatic life or humans. Furthermore, while there are numerous 303(d)
28 listings throughout the affected environment that name pesticides as the cause for beneficial use
29 impairment, the modeled changes in upstream river flows and Delta source water fractions would
30 not be expected to make any of these beneficial use impairments measurably worse. Because long-
31 term average pesticide concentrations are not expected to increase substantially, no long-term
32 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
33 effects on beneficial uses would occur. This impact is considered to be less than significant.

34 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 35 **and Maintenance**

36 As described under Impact WQ-29, facilities operations and maintenance is not expected to result in
37 substantial changes in TSS and Turbidity under the project alternative relative to Existing
38 Conditions in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service
39 Areas. Thus in these areas, long-term changes in the levels of suspended sediment-bound
40 phosphorus are not expected. Additional factors that may affect phosphorus levels are discussed
41 below.

1 **Upstream of the Delta**

2 A conceptual model of nutrients in the Delta stated that: “previous attempts to relate concentration
3 data to flow data in the Central Valley and Delta showed little correlation between the two variables
4 (Tetra Tech 2006b, *Conceptual Model for Organic Carbon in the Central Valley*). One possible reason
5 is that the Central Valley and Delta system is a highly managed system with flows controlled by
6 major reservoirs on most rivers” (Tetra Tech 2006b:4-1 to 4-2). Attempts discussed under Impact
7 WQ-15 also showed weak correlation between nitrate and flows for major source waters to the
8 Delta. The linear regressions between average dissolved ortho-phosphate concentrations and
9 average flows in the San Joaquin and Sacramento Rivers were derived for this analysis (Figures 8-57
10 and 8-58, respectively). As expected, neither relationship is very strong, although over the large
11 range in flows for the Sacramento River, the relationship is stronger than for the San Joaquin River.
12 However, over smaller changes in flows, neither relationship can function as a predictor of
13 phosphorus concentrations because the variability in the data over small to medium ranges of flows
14 (i.e., <10,000 cfs) is large.

15 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
16 because changes in flows do not necessarily result in changes in concentrations or loading of
17 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
18 anticipated for the No Action Alternative, relative to Existing Conditions. Any negligible changes in
19 phosphorus concentrations that may occur in the water bodies of the affected environment located
20 upstream of the Delta would not be of frequency, magnitude and geographic extent that would
21 adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with
22 regards to phosphorus.

23 **Delta**

24 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
25 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
26 long term-average basis. Phosphorus concentrations may increase during January through March at
27 locations where the source fraction of San Joaquin River water increases, due to the higher
28 concentration of phosphorus in the San Joaquin River during these months compared to Sacramento
29 River water or San Francisco Bay water. Based on the DSM2 fingerprinting results (see Appendix 8D,
30 *Source Water Fingerprinting Results*), together with source water concentrations shown in Figure 8-
31 56, the magnitude of increases during these months may range from negligible up to approximately
32 0.05 mg/L. However, there are no state or federal objectives/criteria for phosphorus and thus any
33 increases would not cause exceedances of objectives/criteria. Because algal growth rates are limited
34 by availability of light in the Delta, increases in phosphorus levels that may occur at some locations
35 and times within the Delta would be expected to have little effect on primary productivity in the
36 Delta. Moreover, such increases in concentrations would not be anticipated to be of frequency,
37 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
38 degrade the water quality at these locations, with regards to phosphorus.

39 **SWP/CVP Export Service Areas**

40 The assessment of effects of phosphorus under the No Action Alternative in the SWP and CVP Export
41 Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants.

42 As noted in the Delta Region section above, phosphorus concentrations in the Delta (including Banks
43 and Jones pumping plants) are not anticipated to change substantially on a long term-average basis.

1 During January through March, phosphorus concentrations may increase as a result of more San
2 Joaquin River water reaching Banks and Jones pumping plants and the higher concentration of
3 phosphorus in the San Joaquin River. However, based on the DSM2 fingerprinting results (see
4 Appendix 8D, *Source Water Fingerprinting Results*), together with source water concentrations
5 shown in Figure 8-56, the magnitude of this increase is expected to be negligible (<0.01 mg/L-P).
6 Additionally, there are no state or federal objectives for phosphorus. Moreover, given the many
7 factors that contribute to potential algal blooms in the SWP and CVP canals within the Export
8 Service Area, and the lack of studies that have shown a direct relationship between nutrient
9 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
10 there is no basis to conclude that any seasonal increases in phosphorus concentrations at the levels
11 expected under this alternative, should they occur, would increase the potential for problem algal
12 blooms in the SWP and CVP Export Service Area.

13 Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones
14 pumping plants are not expected to result in adverse effects to beneficial uses of exported water or
15 substantially degrade the quality of exported water, with regards to phosphorus.

16 In summary, based on the discussion above, effects on phosphorus of facilities operations and
17 maintenance are considered to be not adverse.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
19 provided above are summarized here, and are then compared to the CEQA thresholds of significance
20 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
21 determination for this constituent. For additional details on the effects assessment findings that
22 support this CEQA impact determination, see the effects assessment discussion that immediately
23 precedes this conclusion.

24 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
25 because changes in flows do not necessarily result in changes in concentrations or loading of
26 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
27 Delta are not anticipated for the No Action Alternative, relative to Existing Conditions.

28 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
29 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
30 long term-average basis under the No Action Alternative, relative to Existing Conditions. Algal
31 growth rates are limited by availability of light in the Delta, and therefore any minor increases in
32 phosphorus levels that may occur at some locations and times within the Delta would be expected to
33 have little effect on primary productivity in the Delta.

34 The assessment of effects of phosphorus under the No Action Alternative in the SWP and CVP Export
35 Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted
36 above, phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
37 anticipated to change substantially on a long term-average basis.

38 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
39 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
40 CVP and SWP service areas under the No Action Alternative relative to Existing Conditions. As such,
41 this alternative is not expected to cause additional exceedance of applicable water quality
42 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
43 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations

1 are not expected to increase substantially, no long-term water quality degradation is expected to
 2 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 3 within the affected environment and thus any minor increases that may occur in some areas would
 4 not make any existing phosphorus-related impairment measurably worse because no such
 5 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 6 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 7 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 8 than significant.

9 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 10 **Maintenance**

11 ***Upstream of the Delta***

12 Substantial point sources of selenium do not exist upstream in the Sacramento River watershed, in
 13 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
 14 upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of selenium within the
 15 watersheds of the Sacramento River and the eastern tributaries also are relatively low, resulting in
 16 generally low selenium concentrations in the reservoirs and rivers of those watersheds.

17 Consequently, any modified reservoir operations and subsequent changes in river flows under the
 18 No Action Alternative, relative to Existing Conditions, are expected to have negligible, if any, effects
 19 on reservoir and river selenium concentrations upstream of Freeport in the Sacramento River
 20 watershed or in the eastern tributaries upstream of the Delta.

21 Non-point sources of selenium in the San Joaquin River watershed are associated with discharges of
 22 subsurface agricultural drainage to the river or its tributaries. Selenium concentrations in the San
 23 Joaquin River upstream of the Delta comply with NTR criteria and Basin Plan objectives at Vernalis
 24 under Existing Conditions, and they are expected to do so under the No Action Alternative. This is
 25 because a TMDL has been developed by the Central Valley Water Board (2001), the Grassland
 26 Bypass Project has established limits that will result in reduced inputs of selenium to the Delta, and
 27 the Central Valley Water Board (2010a) and State Water Board (2010d, 2010e) have established
 28 Basin Plan objectives that are expected to result in decreasing discharges of selenium from the San
 29 Joaquin River to the Delta, as previously discussed in 8.1.3.15.

30 Selenium concentrations at Vernalis are generally higher during lower San Joaquin River flows, with
 31 considerable variability in concentrations below about 3,000 cfs, as shown in Appendix 8M,
 32 *Selenium*, Table M-33 and Figures M-7 through M-20. Modeling of flows for the San Joaquin River at
 33 Vernalis indicates that average annual flows under the No Action Alternative would vary by less
 34 than 10% from Existing Conditions (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 35 *Technical Appendix*). Given these relatively small decreases in flows and the considerable variability
 36 in the relationship between selenium concentrations and flows in the San Joaquin River, it is
 37 expected that selenium concentrations in the San Joaquin River would be minimally affected, if at all,
 38 by anticipated changes in flow rates under the No Action Alternative.

39 Thus, available information indicates selenium concentrations are well below the Basin Plan
 40 objective and are likely to remain so under the No Action Alternative. The negligible changes in
 41 selenium concentrations that may occur in the water bodies of the affected environment located
 42 upstream of the Delta would not be of frequency, magnitude, and geographic extent that would

1 adversely affect any beneficial uses or substantially degrade the quality of these water bodies as
2 related to selenium.

3 **Delta**

4 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
5 locations under Existing Conditions and the No Action Alternative are presented in Appendix 8M,
6 *Selenium*, Table M-9a for water, Tables M-10 through M-29 for most biota (whole-body fish
7 (excluding sturgeon), bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout
8 the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta locations. Figures 8-
9 59a and 8-59b present graphical distributions of predicted selenium concentration changes (shown
10 as changes in available assimilative capacity based on 1.3 µg/L) in water at each modeled
11 assessment location for all years. Appendix 8M, Figure M-21 provides more detail in the form of
12 monthly patterns of selenium concentrations in water during the modeling period.

13 Relative to Existing Conditions, the No Action Alternative would result in little to no change in
14 average selenium concentrations in water at all modeled Delta assessment locations. Long-term
15 average concentrations at most locations would be the same or lower, with the exception of Old
16 River at Rock Slough and North Bay Aqueduct during the drought period modeled (1987–1991) and
17 Jones pumping plant for the entire period modeled (1976–1991) and drought periods modeled
18 (Appendix 8M, Table M-9a). Long-term average concentrations would increase negligibly (0.01–0.02
19 µg/L) at these locations, resulting in a reduction of assimilative capacity of <1%, relative to the 1.3
20 µg/L USEPA draft water quality criterion (Figure 8-59a). The long-term average selenium
21 concentrations in water under the No Action Alternative would range from 0.09–0.38 µg/L
22 (Appendix 8M, Table 9a), well below the USEPA draft water quality criterion of 1.3 µg/L.

23 Relative to Existing Conditions, the No Action Alternative would result in little to no change in
24 estimated selenium concentrations in most biota (whole-body fish, bird eggs [invertebrate diet],
25 bird eggs [fish diet], and fish fillets), with the largest increase being 0.01 mg/kg dry weight at
26 Buckley Cove for the drought period (Appendix 8M, Table M-20). During the drought period,
27 concentrations of selenium in sturgeon in the western Delta would increase slightly, with about a
28 0.09 mg/kg dry weight (1%) increase for the San Joaquin River at Antioch (Appendix 8M, Tables M-
29 30 and M-31).

30 Modeled selenium concentrations in fish and bird eggs were compared with effect benchmarks to
31 evaluate the potential for selenium to exceed levels of concern for toxicity or health advisories.
32 These effects benchmarks included Levels of Concern for whole fish and bird eggs, Toxicity
33 Thresholds for whole fish, bird eggs, and sturgeon, and Advisory Tissue Levels for fish fillets
34 consumed by people. Toxicity Threshold Exceedance Quotients (i.e., modeled tissue concentration
35 divided by Toxicity Threshold benchmarks) were determined for selenium concentrations in all
36 biota for the entire period modeled and for the drought period modeled. Likewise, Level of Concern
37 Exceedance Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) were also
38 calculated for selenium concentrations in all biota. All Exceedance Quotients for whole fish, bird
39 eggs, and fish fillets are less than 1.0, indicating low probability of adverse effects (Appendix 8M,
40 Table M-20). Low Toxicity Threshold Exceedance Quotients for selenium concentrations in sturgeon
41 from the western Delta exceed 1.0 for the modeled drought period, indicating a higher probability
42 for adverse effects for drought years (Appendix 8M, Table M-32). Relative to Existing Conditions,
43 there would be no increase in any exceedance quotient at any Delta assessment location, except for
44 the whole body fish Toxicity Threshold Exceedance Quotient for the San Joaquin River at Buckley

1 Cove for the drought period (from 0.29 to 0.30). Figures 8-61a through 8-64b show the exceedance
 2 quotients based on the lowest benchmarks for whole-body fish, bird eggs (invertebrate diet), bird
 3 eggs (fish diet), fish fillets, and sturgeon in drought years at each modeled location. In summary,
 4 relative to Existing Conditions, the No Action Alternative would result in essentially no change in
 5 selenium concentrations throughout the Delta. The No Action Alternative would not be expected to
 6 substantially increase the frequency with which applicable toxicity and level of concern benchmarks
 7 would be exceeded in the Delta or substantially degrade the quality of water in the Delta, with
 8 regard to selenium.

9 ***SWP/CVP Export Service Areas***

10 Relative to Existing Conditions, the No Action Alternative would result in little to no change in long-
 11 term average selenium concentrations in water at the south Delta pumping plants. At the Banks
 12 pumping plant, there would be no change in long-term average concentrations for the entire period
 13 modeled or the drought period modeled (Appendix 8M, Table M-9a). At the Jones pumping plant,
 14 selenium concentrations would increase by 0.01 µg/L for the entire period modeled and by 0.02
 15 µg/L for the drought period modeled (Appendix 8M, Table M-9a), which would correspond to a
 16 reduction in assimilative capacity of about 1% (Figure 8-59a). Furthermore, the modeled selenium
 17 concentrations in water (Table M-9a) for the No Action Alternative would range from 0.21–0.29
 18 µg/L, well below the USEPA draft water quality criterion of 1.3 µg/L.

19 Relative to Existing Conditions, the No Action Alternative would result in very small changes (less
 20 than 1%) in estimated selenium concentrations in biota (whole-body fish, bird eggs [invertebrate
 21 diet], bird eggs [fish diet], and fish fillets) (Table M-20). Concentrations of selenium in biota would
 22 not be expected to exceed any benchmarks for biota (Figures 8-61a through 8-64b; Appendix 8M,
 23 Table M-10).

24 Relative to Existing Conditions, the No Action Alternative would result in essentially no change in
 25 selenium concentrations at the SWP/CVP Export Service Areas, because there would essentially be
 26 no change in selenium concentrations at the Banks and Jones pumping plants. Thus, the No Action
 27 Alternative would not be expected to substantially increase the frequency with which applicable
 28 benchmarks would be exceeded in the Export Service Areas or substantially degrade the quality of
 29 water in the Export Service Areas, with regard to selenium.

30 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 32 *Determination of Effects*) for the purpose of making the CEQA impact determination for selenium.
 33 For additional details on the effects assessment findings that support this CEQA impact
 34 determination, see the effects assessment discussion that immediately precedes this conclusion.

35 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
 36 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
 37 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
 38 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
 39 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
 40 Valley Regional Water Quality Control Board 2010d and State Water Board 2010d, 2010e) that are
 41 expected to result in decreasing discharges of selenium from the San Joaquin River to the Delta.
 42 Consequently, any modified reservoir operations and subsequent changes in river flows under the
 43 No Action Alternative, relative to Existing Conditions, are expected to cause negligible changes in
 44 selenium concentrations in water. Any negligible changes in selenium concentrations that may occur

1 in the water bodies of the affected environment located upstream of the Delta would not be of
 2 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 3 substantially degrade the quality of these water bodies as related to selenium.

4 Relative to Existing Conditions, modeling estimates indicate that the No Action Alternative would
 5 result in essentially no change in selenium concentrations throughout the Delta, with all changes on
 6 the order of 0.02 µg/L or less (i.e., <1%). Furthermore, there would not be an increased risk of
 7 exceeding toxicity and level of concern benchmarks for biota.

8 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
 9 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions, the
 10 No Action Alternative would result in essentially no change in long-term average selenium
 11 concentrations at the Banks pumping plant, and very little increase (0.01 µg/L) at the Jones
 12 pumping plant.

13 Based on the above, selenium concentrations that would occur in water under this alternative would
 14 not cause additional exceedances of applicable state or federal numeric or narrative water quality
 15 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
 16 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to
 17 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions,
 18 water quality conditions under this alternative would not increase levels of selenium by frequency,
 19 magnitude, and geographic extent such that the affected environment would be expected to have
 20 measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing
 21 the health risks to wildlife (including fish) or humans consuming those organisms. Water quality
 22 conditions under this alternative with respect to selenium would not cause long-term degradation of
 23 water quality in the affected environment, and therefore would not result in use of available
 24 assimilative capacity such that exceedances of water quality objectives/criteria would be likely and
 25 would result in substantially increased risk for adverse effects to one or more beneficial uses. This
 26 alternative would not further degrade water quality by measurable levels, on a long-term basis, for
 27 selenium and, thus, cause the CWA Section 303(d)-listed impairment of beneficial uses to be made
 28 discernibly worse. This impact is considered to be less than significant.

29 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 30 **and Maintenance**

31 ***Upstream of the Delta***

32 Relative to Existing Conditions, under the No Action Alternative sources of trace metals would not
 33 be expected to change substantially with exception to sources related to population growth, such as
 34 increased municipal wastewater discharges and development contributing to increased urban
 35 runoff. Facility operations could have an effect on these sources if concentrations of dissolved metals
 36 were closely correlated to river flow, suggesting that changes in river flow, and the related capacity
 37 to dilute these sources, could ultimately have a substantial effect on long-term metals
 38 concentrations.

39 On the Sacramento River, available dissolved trace metals data and river flow at Freeport are poorly
 40 associated (Appendix 8N, *Trace Metals*, Figure 1). Similarly, dissolved copper, iron, and manganese
 41 concentrations on the San Joaquin River at Vernalis are poorly associated (Appendix 8N, Figure 3).
 42 While there is an insufficient number of data for the other trace metals to observe trends at Vernalis,

1 it is reasonable to assume that these metals similarly show poor association to San Joaquin River
2 flow, as shown for the corresponding dissolved metals on the Sacramento River.

3 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
4 reservoir storage reductions that would occur under the No Action Alternative, relative to Existing
5 Conditions, would not be expected to result in a substantial adverse change in trace metal
6 concentrations in the reservoirs and rivers upstream of the Delta. As such, the No Action Alternative
7 would not be expected to substantially increase the frequency with which applicable Basin Plan
8 objectives or CTR criteria would be exceeded in water bodies of the affected environment located
9 upstream of the Delta or substantially degrade the quality of these water bodies, with regard to trace
10 metals.

11 **Delta**

12 For metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel, silver, and
13 zinc), average and 95th percentile trace metal concentrations of the primary source waters to the
14 Delta are very similar, with difference typically not greater than a factor of 2 to 5 (Appendix 8N,
15 *Trace Metals*, Tables 1–7). For example, average dissolved copper concentrations on the Sacramento
16 River, San Joaquin River, and Bay (Martinez) are 1.7 µg/L, 2.4 µg/L, and 1.7 µg/L, respectively. The
17 95th percentile dissolved copper concentrations on the Sacramento River, San Joaquin River, and
18 Bay (Martinez) are 3.4 µg/L, 4.5 µg/L, and 2.4 µg/L, respectively. Given this similarity, very large
19 changes in source water fraction would be necessary to effect a relatively small change in trace
20 metal concentration at a particular Delta location. Moreover, average and 95th percentile trace metal
21 concentrations for these primary source waters are all below their respective water quality criteria,
22 including those that are hardness-based without a WER adjustment (Tables 8-58 and 8-59). No
23 mixing of these three source waters could result in a metal concentration greater than the highest
24 source water concentration, and given that the average and 95th percentile source water
25 concentrations for copper, cadmium, chromium, lead, nickel, silver, and zinc do not exceed their
26 respective criteria, more frequent exceedances of criteria in the Delta would not occur under the
27 operational scenario for this alternative.

28 Based on comments received during public review of the Draft EIR/EIS, further evaluation of
29 aluminum data and potential effects are included herein. Aluminum has potential to result in aquatic
30 toxicity effects as well as human health and nuisance aesthetic concerns in potable water. Regarding
31 potential aquatic life effects, monthly DWR data collected in 2013–2014 indicate that the maximum
32 and 95th percentile dissolved aluminum in the Sacramento River exceed the USEPA's default chronic
33 criterion of 87 µg/L, whereas the San Joaquin River concentrations are well below the criterion, and
34 no data were identified for the Bay source water. However, the USEPA national recommended
35 criteria developed in 1988 is recognized as a highly conservative value based on limited toxicity test
36 data and very low water hardness levels. A recent study in Arizona evaluated aluminum criteria
37 with the USEPA recalculation procedure using an updated and comprehensive toxicity test database
38 that determined a hardness-based relationship for aluminum (Pima County Wastewater
39 Management Department 2006). The Pima County study hardness-dependent equation for dissolved
40 aluminum indicates that a chronic criteria of 287 µg/L (at 25 mg/L hardness as CaCO₃) better
41 represents potential aluminum toxicity in ambient water. Similar to the analysis for the other trace
42 metals above, based on the relatively similar Sacramento and San Joaquin River aluminum
43 concentrations, and maximum concentrations not having potential to cause chronic (or acute)
44 toxicity, no change in mixing of the source waters would result in more frequent or potential for
45 toxicity or degradation in the Delta.

1 For metals of primarily human health and drinking water concern (aluminum, arsenic, iron,
 2 manganese), average and 95th percentile concentrations are also very similar (Appendix 8N, Tables
 3 8–10). The arsenic criterion and aluminum primary MCL were established to protect human health
 4 from the effects of long-term chronic exposure, while secondary maximum contaminant levels for
 5 aluminum, iron, and manganese were established as reasonable goals for drinking water quality.
 6 The primary source water average concentrations for aluminum, arsenic, iron, and manganese are
 7 below these criteria. No mixing of these three source waters could result in a metal concentration
 8 greater than the highest source water concentration, and given that the average water
 9 concentrations for aluminum, arsenic, iron, and manganese do not exceed water quality criteria,
 10 more frequent exceedances of drinking water criteria in the Delta would not be expected to occur
 11 under this alternative.

12 Relative to Existing Conditions, facilities operation under the No Action Alternative would result in
 13 negligible change in trace metal concentrations throughout the Delta. The No Action Alternative
 14 would not be expected to substantially increase the frequency with which applicable Basin Plan
 15 objectives or CTR criteria would be exceeded in the Delta or substantially degrade the quality of
 16 water in the Delta, with regard to trace metals.

17 ***SWP/CVP Export Service Areas***

18 The No Action Alternative is not expected to result in substantial changes in trace metal
 19 concentrations in Delta waters. As such, there is not expected to be substantial changes in trace
 20 metal concentrations in the SWP/CVP export service area waters, exported from the Delta through
 21 the south Delta pumps, under the No Action Alternative.

22 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 23 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 24 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 25 constituent. For additional details on the effects assessment findings that support this CEQA impact
 26 determination, see the effects assessment discussion that immediately precedes this conclusion.

27 While greater water demands under the No Action Alternative would alter the magnitude and
 28 timing of reservoir releases north, south and east of the Delta, these activities would have no
 29 substantial effect on the various watershed sources of trace metals. Moreover, long-term average
 30 flow and trace metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly
 31 correlated; therefore, changes in river flows would not be expected to cause a substantial long-term
 32 change in trace metal concentrations upstream of the Delta.

33 Average and 95th percentile trace metal concentrations are very similar across the primary source
 34 waters to the Delta. Given this similarity, very large changes in source water fraction would be
 35 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 36 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 37 waters are all below their respective water quality criteria, including those that are hardness-based
 38 without a WER adjustment. No mixing of these three source waters could result in a metal
 39 concentration greater than the highest source water concentration, and given that trace metals do
 40 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
 41 not be expected to occur under the No Action Alternative.

42 The assessment of the No Action Alternative effects on trace metals in the SWP/CVP Export Service
 43 Areas is based on assessment of changes in trace metal concentrations at Banks and Jones pumping

1 plants. As just discussed regarding similarities in Delta source water trace metal concentrations, the
2 No Action Alternative is not expected to result in substantial changes in trace metal concentrations
3 in Delta waters, including Banks and Jones pumping plants, therefore effects on trace metal
4 concentrations in the SWP/CVP Export Service Area are expected to be negligible.

5 Based on the above, there would be no substantial long-term increase in trace metal concentrations
6 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
7 service area waters under the No Action Alternative relative to Existing Conditions. As such, this
8 alternative is not expected to cause additional exceedance of applicable water quality
9 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
10 on any beneficial uses of waters in the affected environment. Because trace metal concentrations are
11 not expected to increase substantially, no long-term water quality degradation for trace metals is
12 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore,
13 negligible change in long-term trace metal concentrations throughout the affected environment
14 would not be expected to make any existing beneficial use impairments measurably worse. The
15 trace metals discussed in this assessment are not considered bioaccumulative, and thus would not
16 directly cause bioaccumulative problems in aquatic life or humans. This impact is considered to be
17 less than significant.

18 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 19 **Maintenance**

20 ***Upstream of the Delta***

21 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
22 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
23 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
24 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
25 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
26 other biological material in the water.

27 The No Action Alternative would alter the magnitude and timing of water releases from reservoirs
28 upstream of the Delta relative to Existing Conditions, altering downstream river flows relative to
29 Existing Conditions. With respect to TSS and turbidity, an increase in river flow is generally the
30 concern, as this increases shear stress on the channel, suspending particles resulting in higher TSS
31 concentrations and turbidity levels. Schoellhamer et al. (2007b) noted that suspended sediment
32 concentration was more affected by season than flow, with the higher concentrations for a given
33 flow rate occurring during “first flush events” and lower concentrations occurring during spring
34 snowmelt events. Because of such a relationship, the changes in mean monthly average river flows
35 under the No Action Alternative are not expected to cause river TSS concentrations or turbidity
36 levels (highs, lows, typical conditions) to be outside the ranges occurring under Existing Conditions.
37 Consequently, this alternative is expected to have minimal effect on TSS concentrations and
38 turbidity levels in the reservoirs and rivers upstream of the Delta, relative to Existing Conditions.

39 Changes in land use that would occur relative to Existing Conditions could have minor effects on TSS
40 concentrations and turbidity levels throughout this portion of the affected environment. Site-specific
41 and temporal exceptions may occur due to localized temporary construction activities, dredging
42 activities, development, or other land use changes. These localized actions would generally require

1 agency permits that would regulate and limit both their short-term and long-term effects on TSS
2 concentrations and turbidity levels to less-than-substantial levels.

3 ***Delta***

4 TSS concentrations and turbidity levels in Delta waters are affected by TSS concentrations and
5 turbidity levels of the Delta inflows (and associated sediment load). TSS concentrations and
6 turbidity levels within Delta waters also are affected by fluctuation in flows within the channels due
7 to the tides, with sediments depositing as flow velocities and turbulence are low at periods of slack
8 tide, and sediments becoming suspended when flow velocities and turbulence increase when tides
9 are near the maximum. TSS and turbidity variations can also be attributed to phytoplankton,
10 zooplankton and other biological material in the water.

11 Under the No Action Alternative there would be no project actions implemented within or affecting
12 the Delta region of the affected environment. Any land use changes that may occur under this
13 alternative would not be expected to have permanent, substantial effects on TSS concentrations and
14 turbidity levels of Delta waters, relative to Existing Conditions. Furthermore, this alternative would
15 not cause the TSS concentrations or turbidity levels in the rivers contributing inflows to the Delta to
16 be outside the ranges occurring under Existing Conditions. Consequently, this alternative is
17 expected to have minimal effect on TSS concentrations and turbidity levels in the Delta region,
18 relative to Existing Conditions. As such, any minor TSS and turbidity changes that may occur under
19 the No Action Alternative would not be of sufficient frequency, magnitude, and geographic extent
20 that would result in adverse effects on beneficial uses in the Delta region, or substantially degrade
21 the quality of these water bodies, with regard to TSS and turbidity.

22 ***SWP/CVP Export Service Areas***

23 The No Action Alternative is expected to have minimal effect on TSS concentrations and turbidity
24 levels in Delta waters, including water exported at the south Delta pumps, relative to Existing
25 Conditions. As such, the No Action Alternative is expected to have minimal effect on TSS
26 concentrations and turbidity levels in the SWP/CVP Export Service Areas waters relative to Existing
27 Conditions.

28 The effects on TSS and turbidity from implementing the No Action Alternative is determined to not
29 be adverse.

30 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
32 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
33 constituent. For additional details on the effects assessment findings that support this CEQA impact
34 determination, see the effects assessment discussion that immediately precedes this conclusion.

35 Changes river flow rate and reservoir storage that would occur under the No Action Alternative,
36 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
37 TSS concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
38 suspended sediment concentrations are more affected by season than flow. Site-specific and
39 temporal exceptions may occur due to localized temporary construction activities, dredging
40 activities, development, or other land use changes would be site-specific and temporal, which would
41 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
42 than substantial levels.

1 Within the Delta, any land use changes that may occur would not be expected to have permanent,
 2 substantial effects on TSS concentrations and turbidity levels. Furthermore, this alternative would
 3 not cause the TSS concentrations or turbidity levels in the river contributing inflows to the Delta to
 4 be outside the ranges occurring under Existing Conditions. Consequently, this alternative is
 5 expected to have minimal effect on TSS concentrations and turbidity levels in the Delta region,
 6 relative to Existing Conditions.

7 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 8 turbidity levels in the SWP/CVP Export Service Areas waters under the No Action Alternative,
 9 relative to Existing Conditions, because the No Action Alternative is not expected to result in
 10 substantial changes in TSS concentrations and turbidity levels in Delta waters, relative to Existing
 11 Conditions.

12 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 14 concentrations and turbidity levels are not expected to be substantially different from Existing
 15 Conditions, long-term water quality degradation is not expected, and, thus, beneficial uses are not
 16 expected to be adversely affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean
 17 Water Act Section 303(d) listed constituents. This impact is considered to be less than significant.

18 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities**

19 Under the No Action Alternative, existing facilities and operations would be continued and none of
 20 the Conservation Measures 1–21 associated with the BDCP alternatives would be implemented.
 21 However, construction activities would occur in the affected environment over time that are not
 22 directly associated with the BDCP alternatives (herein termed “non-BDCP” effects). Routine non-
 23 BDCP construction activities that may occur for urbanization and infrastructure to accommodate
 24 population growth would generally be anticipated to involve relatively dispersed, temporary, and
 25 intermittent land disturbances across the affected environment. Major, or more complex, non-BDCP
 26 infrastructure construction projects that are identified under the No Action Alternative which may
 27 involve substantial construction activities and potential construction-related water quality effects
 28 are identified in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*
 29 *Alternative, and Cumulative Impact Conditions*, and include:

- 30 ● Levee rehabilitation projects in the Delta by DWR and local reclamation districts.
- 31 ● Suisun Channel (Slough) Operations and Maintenance (shipping channel dredging)
- 32 ● Sacramento Deep Water Ship Channel Project (shipping channel dredging).
- 33 ● San Joaquin River Restoration Program.
- 34 ● Dutch Slough Tidal Marsh Restoration Project.
- 35 ● Suisun Marsh restoration activities (tidal marsh restoration)
- 36 ● Yolo Bypass Salmonid Habitat Restoration and Fish Passage.

37 Potential construction-related water quality effects associated with non-BDCP activities may include
 38 discharges of turbidity/TSS due to the erosion of disturbed soils and associated sedimentation
 39 entering surface water bodies or other construction-related wastes (e.g., concrete, asphalt, cleaning
 40 agents, paint, and trash). Construction activities also may result in temporary or permanent changes
 41 in stormwater generation or drainage and runoff patterns (i.e., velocity, volume, and direction) that

1 may cause or contribute to soil erosion and offsite sedimentation, such as creation of additional
2 impervious surfaces (e.g., pavement, buildings, compacted soils), blockage or restriction of existing
3 drainage channels, or general surface drainage changes from grading and excavation activity.
4 Additionally, the use of heavy earthmoving equipment may result in spills and leakage of oils,
5 gasoline, diesel fuel, and related petroleum contaminants used in the fueling and operation of such
6 construction equipment.

7 Some construction-related contaminants, such as PAHs that may be in some fuel and oil petroleum
8 byproducts, may be bioaccumulative in aquatic and terrestrial organisms. Construction activities
9 also may disturb areas where bioaccumulative constituents are present in the soil (e.g., mercury,
10 selenium, organochlorine pesticides, PCBs, dioxin/furan compounds), or may disturb soils that
11 contain constituents included on the Section 303(d) lists of impaired water bodies in the affected
12 environment. While the 303(d)-listed Delta channels impaired by mercury are widespread,
13 impairment by selenium, pesticides, PCBs, and dioxin/furan compounds is more limited, and there
14 are no 303(d) listings for PAH impairment. Bioaccumulation of constituents in the aquatic
15 foodchain, and 303(d)-related impaired water bodies, arise as a result of long-term loading of a
16 constituent or a pervasive and widespread source of constituent discharge (e.g., mercury). However,
17 as a result of the generally localized disturbances, and intermittent and temporary nature of
18 construction-related activities, construction would not be anticipated to result in contaminant
19 discharges of substantial magnitude or duration to contribute to long-term bioaccumulation
20 processes, or cause measureable long-term degradation such that existing 303(d) impairments
21 would be made discernibly worse or TMDL actions to reduce loading would be adversely affected.

22 It is assumed that non-BDCP construction activities would be regulated, as necessary, under state
23 grading and erosion control regulations, proponent-defined CEQA-NEPA mitigation measures and
24 BMPs, and applicable environmental permits such as the State Water Board's NPDES Stormwater
25 General Permit for Stormwater Discharges Associated with Construction and Land Disturbance
26 Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002, as amended by Order No.
27 2010-0014-DWQ), project-specific WDRs or CWA Section 401 water quality certification from the
28 appropriate Regional Water Board, CDFW Streambed Alteration Agreements, and USACE CWA
29 Section 404 dredge and fill permits. Consequently, relative to the Existing Conditions, the potential
30 contaminant discharges associated with construction-related activities that may occur under the No
31 Action Alternative would be avoided and minimized upon implementation of BMPs and adherence
32 to permit terms and conditions. Consequently, construction-related activities would not be expected
33 to cause constituent discharges of sufficient magnitude to result in a substantial increased frequency
34 of exceedances of water quality objectives/criteria, or substantially degrade water quality with
35 respect to the constituents of concern, and thus would not adversely affect any beneficial uses in
36 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area.

37 **CEQA Conclusion:** BDCP construction-related contaminant discharges under the No Action
38 Alternative would not occur. Other reasonably foreseeable projects that are independent from BDCP
39 would result in construction related impacts that are temporary and intermittent in nature and
40 would involve negligible, if any, discharges of bioaccumulative or 303(d) listed constituents to water
41 bodies of the affected environment. As such, construction activities would therefore not contribute
42 to bioaccumulation of contaminants in organisms or humans or cause 303(d) impairments to be
43 discernibly worse. Relative to Existing Conditions, the construction-related effects of other projects
44 in the Delta would not be expected to cause or contribute to a substantial increased frequency of
45 exceedances of water quality objectives/criteria, or substantially degrade water quality on a long-
46 term average basis with respect to the constituents of concern, and thus would not adversely affect

1 any beneficial uses in water bodies upstream of the Delta, within the Delta, or in the SWP and CVP
2 service area. Based on these findings, this impact is determined to be less than significant.

3 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 4 **and Maintenance (CM1)**

5 ***Upstream of the Delta***

6 Impacts from *Microcystis* upstream of the Delta have only been documented in lakes such as Clear
7 Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over other
8 phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
9 characterized by low nutrient concentrations, where other phytoplankton outcompete
10 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
11 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
12 Joaquin River upstream of the Delta, under Existing Conditions, bloom development is limited by
13 high water velocity and low residence times. These conditions are not expected to change under the
14 No Action Alternative. Consequently, any modified reservoir operations under the No Action
15 Alternative are not expected to promote *Microcystis* production upstream of the Delta, relative to
16 Existing Conditions.

17 ***Delta***

18 Modeled residence times in the six Delta sub-regions during the *Microcystis* bloom season of June
19 through October under the No Action Alternative are greater than under than Existing Conditions by
20 0–7 days (Table 8-60a), a small increase, given that modeled residence times of the six Delta sub-
21 regions range from 5–49 days under Existing Conditions. One exception is the East Delta, where
22 modeled residence times are expected to increase by up to 20 days relative to Existing Conditions.
23 The changes in residences time are driven by a number of factors accounted for in the modeling,
24 including climate change, sea level rise, and changes in operations and maintenance that affect net
25 Delta outflows. Variability in local residence times is expected within any Delta sub-region because
26 major portions of the Delta are comprised of complex networks of intertwining channels, shallow
27 back water areas, and submerged islands. Thus, the summer and fall period average residence times
28 provide a general direction and degree to which water residence times may change. Because the
29 change is relatively small, it is unknown whether the increase in modeled residence times expected
30 under the No Action Alternative relative to Existing Conditions will result in measurable increases in
31 the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout the Delta.

32 The relationship between Delta water temperatures, climate change, and changes in water
33 deliveries from upstream reservoirs is discussed in Appendix 29C, *Climate Change and the Effects of*
34 *Reservoir Operations on Water Temperatures in the Study Area*. In short, ambient meteorological
35 conditions are the primary driver of Delta water temperatures, meaning that climate warming and
36 not water operations will determine future water temperatures in the Delta. Climate projections for
37 the Central Valley discussed in Appendix 5A, Section D indicate substantial warming of ambient air
38 temperatures with a median increase in annual temperature of about 1.1°C (2.0°F) by 2025 and
39 2.2°C (4.0°F) by 2060. The projected water temperature change ranges from 0.7 to 1.4°C (1.3 to
40 2.5°F) by 2025 and 1.6 to 2.7°C (2.9–4.9°F) by 2060. Increasing water temperatures could lead to
41 earlier attainment of the water temperature threshold of 19°C required to initiate *Microcystis* bloom
42 formation, and thus earlier occurrences of *Microcystis* blooms in the Delta, relative to Existing
43 Conditions. Elevated ambient water temperatures in the Delta, and thus an increase in *Microcystis*

1 bloom duration and magnitude, are expected under the No Action Alternative, relative to Existing
2 Conditions.

3 ***CVP/SWP Export Service Area***

4 The assessment of effects on *Microcystis* in the SWP/CVP Export Service Areas is based on the
5 assessment of *Microcystis* production in source waters to Banks and Jones Pumping plants, and upon
6 the effects of residence time and water temperature on the potential for *Microcystis* blooms to occur
7 in the Export Service Area.

8 Under the No Action Alternative, exports from Banks and Jones pumping plants will consist of water
9 characteristic of Sacramento and San Joaquin River water that has flowed through various portions
10 of the North, South, and West Delta. Water flowing through the Delta that reaches the existing south
11 Delta intakes is expected to be influenced by an increase in the frequency, magnitude, and
12 geographic extent of *Microcystis* blooms discussed in the *Delta* section above. Therefore, an increase
13 in *Microcystis* blooms, and thus microcystins concentrations, is expected in the mixture of source
14 waters exported from Banks and Jones pumping plants under the No Action Alternative relative to
15 Existing Conditions.

16 *Microcystis* blooms have not occurred in the Export Service Areas even though source waters to the
17 SWP and CVP have been affected. Conditions in the Export Service Areas under the No Action
18 Alternative may become more conducive to *Microcystis* bloom formation, relative to Existing
19 Conditions, because water temperatures will increase in the Export Service Areas due to the
20 expected increase in ambient air temperatures resulting from climate change. Residence times in
21 this area are not expected to substantially change under the No Action Alternative, relative to
22 Existing Conditions.

23 ***CEQA Conclusion:*** Based on the above, the No Action Alternative would not be expected to cause
24 additional exceedance of applicable water quality objectives/criteria by frequency, magnitude, and
25 geographic extent that would cause significant impacts on any beneficial uses of waters in the
26 affected environment. *Microcystis* and microcystins are not 303(d) listed within the affected
27 environment and thus any increases that could occur in some areas would not make any existing
28 *Microcystis* impairment measurably worse because no such impairments currently exist. However,
29 because it is possible that increases in the frequency, magnitude, and geographic extent of
30 *Microcystis* blooms in the Delta will occur due to increased water temperatures from climate change
31 under the No Action Alternative, long-term water quality degradation may occur in the Delta and
32 water exported from the Delta to the SWP and CVP Export Service Areas. Thus, impacts on beneficial
33 uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb (Lehman 2010).
34 Thus, potential increases in *Microcystis* occurrences may lead to increased microcystin presence in
35 the Delta relative to Existing Conditions. This has potential to cause microcystins to bioaccumulate
36 to greater levels in aquatic organisms that would, in turn, pose health risks to fish, wildlife or
37 humans. This impact is considered to be significant and unavoidable.

38 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities** 39 **Operations and Maintenance**

40 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-32) concluded
41 that the No Action Alternative would have a less than significant impact/no adverse effect on the
42 following constituents in the Delta:

- 1 • Boron
- 2 • Bromide
- 3 • Dissolved Oxygen
- 4 • Dissolved Organic Carbon (DOC)
- 5 • Pathogens
- 6 • Pesticides
- 7 • Trace Metals
- 8 • Turbidity and TSS

9 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 10 Elevated concentrations of bromide and DOC also are of concern in drinking water supplies.
 11 However, waters in the San Francisco Bay are not designated to support municipal water supply
 12 (MUN) and agricultural supply (AGR) beneficial uses. The strong tidal nature of this area and
 13 proximity to the ocean make salinities too high to be suitable for these uses. Changes in Delta DO,
 14 pathogens, pesticides, and turbidity and TSS are not anticipated to be of a frequency, magnitude and
 15 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 16 quality of the Delta. Thus, changes in boron, bromide, DO, DOC, pathogens, pesticides, and turbidity
 17 and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and geographic extent
 18 that would adversely affect any beneficial uses or substantially degrade the quality of the of San
 19 Francisco Bay.

20 The effects of the No Action Alternative on chloride and EC in the Delta were determined to be
 21 significant/adverse. Increases in chloride concentrations are of concern for their potential to impact
 22 municipal drinking water aesthetics; however, as described previously, the San Francisco Bay does
 23 not have a designated MUN use. Thus, changes in chloride in Delta outflow would not adversely
 24 affect any beneficial uses of San Francisco Bay. Elevated EC, as assessed for this alternative, is of
 25 concern for its effects on the AGR beneficial use and fish and wildlife beneficial uses. As discussed
 26 above, San Francisco Bay does not have an AGR beneficial use designation. However, potential
 27 effects on bay salinity are discussed further below, with consideration to effects on fish and wildlife
 28 beneficial uses.

29 While effects of the No Action Alternative on the nutrients ammonia, nitrate, and phosphorus were
 30 determined to be less than significant/not adverse, these constituents are addressed further below
 31 because the response of the seaward bays to changed nutrient concentrations/loading may differ
 32 from the response of the Delta. Because the potential change in *Microcystis* levels were found to be
 33 significant in the Delta, potential effects on *Microcystis* levels and microcystin concentrations in San
 34 Francisco Bay are discussed. Selenium and mercury are discussed further, because they are
 35 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
 36 and exports are of concern.

37 **Nutrients: Ammonia, Nitrate, and Phosphorus**

38 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under the No Action Alternative
 39 would be dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result
 40 in >95% removal of ammonia in its effluent. Relative to Existing Conditions, total nitrogen loads to
 41 Suisun and San Pablo Bays would decrease by 32% (Appendix 80, *San Francisco Bay Analysis*, Table

1 0-1). The change in nitrogen loading to Suisun and San Pablo Bays under the No Action Alternative
 2 would not adversely impact primary productivity in these embayments because light limitation and
 3 grazing current limit algal production in these embayments. To the extent that algal growth
 4 increases in relation to a change in ammonia concentration, this would have net positive benefits,
 5 because current algal levels in these embayments are low. Nutrient levels and ratios are not
 6 considered a direct driver of *Microcystis* and cyanobacteria levels in the North Bay.

7 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for the No Action
 8 Alternative is estimated to increase by 5% relative to Existing Conditions (Appendix 80, Table O-1).
 9 The only postulated effect of changes in phosphorus loads to Suisun and San Pablo Bays is related to
 10 the influence of nutrient stoichiometry on primary productivity. However, there is uncertainty
 11 regarding the impact of nutrient ratios on phytoplankton community composition and abundance.
 12 Any effect on phytoplankton community composition would likely be small compared to the effects
 13 of grazing from introduced clams and zooplankton in the estuary (Senn and Novick 2014; Kimmerer
 14 and Thompson 2014). Therefore, the projected decrease in total nitrogen loading and increase in
 15 phosphorus loading that would occur in Delta outflow to San Francisco Bay are not expected to
 16 result in adverse effects to beneficial uses or substantially degrade the water quality with regard to
 17 nutrients.

18 **Mercury**

19 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
 20 Appendix 80, *San Francisco Bay Analysis*, Table O-2. Loads of mercury and methylmercury from the
 21 Delta to San Francisco Bay are estimated to change relatively little due to changes in source water
 22 fractions and net Delta outflow that would occur under the No Action Alternative. Mercury load to
 23 the Bay, relative to Existing Conditions, is estimated to increase by 3 kg/year (1%). Methylmercury
 24 load, relative to Existing Conditions, is estimated to increase by 0.09 kg/year (3%). The estimated
 25 total mercury load to the Bay is 263 kg/year, which would be less than the San Francisco Bay
 26 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
 27 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
 28 term average net Delta outflow and the long-term average mercury and methylmercury
 29 concentrations in Delta source waters. The estimated changes in mercury load under the alternative
 30 would also be substantially less than the considerable differences among estimates in the current
 31 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
 32 David et al. 2009).

33 Given that the estimated incremental increases of mercury and methylmercury loading to San
 34 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
 35 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
 36 Francisco Bay due to the No Action Alternative are not expected to result in adverse effects to
 37 beneficial uses or substantially degrade the water quality with regard to mercury, or make the
 38 existing CWA Section 303(d) impairment measurably worse.

39 **Salinity**

40 Salinity throughout San Francisco Bay is largely a function of the tides, as well as to some extent the
 41 freshwater inflow from upstream. Thus, Delta outflow is the main mechanism by which the
 42 alternative could affect salinity in San Francisco Bay. According to the Delta Atlas (California
 43 Department of Water Resources 1995), average historical tidal flow through the Golden Gate Bridge
 44 is 2,300,000 cfs and average historical tidal flow at Chippis Island is 170,000 cfs. The historical

1 average tidal flows are two to three orders of magnitude larger than the largest mean monthly
2 change in Delta outflow due to the No Action Alternative (shown in Appendix 5A, Section C.7). Thus,
3 the changes in Delta outflow due to the No Action Alternative would be minor compared to tidal
4 flows, and thus no substantial adverse effects on salinity, or fish and wildlife beneficial uses,
5 downstream of the Delta are expected.

6 **Selenium**

7 Changes in source water fraction and net Delta outflow under the No Action Alternative, relative to
8 Existing Conditions, are projected to cause the total selenium load to the North Bay to increase by
9 3% (Appendix 80, *San Francisco Bay Analysis*, Table O-3). Changes in long-term average selenium
10 concentrations of the North Bay are assumed to be proportional to changes in North Bay selenium
11 loads. Under the No Action Alternative, the long-term average total selenium concentration of the
12 North Bay is estimated to be 0.13 µg/L and the dissolved selenium concentration is estimated to be
13 0.11 µg/L, which would be the same as Existing Conditions (Appendix 80, Table O-3). The dissolved
14 selenium concentration would be below the target of 0.202 µg/L developed by Presser and Luoma
15 (2013) to coincide with a white sturgeon whole-body fish tissue selenium concentration not greater
16 than 8 mg/kg in the North Bay. The incremental increase in dissolved selenium concentrations in
17 the North Bay, relative to Existing Conditions, would be negligible (0.00 µg/L) under this alternative.
18 Thus, the estimated changes in selenium loads in Delta exports to San Francisco Bay due to the No
19 Action Alternative are not expected to result in adverse effects to beneficial uses or substantially
20 degrade the water quality with regard to selenium, or make the existing CWA Section 303(d)
21 impairment measurably worse.

22 **Microcystis**

23 *Microcystis* has not been detected in embayments of the San Francisco Bay downstream of Suisun
24 Bay. Low levels of microcystins occur throughout San Francisco Bay, but their concentrations do not
25 correspond to *Microcystis* abundance, nor is there evidence that they have been transported
26 downstream from *Microcystis* blooms that have occurred in the Delta (Senn and Novick 2013). The
27 low levels of microcystins present in San Francisco Bay are likely derived from cyanobacteria
28 besides *Microcystis*, such as *Cyanobium* sp. and *Synechocystis*, which are currently resident in the San
29 Francisco Bay at levels well below bloom magnitude (Senn and Novick 2013). Elevated microcystin
30 levels could occur at various locations in the Delta during *Microcystis* blooms under the No Action
31 Alternative, but because of the sufficient dilution available in San Francisco Bay, downstream
32 transport of Delta-derived microcystins are not expected to result in measurable changes in the
33 microcystin levels of San Francisco Bay.

34 The absence of *Microcystis* in San Francisco Bay is likely directly related to its intolerance of elevated
35 salinity, as its growth ceases and breakdown of its cellular tissues starts at salinities of 10–12.6 ppt
36 (Tonk et al. 2007; Black et al. 2011). San Pablo Bay is the only embayment of San Francisco Bay
37 downstream of Suisun Bay that would experience salinities of this magnitude for any significant
38 duration of the year, although these and lower salinities would only occur under conditions of high
39 Delta outflow. However, high Delta outflows occur during wet years and during the winter and
40 spring runoff season, under which water temperatures are expected to be low, turbidity high, and
41 water residence times low, making the environment of San Pablo Bay unsuitable for *Microcystis*
42 growth. Additionally, these hydrodynamics conditions typically only occur when the potential for
43 *Microcystis* blooms to occur upstream of, and thus potentially seed *Microcystis* to, San Pablo Bay are
44 minimal. The No Action Alternative is not expected to result in significant modification to net Delta

1 outflows or the timing of high outflow events related to wet season runoff. Thus, the effects of the No
2 Action Alternative on *Microcystis* levels in San Francisco Bay are expected to be negligible.

3 **CEQA Conclusion:** Based on the above, the No Action Alternative would not be expected to cause
4 long-term degradation of water quality in San Francisco Bay resulting in sufficient use of available
5 assimilative capacity such that occasionally exceeding water quality objectives/criteria would be
6 likely and would result in substantially increased risk for adverse effects to one or more beneficial
7 uses. Further, based on the above, this alternative would not be expected to cause additional
8 exceedance of applicable water quality objectives/criteria in the San Francisco Bay by frequency,
9 magnitude, and geographic extent that would cause significant impacts on any beneficial uses of
10 waters in the affected environment. Any changes in boron, bromide, chloride, and DOC in the San
11 Francisco Bay would not adversely affect beneficial uses, because the uses most affected by changes
12 in these parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial
13 changes in DO, pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta,
14 relative to Existing Conditions; therefore, no substantial changes these constituents' levels in the
15 Bay are anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay
16 salinity, as the change in Delta outflow would two to three orders of magnitude lower than (and thus
17 minimal compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in
18 the Delta would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant
19 of the Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 32%
20 reduction in total nitrogen load and 5% increase in phosphorus load, relative to Existing Conditions,
21 are expected to have minimal effect on water quality degradation, primary productivity, or
22 phytoplankton community composition. The estimated increase in mercury load (3 kg/year; 1%)
23 and methylmercury load (0.09 kg/year; 3%), relative to Existing Conditions, is within the level of
24 uncertainty in the mass load estimate and not expected to contribute to water quality degradation,
25 make the CWA Section 303(d) mercury impairment measurably worse or cause
26 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
27 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
28 load would be 3%, but estimated total and dissolved selenium concentrations under the No Action
29 Alternative would be the same as Existing Conditions, and less than the target associated with white
30 sturgeon whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium load is
31 not expected to contribute to water quality degradation, or make the CWA Section 303(d) selenium
32 impairment measurably worse or cause selenium to bioaccumulate to greater levels in aquatic
33 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
34 is considered to be less than significant.

35 **8.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and** 36 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

37 Alternative 1A would convey up to 15,000 cfs of water from the north Delta to the south Delta
38 through pipelines/tunnels via five screened intakes on the east bank of the Sacramento River
39 between Clarksburg and Walnut Grove (i.e., Intakes 1 through 5). Intakes 1 through 5 would
40 introduce large, multi-story industrial concrete and steel structures approximately 55 feet in height
41 from river bottom to the top of the structure with a length of 900–1,600 feet depending on the
42 location. A new 600-acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would
43 be constructed which would provide water to the south Delta pumping plants. Construction of a
44 750-acre Intermediate Forebay near Hood is also included in this alternative.

1 Construction of all structural components under Alternative 1A could potentially occur over a
 2 period of 9 or more years, although construction of individual components would occur on shorter
 3 time scales (See Appendix 3C, *Construction Assumptions for Water Conveyance Facilities*). Water
 4 supply and conveyance operations would follow the guidelines described as Scenario A, which does
 5 not include Fall X2. CM1–CM3 would manage the routing, timing, and amount of flow through the
 6 Delta. CM4–CM11 would restore, enhance, and manage physical habitats on a natural community
 7 scale. CM11–CM21 are designed to reduce other stressors on a species scale. See Chapter 3,
 8 *Description of Alternatives*, Section 3.5.2, for additional details on Alternative 1A.

9 **Effects of the Alternative on Delta Hydrodynamics**

10 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
 11 substantially affect water quality within the Delta:

- 12 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 13 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 14 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 15 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 16 decreased exports of San Joaquin River water (due to increased Sacramento River water
 17 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 18 also can affect water residence time and many related physical, chemical, and biological
 19 variables.
- 20 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
 21 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
 22 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
 23 and above normal water years) will decrease levels of these constituents, particularly in the
 24 west Delta.

25 Under Alternative 1A, over the long term, average annual delta exports are anticipated to increase
 26 by 312 TAF relative to Existing Conditions, and by 1016 TAF relative to the No Action Alternative.
 27 Since, over the long-term, approximately 50% of the exported water will be from the new north
 28 Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of
 29 the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
 30 information). The result of this is increased San Joaquin River water influence throughout the south,
 31 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
 32 can be seen, for example, in Appendix 8D, ALT 1–Old River at Rock Slough for ALL years (1976–
 33 1991), which shows increased SJR percentage and decreased SAC percentage under the alternative,
 34 relative to Existing Conditions and the No Action Alternative.

35 Under Alternative 1A, long-term average annual Delta outflow is anticipated to decrease 323 TAF
 36 relative to Existing Conditions due to both changes in operations (including north Delta intake
 37 capacity of 15,000 cfs and numerous other components of Operational Scenario A) and climate
 38 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 39 increased sea water intrusion in the west Delta. The increase of sea water intrusion in the west Delta
 40 under Alternative 1A is greater relative to the No Action alternative because the No Action
 41 alternative includes operations to meet Fall X2, whereas Existing Conditions and Alternative 1A do
 42 not. Long-term average annual Delta outflow is anticipated to decrease under Alternative 1A by
 43 1072 TAF relative to the No Action Alternative, due only to changes in operations. The increases in

1 sea water intrusion (represented by an increase in BAY percentage) can be seen, for example, in
2 Appendix 8D, ALT 1A–Sacramento River at Mallard Island for ALL years (1976–1991).

3 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 4 **Maintenance (CM1)**

5 *Upstream of the Delta*

6 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
7 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
8 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
9 concentrations that could occur in the water bodies of the affected environment in the Upstream of
10 the Delta Region would not be of frequency, magnitude, and geographic extent that would adversely
11 affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to
12 ammonia.

13 *Delta*

14 As summarized in Table 8-40, it is assumed that SRWTP effluent ammonia concentrations would be
15 substantially lower under Alternative 1A than under Existing Conditions, and would be the same as
16 would occur under the No Action Alternative. Thus, for the same reasons stated for the No Action
17 Alternative, Alternative 1A would not result in substantial increases in ammonia concentrations in
18 the Plan Area, relative to Existing Conditions.

19 Because the SRWTP discharge ammonia concentrations are assumed to be the same under
20 Alternative 1A as would occur under the No Action Alternative, the primary mechanism that could
21 potentially increase ammonia concentrations in the Delta under Alternative 1A, relative to the No
22 Action Alternative, is decreased flows in the Sacramento River, which would lower dilution available
23 to the SRWTP discharge. This change would be attributable only to operations of Alternative 1A,
24 since the same assumptions regarding water demands, climate change, and sea level rise are
25 included in both Alternative 1A and the No Action Alternative.

26 **Table 8-64. Estimated Ammonia-N (mg/L as N) Concentrations in the Sacramento River Downstream**
27 **of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and**
28 **Alternative 1A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 1A	0.068	0.089	0.068	0.060	0.057	0.060	0.058	0.062	0.063	0.065	0.073	0.077	0.067

29
30 To address this possibility, a simple mixing calculation was performed to assess concentrations of
31 ammonia downstream of the SRWTP discharge (i.e., downstream of Freeport) under Alternative 1A
32 and the No Action Alternative. Monthly average CALSIM II flows at Freeport and the upstream
33 ammonia concentration (0.04 mg/L-N; Central Valley Regional Water Quality Control Board
34 2010a:5) were used, together with the SRWTP permitted average dry weather flow (181 mgd) and
35 seasonal ammonia concentration (1.5 mg/L-N in Apr-Oct, 2.4 mg/L-N in Nov-Mar), to estimate the

1 average change in ammonia concentrations downstream of the SRWTP. Table 8-64 shows monthly
2 average and long term annual average predicted concentrations under the two scenarios.

3 As Table 8-64 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
4 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 1A and the
5 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
6 would occur during July through September and in November, and remaining months would be
7 unchanged or have a minor decrease. A minor increase in the annual average concentration would
8 occur under Alternative 1A, compared to the No Action Alternative. Moreover, the estimated
9 concentrations downstream of Freeport under Alternative 1A would be similar to existing source
10 water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in
11 source water fraction anticipated under Alternative 1A, relative to the No Action Alternative, would
12 not be expected to substantially increase ammonia concentrations at any Delta locations.

13 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
14 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
15 beneficial uses or substantially degrade the water quality at these locations, with regards to
16 ammonia.

17 ***SWP/CVP Export Service Areas***

18 The assessment of effects on ammonia in the SWP and CVP Export Service Area is based on
19 assessment of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source
20 waters influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers
21 (see Appendix 8D, *Source Water Fingerprinting Results*). As discussed above for the Plan Area, for
22 areas of the Delta that are influenced by Sacramento River water, including Banks and Jones
23 pumping plants, ammonia-N concentrations are expected to decrease under Alternative 1A, relative
24 to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This
25 decrease in ammonia-N concentrations for water exported via the south Delta pumps is not
26 expected to result in an adverse effect on beneficial uses or substantially degrade water quality of
27 exported water, with regards to ammonia.

28 ***NEPA Effects:*** As discussed above for the Plan Area, for all areas of the Delta, including Banks and
29 Jones pumping plants, ammonia-N concentrations would not be expected to substantially differ
30 under Alternative 1A, relative to No Action Alternative. Any negligible increases in ammonia-N
31 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
32 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
33 degrade the water quality at these locations, with regards to ammonia. In summary, based on the
34 discussion above, effects on ammonia from implementation of CM1 are considered to be not
35 adverse.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
38 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
39 constituent. For additional details on the effects assessment findings that support this CEQA impact
40 determination, see the effects assessment discussion that immediately precedes this conclusion.

41 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
42 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
43 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,

1 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 2 any modified reservoir operations and subsequent changes in river flows under Alternative 1A,
 3 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 4 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 5 of the Delta in the San Joaquin River watershed.

6 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 7 substantially lower under Alternative 1A, relative to Existing Conditions, due to upgrades to the
 8 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 9 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 10 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 11 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 12 either of these concentrations.

13 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 14 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 15 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 16 Jones pumping plants, ammonia-N concentrations are expected to decrease under the Alternative
 17 1A, relative to Existing Conditions.

18 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 19 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 20 CVP and SWP service areas under Alternative 1A relative to Existing Conditions. As such, this
 21 alternative would not be expected to cause additional exceedance of applicable water quality
 22 objectives/criteria by frequency, magnitude, and geographic extent that would cause significant
 23 impacts on any beneficial uses of waters in the affected environment. Because ammonia
 24 concentrations would not be expected to increase substantially, no long-term water quality
 25 degradation would be expected to occur and, thus, no significant impacts on beneficial uses would
 26 occur. Ammonia is not 303(d) listed within the affected environment and thus any minor increases
 27 that could occur in some areas would not make any existing ammonia-related impairment
 28 measurably worse because no such impairments currently exist. Because ammonia-N is not
 29 bioaccumulative, minor increases that could occur in some areas would not bioaccumulate to
 30 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
 31 or humans. This impact would be considered less than significant. No mitigation is required.

32 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 33 CM21**

34 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
 35 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
 36 increased biota in those areas as a result of restored habitat may increase ammonia loading
 37 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
 38 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be
 39 expected to substantially increase ammonia concentrations in the Delta. CM2-CM11 would not
 40 substantially increase ammonia concentrations in the water bodies of the affected environment.
 41 Additionally, implementation of CM12-CM21 would not be expected to substantially alter ammonia
 42 concentrations in the affected environment. The effects of ammonia from implementation of CM2-
 43 CM21 are considered to be not adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in ammonia-N concentrations
 2 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 3 CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions. As
 4 such, implementation of these conservation measures would not be expected to cause additional
 5 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 6 extent that would cause significant impacts on any beneficial uses of waters in the affected
 7 environment. Because ammonia concentrations would not be expected to increase substantially
 8 from implementation of these conservation measures, no long-term water quality degradation
 9 would be expected to occur and, thus, no significant impact on beneficial uses would occur.
 10 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
 11 could occur in some areas would not make any existing ammonia-related impairment measurably
 12 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,
 13 minor increases that could occur in some areas would not bioaccumulate to greater levels in aquatic
 14 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 15 is considered less than significant. No mitigation is required.

16 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 17 **Maintenance (CM1)**

18 ***Upstream of the Delta***

19 Under Alternative 1A there would be no expected change to the sources of boron in the Sacramento
 20 and eastside tributary watersheds. Boron loading in these watersheds would remain unchanged and
 21 resultant changes in flows from altered system-wide operations would have negligible, if any, effects
 22 on the concentration of boron in the rivers and reservoirs of these watersheds. Under Alternative
 23 1A, the modeled long-term annual average flows on the lower San Joaquin River at Vernalis would
 24 decrease by an estimated 6%, relative to Existing Conditions (in association with changed
 25 operations, climate change, and increased water demands), and would remain virtually the same
 26 relative to the No Action Alternative considering only changes associated with Alternative 1A
 27 operations (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). The
 28 reduced flow would result in possible increases in long-term average boron concentrations of about
 29 2%, relative to the Existing Conditions, with no change relative to the No Action Alternative
 30 (Appendix 8F, Table Bo-32). However, the small increases in lower San Joaquin River boron levels
 31 that may occur under Alternative 1A, relative to Existing Conditions would not result in an increased
 32 frequency of exceedances of any applicable objectives or criteria. Moreover, any negligible change in
 33 boron concentration would not be expected to cause further degradation at measurable levels in the
 34 lower San Joaquin River, and thus would not cause the existing impairment there to be discernibly
 35 worse. Consequently, Alternative 1A would not be expected to cause exceedance of boron
 36 objectives/criteria or substantially degrade water quality with respect to boron, and thus would not
 37 adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, associated
 38 reservoirs upstream of the Delta, or the lower San Joaquin River.

39 ***Delta***

40 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 41 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 42 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 43 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 44 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
2 more information.

3 Relative to the Existing Conditions and the No Action Alternative, Alternative 1A would result in
4 similar or reduced long-term average boron concentrations for the 16-year period modeled at
5 northern and eastern Delta locations (i.e., 14% reduction at North Bay Aqueduct at Barker Slough
6 and 6% reduction at the San Joaquin River at Buckley Cove, compared to Existing Conditions)
7 (Appendix 8F, *Boron*, Table Bo-6). Moreover, the direction and magnitude of predicted changes for
8 Alternative 1A are similar between the alternatives, thus, the effects relative to Existing Conditions
9 and the No Action Alternative are discussed together. The comparison to Existing Conditions reflects
10 changes due to both Alternative 1A operations (including north Delta intake capacity of 15,000 cfs
11 and numerous other components of Operational Scenario A) and climate change/sea level rise. The
12 comparison to the No Action Alternative reflects changes due only to operations.

13 The long-term average boron concentrations for the 16-year period modeled would increase at
14 interior and western Delta locations (by as much as 8% at the SF Mokelumne River at Staten Island,
15 13% at Franks Tract, 10% at Old River at Rock Slough, and 9% at the Sacramento River at
16 Emmaton) (Appendix 8F, *Boron*, Table Bo-6). Additionally, implementation of tidal habitat
17 restoration under CM4 would increase the tidal exchange volume in the Delta, and thus may
18 contribute to increased boron concentrations in the Bay source water as a result of increased
19 salinity intrusion. More discussion of the assessment methods for changes in source water
20 concentrations caused by project-related hydrodynamic changes is included in Section 8.3.1.3, *Plan*
21 *Area*. While uncertain, the magnitude of boron increases may be greater than indicated herein and
22 would affect the western Delta assessment locations the most (since they are influenced to the
23 greatest extent by the Bay source water), and thus would not be anticipated to substantially affect
24 agricultural use of water because diversions occur primarily at interior Delta locations.

25 The long-term annual average and monthly average boron concentrations, for either the 16-year
26 period or drought period modeled, would never exceed the 2,000 µg/L human health advisory
27 objective (i.e., for children) or 500 µg/L agricultural objective at any of the eleven Delta assessment
28 locations, which represents no change from the Existing Conditions and No Action Alternative
29 conditions (Appendix 8F, *Boron*, Table Bo-3A). Increased boron concentrations would result in
30 minor reductions in the modeled long-term average assimilative capacity with respect to the 2,000
31 µg/L human health advisory objective. The reductions in long-term average assimilative capacity of
32 up to 6% at interior Delta locations (i.e., Franks Tract and Old River at Rock Slough) also would be
33 small with respect to the 500 µg/L agricultural objective (Appendix 8F, Table Bo-7). However,
34 because the absolute boron concentrations would still be well below the lowest 500 µg/L objective
35 for the protection of the agricultural beneficial use under Alternative 1A, the levels of boron
36 degradation would not be of sufficient magnitude to substantially increase the risk of exceeding
37 objectives or cause adverse effects to municipal and agricultural water supply beneficial uses, or any
38 other beneficial uses, in the Delta (Appendix 8F, Figure Bo-2).

39 ***SWP/CVP Export Service Areas***

40 Under Alternative 1A, improvement in long-term average boron concentrations would occur at the
41 Banks and Jones pumping plants as a result of export of a greater proportion of low-boron
42 Sacramento River water. Long-term average boron concentrations for the modeled 16-year
43 hydrologic period at these locations would decrease by as much as 22% at Banks and by as much as
44 18% at Jones relative to Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table

1 Bo-6). Commensurate with the decrease in boron concentrations in exported water to the San
2 Joaquin River basin, there could be reduced boron loading and concentrations in the lower San
3 Joaquin River related to irrigation water deliveries from the Delta. While the magnitude of this
4 expected lower San Joaquin River improvement in boron is difficult to predict, the relative decrease
5 in overall loading of boron to the export service area would likely alleviate or lessen any expected
6 increase in boron concentrations at Vernalis associated with flow reductions (see discussion of
7 Upstream of the Delta), as well as locations in the Delta receiving a large fraction of San Joaquin
8 River water, such as much of the south Delta. Reduced export boron concentrations also may
9 contribute to reducing the existing 303(d) impairment in the lower San Joaquin River and associated
10 TMDL actions for reducing boron loading.

11 Maintenance of SWP and CVP facilities under Alternative 1A would not be expected to create new
12 sources of boron or contribute towards a substantial change in existing sources of boron in the
13 affected environment. Maintenance activities would not be expected to cause any substantial
14 increases in boron concentrations or degradation with respect to boron such that objectives would
15 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
16 affected environment.

17 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 1A would
18 result in relatively small increases in long-term average boron concentrations in the Delta and not
19 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
20 would not be expected to cause exceedances of applicable objectives or further measurable water
21 quality degradation, and thus would not constitute an adverse effect on water quality.

22 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
23 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
24 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
25 constituent. For additional details on the effects assessment findings that support this CEQA impact
26 determination, see the effects assessment discussion that immediately precedes this conclusion.

27 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
28 river flow rate and reservoir storage reductions that would occur under the Alternative 1A, relative
29 to Existing Conditions, would not be expected to result in a substantial adverse change in boron
30 levels. Additionally, relative to Existing Conditions, Alternative 1A would not result in reductions in
31 river flow rates (i.e., less dilution) or increased boron loading such that there would be any
32 substantial increases in boron concentration upstream of the Delta in the San Joaquin River
33 watershed.

34 Small increased boron levels predicted for interior and western Delta locations (i.e., up to 13%
35 increase) in response to a shift in the Delta source water percentages and tidal habitat restoration
36 under this alternative would not be expected to cause exceedances of objectives, or substantial
37 degradation of these water bodies. Alternative 1A maintenance also would not result in any
38 substantial increases in boron concentrations in the affected environment. Boron concentrations
39 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
40 reflecting a potential improvement to boron loading in the lower San Joaquin River.

41 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 1A
42 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
43 Existing Conditions, Alternative 1A would not result in substantially increased boron concentrations
44 such that frequency of exceedances of municipal and agricultural water supply objectives would

1 increase. The levels of boron degradation that may occur under Alternative 1A would not be of
 2 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
 3 agricultural beneficial uses within the affected environment. Long-term average boron
 4 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
 5 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
 6 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
 7 mitigation is required.

8 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

9 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21), of which
 10 most do not involve land disturbance, present no new direct sources of boron to the affected
 11 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
 12 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 13 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
 14 hydrodynamic conditions is addressed above in the discussion of Impact WQ-3. The potential
 15 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
 16 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-3. Habitat
 17 restoration activities in the Delta (i.e., CM4–CM10), including restored tidal wetlands, floodplain,
 18 and related channel margin and off-channel habitats, while involving increased land and water
 19 interaction within these habitats, would not be anticipated to contribute boron which is primarily
 20 associated with source water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and
 21 Bay source water). Moreover, some habitat restoration conservation measures (CM4–CM10) would
 22 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 23 land uses with restored habitats. The potential reduction in irrigated lands within the Delta may
 24 result in reduced discharges of agricultural field drainage with elevated boron concentrations,
 25 which would be considered an improvement compared to Existing Conditions. CM3 and CM11
 26 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
 27 themselves, affect boron levels in the Delta. CM12–CM21 involve actions that target reduction in
 28 other stressors at the species level involving actions such as methylmercury reduction management
 29 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
 30 treatment (CM19). None of the CM12–CM21 actions would contribute to substantially increasing
 31 boron levels in the Delta. Consequently, as they pertain to boron, implementation of CM2–CM21
 32 would not be expected to adversely affect any of the beneficial uses of the affected environment.

33 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 1A would not present new or
 34 substantially changed sources of boron to the affected environment upstream of the Delta, within
 35 Delta, or in the SWP and CVP service area. As such, their implementation would not be expected to
 36 substantially increase the frequency with which applicable Basin Plan objectives or other criteria
 37 would be exceeded in water bodies of the affected environment located upstream of the Delta,
 38 within the Delta, or in the SWP and CVP Service Area or substantially degrade the quality of these
 39 water bodies, with regard to boron. Based on these findings, this impact is considered to be less than
 40 significant. No mitigation is required.

1 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 1A there would be no expected change to the sources of bromide in the
 5 Sacramento River and eastside tributary watersheds. Bromide loading in these watersheds would
 6 remain unchanged and resultant changes in flows from altered system-wide operations under
 7 Alternative 1A would have negligible, if any, effects on the concentration of bromide in the rivers
 8 and reservoirs of these watersheds. Consequently, Alternative 1A would not be expected to
 9 adversely affect the MUN beneficial use, or any other beneficial uses, of the Sacramento River, the
 10 eastside tributaries, or their associated reservoirs upstream of the Delta.

11 Under Alternative 1A, modeling indicates that long-term annual average flows on the San Joaquin
 12 River would decrease by 6% relative to Existing Conditions and would remain virtually the same
 13 relative to No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 14 *Technical Appendix*). These decreases in flow would result in possible increases in long-term average
 15 bromide concentrations of about 3%, relative to Existing Conditions and less than <1% relative to
 16 the No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower San
 17 Joaquin River bromide levels that may occur under Alternative 1A, relative to existing and No Action
 18 Alternative conditions would not be expected to adversely affect the MUN beneficial use, or any
 19 other beneficial uses, of the lower San Joaquin River.

20 ***Delta***

21 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 22 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 23 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 24 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 25 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 26 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 27 more information.

28 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
 29 Conditions, Alternative 1A would result in small decreases in long-term average bromide
 30 concentration at most Delta assessment locations, with the exceptions being the North Bay
 31 Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River (Appendix 8E,
 32 *Bromide*, Table 4). Overall effects would be greatest at Barker Slough, where predicted long-term
 33 average bromide concentrations would increase from 51 µg/L to 71 µg/L (38% relative increase)
 34 for the modeled 16-year hydrologic period and would increase from 54 µg/L to 104 µg/L (94%
 35 relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L bromide
 36 threshold exceedance frequency would increase from 49% under Existing Conditions to 51% under
 37 Alternative 1A (55% to 75% during the modeled drought period) and the predicted 100 µg/L
 38 exceedance frequency would increase from 0% under Existing Conditions to 22% under Alternative
 39 1A (0% to 48% during the modeled drought period). In contrast, increases in bromide at Staten
 40 Island would result in a 50 µg/L bromide threshold exceedance increase from 47% under Existing
 41 Conditions to 73% under Alternative 1A (52% to 75% during the modeled drought period).
 42 However, unlike Barker Slough, modeling shows that the long-term average bromide concentrations
 43 at Staten Island would exceed the 100 µg/L assessment threshold concentration 1% under Existing
 44 Conditions and 3% under Alternative 1A (0% to 2% during the modeled drought period) (Appendix

1 8E, *Bromide*, Table 4). The long-term average bromide concentrations would be about 61 µg/L (62
2 µg/L during the modeled drought period) at Staten Island under Alternative 1A. Changes in
3 exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
4 change in long-term average concentration, at other assessment locations would be less substantial.
5 The comparison to Existing Conditions reflects changes in bromide due to both Alternative 1A
6 operations (including north Delta intake capacity of 15,000 cfs and numerous other components of
7 Operational Scenario A) and climate change/sea level rise.

8 In comparison, Alternative 1A relative to the No Action Alternative would result in predicted
9 increases in long-term average bromide concentrations at all locations with the exception of the
10 Banks and Jones pumping plants (Appendix 8E, *Bromide*, Table 4). Increases would be greatest at
11 Barker Slough, where long-term average concentrations are predicted to increase by about 43%
12 (93% for the modeled drought period). Increases in long-term average bromide concentrations
13 would be less than 27% at the remaining assessment locations. Due to the relatively small
14 differences between modeled Existing Conditions and No Action Alternative, changes in the
15 frequency with which concentration thresholds of 50 µg/L and 100 µg/L are exceeded are of similar
16 magnitude to those previously described for Existing Conditions comparison (Appendix 8E,
17 *Bromide*, Table 4). Unlike the comparison to Existing Conditions, the comparison to the No Action
18 Alternative reflects changes in bromide due only to operations.

19 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
20 conditions are very similar (Appendix 8E, *Bromide*, Tables 4 and 5). Such similarity demonstrates
21 that the modeled Alternative 1A change in bromide is almost entirely due to Alternative 1A
22 operations, and not climate change/sea level rise. Therefore, operations are the primary driver of
23 effects on bromide at Barker Slough, regardless of whether Alternative 1A is compared to Existing
24 Conditions, or compared to the No Action Alternative. Results of the modeling approach, which used
25 relationships between EC and chloride and between chloride and bromide (see Section 8.3.1.3, *Plan*
26 *Area*), differed somewhat from what is presented above for the mass-balance approach (see
27 Appendix 8E, *Bromide*, Table 5). For most locations, the frequency of exceedance of the 50 µg/L and
28 100 µg/L were similar. The greatest difference between the methods was predicted for Barker
29 Slough. The increases in frequency of exceedance of the 100 µg/L threshold, relative to Existing
30 Conditions and the No Action Alternative, were not as great using this alternative EC to chloride and
31 chloride to bromide relationship modeling approach as compared to that presented above from the
32 mass-balance modeling approach. However, there were still substantial increases, resulting in 10%
33 exceedance over the modeled period under Alternative 1A, as compared to 1% under Existing
34 Conditions, and 2% under the No Action Alternative. For the drought period, exceedance frequency
35 increased from 0% under Existing Conditions and the No Action Alternative, to 22% under
36 Alternative 1A. Because the mass-balance approach predicts a greater level of impact at Barker
37 Slough, determination of impacts was based on the mass-balance results.

38 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
39 the relative increase in the 100 µg/L exceedance frequency, would result in a substantial change in
40 source water quality to existing drinking water treatment plants drawing water from the North Bay
41 Aqueduct. Drinking water treatment plants in this region utilize a variety of conventional and
42 enhanced treatment systems to achieve DBP drinking water criteria. Depending on the necessary
43 disinfection requirements surrounding removal of pathogenic organisms, as well as the aggregate
44 quality of water such as pH and alkalinity, a change in long-term average bromide of the magnitude
45 predicted may necessitate changes in treatment plant operation or treatment plant facilities in order
46 to maintain DBP compliance. For example, for a water treatment plant utilizing ozone to achieve

1 disinfection equivalent to 1 or 2 log inactivation of *Giardia*, an increase in long-term average
2 bromide above 50 µg/L may require pH control systems (California Urban Water Agencies 1998:4-
3 18). For a water treatment plant utilizing chlorine to achieve 1 or 2 log inactivation of *Giardia*, an
4 increased frequency of bromide in excess 100 µg/L may require a switch to ozonation with pH
5 control (California Urban Water Agencies 1998: 4-20). While the implications of such a modeled
6 change in bromide at Barker Slough are difficult to predict, the substantial modeled increases could
7 lead to adverse changes in the formation of disinfection byproducts such that considerable water
8 treatment plant upgrades would be necessary in order to achieve equivalent levels of health
9 protection. This would be an adverse effect. Because many of the other modeled locations already
10 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,
11 these locations likely already require treatment plant technologies to achieve equivalent levels of
12 health protection, and thus no additional treatment technologies would be triggered by the small
13 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
14 drinking water beneficial use would be expected at these locations.

15 The seasonal intakes at Mallard Slough and city of Antioch are infrequently used because of water
16 quality constraints related to sea water intrusion. On a long-term average, bromide at these
17 locations exceeds 3,000 µg/L, but during seasonal periods of high Delta outflow levels can be <300
18 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
19 Slough and city of Antioch under Alternative 1A would experience a period average increase in
20 bromide during the months when these intakes would most likely be utilized. For those wet and
21 above normal water year types where mass balance modeling would predict water quality typically
22 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 173
23 µg/L (68% increase) at city of Antioch and would increase from 150 µg/L to 204 µg/L (36%
24 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
25 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
26 to chloride and chloride to bromide relationships show increases during these months, but the
27 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of
28 the differences in the data between the two modeling approaches, the decisions surrounding the use
29 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
30 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
31 bromide concentrations at the city of Antioch and Mallard Slough intake would not be expected to
32 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

33 Important to the results presented above is the assumed habitat restoration footprint on both the
34 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
35 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3, *Plan*
36 *Area*), not operations covered under CM1, are the driving factor in the modeled bromide increases.
37 The timing, location, and specific design of habitat restoration will have effects on Delta
38 hydrodynamics, and any deviations from modeled habitat restoration and implementation schedule
39 will lead to different outcomes. Although habitat restoration near Barker Slough is an important
40 factor contributing to modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat
41 restoration elsewhere in the Delta can also have large effects. Because of these uncertainties, and the
42 possibility of adaptive management changes to BDCP restoration activities, including location,
43 magnitude, and timing of restoration, the estimates are not predictive of the bromide levels that
44 would actually occur in Barker Slough or elsewhere in the Delta.

1 **SWP/CVP Export Service Areas**

2 Under Alternative 1A, improvement in long-term average bromide concentrations would occur at
3 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
4 16-year hydrologic period at these locations would decrease by as much as 37% relative to Existing
5 Conditions and 28% relative to the No Action Alternative. Relative changes in long-term average
6 bromide concentrations would be less during drought conditions ($\leq 31\%$), but would still represent
7 considerable improvement (Appendix 8E, *Bromide*, Table 4). As a result, less frequent bromide
8 concentration exceedances of the 50 $\mu\text{g/L}$ and 100 $\mu\text{g/L}$ assessment thresholds would be predicted
9 and an overall improvement in water quality would be experienced respective to bromide in the
10 SWP/CVP Export Service Areas. Commensurate with the decrease in exported bromide, an
11 improvement in lower San Joaquin River bromide would also be observed because bromide in the
12 lower San Joaquin River is principally related to irrigation water deliveries from the Delta. While the
13 magnitude of this expected lower San Joaquin River improvement in bromide is difficult to predict,
14 the relative decrease in overall loading of bromide to the Export Service Areas would likely alleviate
15 or lessen any expected increase in bromide concentrations at Vernalis (see discussion of Upstream
16 of the Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water,
17 such as much of the south Delta.

18 The discussion above is based on results of the mass-balance modeling approach. Results of the
19 modeling approach which used relationships between EC and chloride and between chloride and
20 bromide (see Section 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment
21 of bromide using these data results in the same conclusions as are presented above for the mass-
22 balance approach (see Appendix 8E, *Bromide*, Table 5).

23 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
24 facilities under Alternative 1A would not be expected to create new sources of bromide or
25 contribute a substantial change in existing sources of bromide in the affected environment.
26 Maintenance activities would not be expected to cause any substantial change in bromide such that
27 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
28 affected environment.

29 **NEPA Effects:** In summary, Alternative 1A operations and maintenance, relative to the No Action
30 Alternative, would result in small increases (i.e., $<1\%$) in long-term average bromide concentrations
31 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
32 However, Alternative 1A operation and maintenance activities would cause substantial degradation
33 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
34 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
35 changes in water treatment plant operations or require treatment plant upgrades in order to
36 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
37 Measure WQ-5 is available to reduce these effects (implementation of this measure along with
38 separate, other commitments as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
39 *AMMs*, and *CMs*, relating to the potential increased treatment costs associated with bromide-related
40 changes would reduce these effects).

41 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
43 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
44 constituent. For additional details on the effects assessment findings that support this CEQA impact
45 determination, see the effects assessment discussion that immediately precedes this conclusion.

1 Under Alternative 1A there would be no expected change to the sources of bromide in the
2 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
3 unchanged and resultant changes in flows from altered system-wide operations under Alternative
4 1A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
5 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
6 bromide, primarily due to the use of irrigation water imported from the southern Delta.
7 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
8 1A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
9 substantial predicted increases in long-term average bromide of about 3% relative to Existing
10 Conditions.

11 Relative to Existing Conditions, Alternative 1A would result in small decreases in long-term average
12 bromide concentration at most Delta assessment locations, with principal exceptions being the
13 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
14 effects would be greatest at Barker Slough, where substantial increases in long-term average
15 bromide concentrations would be predicted. The increase in long-term average bromide
16 concentrations predicted for Barker Slough would result in a substantial change in source water
17 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
18 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
19 formation of disinfection byproducts at drinking water treatment plants such that considerable
20 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
21 water health protection.

22 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
23 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 1A,
24 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
25 long-term average bromide concentrations are predicted to decrease by as much as 37% relative to
26 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
27 in the SWP/CVP Export Service Areas.

28 Based on the above, Alternative 1A operation and maintenance would not result in any substantial
29 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
30 Alternative 1A, water exported from the Delta to the SWP/CVP Export Service Areas would be
31 substantially improved relative to bromide. Bromide is not bioaccumulative, therefore change in
32 long-term average bromide concentrations would not directly cause bioaccumulative problems in
33 aquatic life or humans. Additionally, bromide is not a constituent related to any 303(d) listings.
34 Alternative 1A operation and maintenance activities would not cause substantial degradation to
35 water quality respective to bromide in the Plan Area with the exception of water quality at Barker
36 Slough, source of the North Bay Aqueduct. At Barker Slough, modeled long-term annual average
37 concentrations of bromide would increase by 38%, and 94% during the modeled drought period.
38 For the modeled 16-year hydrologic period the frequency of predicted bromide concentrations
39 exceeding 100 µg/L would increase from 0% under Existing Conditions to 22% under Alternative
40 1A, while for the modeled drought period, the frequency would increase from 0% to 48%.
41 Substantial changes in long-term average bromide could necessitate changes in water treatment
42 plant operation or require treatment plant upgrades in order to maintain DBP compliance. The
43 modeled change at Barker Slough is substantial and, therefore, would represent a substantially
44 increased risk for significant impacts on existing MUN beneficial uses should treatment upgrades
45 not be undertaken. The impact would be significant.

1 Implementation of Mitigation Measure WQ-5 along with a separate, other commitment relating to
 2 the potential increased treatment costs associated with bromide-related changes would reduce
 3 these effects. While mitigation measures to reduce these water quality effects in affected water
 4 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
 5 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
 6 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 7 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 8 significant and unavoidable.

9 In addition to and to supplement Mitigation Measure WQ-5, the project proponents have
 10 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 11 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
 12 costs that could result from bromide-related concentration effects on municipal water purveyor
 13 operations. Potential options for making use of this financial commitment include funding or
 14 providing other assistance towards implementation of the North Bay Aqueduct AIP, acquiring
 15 alternative water supplies, or other actions to indirectly reduce the effects of elevated bromide and
 16 DOC in existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
 17 potential actions that could be taken pursuant to this commitment in order to reduce the water
 18 quality treatment costs associated with water quality effects relating to chloride, electrical
 19 conductivity, and bromide.

20 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 21 **Conditions; Site and Design Restoration Sites to Reduce Bromide Increases in Barker**
 22 **Slough**

23 It remains to be determined whether, or to what degree, the available and existing salinity
 24 response and countermeasure actions of SWP and CVP facilities or municipal water purveyors
 25 would be capable of offsetting the actual level of changes in bromide that may occur from
 26 implementation of Alternative 1A. Therefore, to determine the feasibility of reducing the effects
 27 of increased bromide levels, and potential adverse effects on beneficial uses associated with
 28 CM1 operations (and hydrodynamic effects of tidal restoration under CM4), the proposed
 29 mitigation requires a series of phased actions to identify and evaluate existing and possible
 30 feasible actions, followed by development and implementation of the actions, if determined to
 31 be necessary. The development and implementation of any mitigation actions shall be focused
 32 on those incremental effects attributable to implementation of Alternative 1A operations only.
 33 Development of mitigation actions for the incremental bromide effects attributable to climate
 34 change/sea level rise are not required because these changed conditions would occur with or
 35 without implementation of Alternative 1A. The goal of specific actions would be to reduce/avoid
 36 additional degradation of Barker Slough water quality conditions with respect to the CALFED
 37 bromide goal.

38 The project proponents shall consider effects of site-specific restoration areas proposed under
 39 CM4 on bromide concentrations in Barker Slough. Design and siting of restoration areas shall
 40 attempt to reduce potential effects to the extent feasible without compromising proposed
 41 benefits of the restoration areas. It is anticipated that these efforts will be able to reduce the
 42 level of projected increase, though it is unknown whether it would be able to completely
 43 eliminate any increases.

1 Additionally, following commencement of initial operations of CM1, the project proponents will
 2 conduct additional evaluations described herein, and develop additional modeling (as
 3 necessary), to define the extent to which modified operations could reduce or eliminate the
 4 increased bromide concentrations currently modeled to occur under Alternative 1A. The
 5 additional evaluations should also consider specifically the changes in Delta hydrodynamic
 6 conditions associated with tidal habitat restoration under CM4 (in particular the potential for
 7 increased bromide concentrations that could result from increased tidal exchange) once the
 8 specific restoration locations are identified and designed. The evaluations will also consider up-
 9 to-date estimates of climate change and sea level rise, if and when such information is available.
 10 If sufficient operational flexibility to offset bromide increases is not feasible under Alternative
 11 1A operations, and/or siting and design of restoration areas cannot feasibly reduce bromide
 12 increases to a less-than-significant level without compromising the benefits of the proposed
 13 areas, achieving bromide reduction pursuant to this mitigation measure would not be feasible
 14 under this alternative.

15 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2-
 16 CM21**

17 **NEPA Effects:** CM2–CM21 would present no new sources of bromide to the affected environment,
 18 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 19 As they pertain to bromide, implementation of these conservation measures would not be expected
 20 to adversely affect MUN beneficial use, or any other beneficial uses, of the affected environment.

21 With exception to habitat restoration areas that would effectively alter Delta hydrodynamics, habitat
 22 restoration and the various land-disturbing conservation measures proposed for Alternative 1A
 23 would not present new or substantially changed sources of bromide to the study area. Modeling
 24 scenarios included assumptions regarding how certain habitat restoration activities would affect
 25 Delta hydrodynamics (CM2 and CM4), and thus such hydrodynamic effects of these restoration
 26 measures were included in the assessment of CM1 facilities operations and maintenance (see Impact
 27 WQ-5).

28 Some habitat restoration activities would occur on lands in the Delta formerly used for irrigated
 29 agriculture. Such replacement or substitution of land use activity would not be expected to result in
 30 new or increased sources of bromide to the Delta. Implementation of CM2–CM11 would not be
 31 expected to adversely affect MUN beneficial use, or any other beneficial uses, within the affected
 32 environment.

33 In summary, implementation of CM2–CM21 under Alternative 1A, relative to the No Action
 34 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 35 from implementing CM2–CM21 are determined to not be adverse.

36 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 1A would not present new or
 37 substantially changed sources of bromide to the study area. Some conservation measures may
 38 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 39 would not be expected to substantially increase or present new sources of bromide. Implementation
 40 of CM2–CM21 would have negligible, if any, effects on bromide concentrations throughout the
 41 affected environment, would not cause exceedance of applicable state or federal numeric or
 42 narrative water quality objectives/criteria because none exist for bromide, and would not cause
 43 changes in bromide concentrations that would result in significant impacts on any beneficial uses
 44 within affected water bodies. Implementation of CM2–CM21 would not cause significant long-term

1 water quality degradation such that there would be greater risk of significant impacts on beneficial
 2 uses, would not cause greater bioaccumulation of bromide, and would not further impair any
 3 beneficial uses due to bromide concentrations because no uses are currently impaired due to
 4 bromide levels. This impact is therefore considered less than significant. No mitigation is required.

5 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 1A there would be no expected change to the sources of chloride in the
 9 Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain
 10 unchanged and resultant changes in flows from altered system-wide operations would have
 11 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
 12 watersheds. Under Alternative 1A, the modeled long-term annual average flows on the lower San
 13 Joaquin River at Vernalis would decrease by an estimated 6%, relative to Existing Conditions in
 14 association with climate change and increased water demands, and would remain virtually the same
 15 relative to No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 16 *Technical Appendix*). The reduced flow would result in possible increases in long-term average
 17 chloride concentrations of about 2%, relative to the Existing Conditions, and no change relative to
 18 No Action Alternative (Appendix 8G, Table CI-62). However, the small increases in lower San Joaquin
 19 River chloride levels that could occur under Alternative 1A, relative to Existing Conditions would not
 20 result in an increased frequency of exceedances of any applicable objectives or criteria.
 21 Consequently, Alternative 1A would not be expected to cause exceedance of chloride
 22 objectives/criteria or substantially degrade water quality with respect to chloride, and thus would
 23 not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, associated
 24 reservoirs upstream of the Delta, or the San Joaquin River.

25 ***Delta***

26 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 27 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 28 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 29 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 30 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 31 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 32 more information.

33 Relative to Existing Conditions, modeling predicts that Alternative 1A would result in decreased
 34 long-term average chloride concentration at some assessment locations for the 16-year period
 35 modeled (i.e., 1976–1991), in particular at interior and south Delta assessment locations (i.e., San
 36 Joaquin River at Buckley Cove, Franks Tract, and Old River at Rock Slough) (Appendix 8G, *Chloride*,
 37 Table CI-7 and Table CI-8) Long-term average chloride concentrations would remain relatively
 38 unchanged at the San Joaquin River at Antioch and Contra Costa Canal at Pumping Plant #1
 39 locations, and, depending on modeling approach (see Section 8.3.1.3, *Plan Area*), would increase at
 40 the Sacramento River at Emmaton (i.e., $\leq 18\%$), Sacramento River at Mallard Island (i.e., $\leq 6\%$), North
 41 Bay Aqueduct at Barker Slough (i.e., $\leq 32\%$), and SF Mokelumne at Staten Island (i.e., $\leq 21\%$).
 42 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
 43 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the

1 Bay source water as a result of increased salinity intrusion. More discussion of this the assessment
2 methods for changes in source water concentrations caused by project-related hydrodynamic
3 changes is included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride
4 increases may be greater than indicated herein and would have the greatest effect on the western
5 Delta assessment locations which are influenced to the greatest extent by the Bay source water. The
6 comparison to Existing Conditions reflects changes in chloride due to both Alternative 1A operations
7 (including north Delta intake capacity of 15,000 cfs and numerous other components of Operational
8 Scenario A) and climate change/sea level rise.

9 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
10 indicated that Alternative 1A would result in increased long-term average chloride concentrations
11 for the 16-year period modeled at nine of the Delta assessment locations (Appendix 8G, Table CI-7).
12 The increases in long-term average chloride concentrations would be largest compared to the No
13 Action Alternative condition, ranging from 2% at the San Joaquin River at Buckley Cove to 36% at
14 the North Bay Aqueduct at Barker Slough. The comparison to the No Action Alternative reflects
15 chloride changes due only to operations.

16 The following discussion outlines the modeled chloride changes relative to Existing Conditions and
17 the No Action Alternative regarding the applicable objectives and beneficial uses of Delta waters.

18 *Municipal and Industrial Beneficial Uses—Relative to Existing Conditions*

19 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
20 (see Section 8.3.1.3, *Plan Area*) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for
21 municipal and industrial beneficial uses on a basis of the percent of years the chloride objective is
22 exceeded for the modeled 16-year period. The objective is exceeded if chloride concentrations
23 exceed 150 mg/L for a specified number of days in a given water year at both the Antioch and
24 Contra Costa Pumping Plant #1 locations. For Alternative 1A, the modeled frequency of objective
25 exceedance would increase from 7% of modeled years under Existing Conditions, to 13% of
26 modeled years under Alternative 1A (Appendix 8G, Table CI-64).

27 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
28 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
29 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
30 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
31 year period. For Alternative 1A, the modeled frequency of objective exceedance would decrease by
32 approximately one half, from 6% of modeled days under Existing Conditions, to 3% of modeled days
33 under Alternative 1A (Appendix 8G, *Chloride*, Table CI-63). Given the limitations inherent to
34 estimating future chloride concentrations (see Section 8.3.1.3), estimation of chloride
35 concentrations through both a mass balance approach and an EC-chloride relationship approach was
36 used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance
37 and use of assimilative capacity. When utilizing the mass balance approach to model monthly
38 average chloride concentrations for the 16-year period, the predicted frequency of exceeding the
39 250 mg/L objective would increase at the San Joaquin River at Antioch location from 66% under
40 Existing Conditions to 74%, and would increase by 2% at the Sacramento River at Mallard Island
41 location (i.e., from 85% under Existing Conditions to 87%) (Appendix 8G, Table CI-9). The increased
42 chloride concentrations at the Antioch and Mallard Slough locations would occur during the months
43 of January through June, thus reducing water quality during the period of seasonal freshwater
44 diversions (Appendix 8G, Figure CI-1). The available assimilative capacity would decrease

1 substantially at the Antioch location in the months of March and April (i.e., maximum reduction of
2 66% for the 16-year period modeled, and 100% reduction, or elimination of assimilative capacity,
3 during the drought period modeled) (Appendix 8G, Table Cl-9). Similar to modeling results that
4 predicted daily exceedance frequency, the frequency of monthly average exceedances at the Contra
5 Costa Canal at Pumping Plant #1 would decrease (Appendix 8G, Table Cl-9); however, available
6 assimilative capacity would be reduced compared to the Existing Conditions up to 100% in October
7 (i.e., eliminated) (Appendix 8G, Table Cl-11). Additional long-term degradation at the Antioch and
8 Contra Costa Canal at Pumping Plant #1 locations would occur when chloride concentrations would
9 be near, or exceed, the objectives, thus increasing the risk of exceeding objectives.

10 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
11 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
12 capacity would be similar to those discussed when utilizing the mass balance modeling approach
13 (Appendix 8G, *Chloride*, Table Cl-10 and Table Cl-12). However, the predicted magnitude change at
14 western Delta locations are substantially different when the predictions from both modeling
15 approaches are compared. For example, both modeling approaches indicated that the frequency of
16 exceeding the 250 mg/L objective at Contra Costa Canal at Pumping Plant #1 on a monthly average
17 basis would decrease relative to Existing Conditions, but their predictions of the magnitude use of
18 assimilative capacity varied substantially. Modeling using the mass balance approach predicted that
19 100% of assimilative capacity would be utilized in October, but modeling using the chloride-EC
20 relationship approach predicted that only 20% of assimilative capacity would be utilized. As
21 discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the approach that yielded the
22 more conservative predictions was used as the basis for determining adverse impacts.

23 Based on the additional predicted seasonal and annual exceedances of one or both Bay Delta WQCP
24 objectives for chloride, and the associated long-term water quality degradation and use of
25 assimilative capacity, the potential exists for adverse effects on the municipal and industrial
26 beneficial uses in the western Delta, particularly at the Contra Costa Pumping Plant #1 and Antioch
27 locations.

28 *303(d) Listed Water Bodies—Relative to Existing Conditions*

29 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
30 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
31 nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would generally be similar
32 or lower compared to Existing Conditions, and thus, would not be further degraded on a long-term
33 basis (Appendix 8G, Figure Cl-2).

34 With respect to Suisun Marsh, the long-term average chloride concentration at the Sacramento River
35 at Mallard Island for the 16-year period modeled would increase by 91 mg/L (4%) compared to
36 Existing Conditions (Appendix 8G, Table Cl-7) and chloride concentrations would increase in some
37 months during October through May at Mallard Island (Appendix 8G, Figure Cl-1) and in the
38 Sacramento River at Collinsville (Appendix 8G, Figure Cl-3). Monthly average chloride
39 concentrations at the Montezuma Slough at Beldon's Landing would increase substantially
40 compared to Existing Conditions in October through May, with over a doubling of concentrations in
41 December through February (Appendix 8G, Figure Cl-4). Although modeling of Alternative 1A
42 assumed no operation of the Montezuma Slough Salinity Control Gates, the project description
43 assumes continued operation of the Salinity Control Gates, consistent with assumptions included in
44 the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative 4 with the

1 gates operational consistent with the No Action Alternative resulted in substantially lower EC levels
2 than indicated in the original Alternative 4 modeling results for Suisun Marsh, but EC levels were
3 still somewhat higher than EC levels under Existing Conditions for several locations and months.
4 Although chloride was not specifically modeled in this sensitivity analysis, it is expected that
5 chloride concentrations would be nearly proportional to EC levels in Suisun Marsh. Another
6 modeling run with the gates operational and restoration areas removed resulted in EC levels nearly
7 equivalent to Existing Conditions, indicating that design and siting of restoration areas has notable
8 bearing on EC levels at different locations within Suisun Marsh (see Appendix 8H, *Electrical*
9 *Conductivity*, Attachment 1, for more information on these sensitivity analyses). These analyses also
10 indicate that increases in salinity are related primarily to the hydrodynamic effects of CM4, not
11 operational components of CM1. Based on the sensitivity analyses, optimizing the design and siting
12 of restoration areas may limit the magnitude of long-term chloride increases in the Marsh. However,
13 the chloride concentration increases at certain locations could be substantial, depending on siting
14 and design of restoration areas. Thus, these increased chloride levels in Suisun Marsh are
15 considered to contribute to additional, measureable long-term degradation that potentially would
16 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

17 *Municipal Beneficial Uses—Relative to No Action Alternative*

18 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
19 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3, *Plan Area*) were
20 used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial
21 uses. For Alternative 1A, the modeled frequency of objective exceedance would increase from 0%
22 under the No Action Alternative to 13% of years under Alternative 1A (Appendix 8G, Table Cl-64).

23 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
24 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
25 for chloride at Contra Costa Pumping Plant #1, where, daily average objectives apply. For
26 Alternative 1A, the modeled frequency of objective exceedance would decrease from 5% of modeled
27 days under the No Action Alternative to 3% of modeled days under Alternative 1A (Appendix 8G,
28 Table Cl-63).

29 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
30 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
31 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
32 model monthly average chloride concentrations for the 16-year period, the exceedance frequency of
33 the 250 mg/L objective is predicted relative to the No Action Alternative would increase slightly by
34 1% at the Antioch location (i.e., from 73% to 74%), by 7% at the Contra Costa Canal at Pumping
35 Plant #1 (i.e., from 14% to 21%), and by 1% at Mallard Island (i.e., from 86% to 87%) (Appendix 8G,
36 *Chloride*, Table Cl-9). The available assimilative capacity for the 16-year period modeled would be
37 reduced at the Antioch location during the months of February and March by approximately 28%
38 and 44%, respectively, compared to the No Action Alternative (Appendix 8G, Table Cl-11). The
39 available assimilative capacity would be reduced at the Contra Costa Canal at Pumping Plant #1 in
40 September through April compared to the No Action Alternative (i.e., reduction ranging from 18% in
41 January up to 100%, or eliminated, in October), reflecting substantial degradation during the
42 months October through December when average concentrations would be near, or exceed, the
43 objective.

1 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
2 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
3 capacity would be similar to those discussed when utilizing the mass balance modeling approach
4 (Appendix 8G, Table CI-10 and Table CI-12). But like the assessment relative to Existing Conditions,
5 the predicted magnitude change at western Delta locations are substantially different. For example,
6 both modeling approaches indicated that the frequency of exceeding the 250 mg/L objective at
7 Contra Costa Pumping Plant #1 on a monthly average basis would increase slightly or remain
8 unchanged relative to the No Action Alternative. Modeling using the mass balance approach
9 predicted that 100% of assimilative capacity would be utilized in October, but modeling using the
10 chloride-EC relationship approach predicted that only 35% would be utilized under the No Action
11 Alternative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the approach
12 that yielded the more conservative predictions was used as the basis for determining adverse
13 impacts.

14 Based on the additional predicted seasonal and annual exceedances of one of both Bay Delta WQCP
15 objectives for chloride, and the associated long-term water quality degradation, the potential exists
16 for adverse effects on the municipal and industrial beneficial uses in the western Delta, particularly
17 at the Antioch intake, through reduced opportunity for diversion of water with acceptable chloride
18 levels.

19 *303(d) Listed Water Bodies—Relative to No Action Alternative*

20 With respect to the 303(d) listing for chloride for Tom Paine Slough, relative to the No Action
21 Alternative, monthly average chloride concentrations at Old River at Tracy Road for the 16-year
22 period modeled, which represents the nearest DSM2-modeled location to Tom Paine Slough in the
23 south Delta, would not be further degraded under Alternative 1A (Appendix 8G, Figure CI-2).

24 Modeling results indicate that concentrations at source water channel locations for the Suisun
25 Marsh would increase in some months during October through May compared to the No Action
26 Alternative (Appendix 8G, Figures CI-1, CI-3, and CI-4). Sensitivity analyses suggested that operation
27 of the Salinity Control Gates and restoration area siting and design considerations could reduce
28 these increases. However, the chloride concentration increases at certain locations could be
29 substantial, depending on siting and design of restoration areas. Thus, these increased chloride
30 levels in Suisun Marsh are considered to contribute to additional, measureable long-term
31 degradation in Suisun Marsh that potentially would adversely affect the necessary actions to reduce
32 chloride loading for any TMDL that is developed.

33 ***SWP/CVP Export Service Areas***

34 Under Alternative 1A, long-term average chloride concentrations based on the mass balance
35 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
36 would decrease by as much as 32% relative to Existing Conditions and 20% compared to No Action
37 Alternative (Appendix 8G, *Chloride*, Table CI-7). The modeled frequency of exceedances of applicable
38 water quality objectives/criteria would decrease relative to Existing Conditions and No Action
39 Alternative, for both the 16-year period and the drought period modeled (Appendix 8G, *Chloride*,
40 Table CI-9). Consequently, water exported to the SWP/CVP service area would generally be of
41 similar or better quality with regard to chloride relative to Existing Conditions and the No Action
42 Alternative conditions.

1 Results of the modeling approach which used relationships between EC and chloride (see Section
2 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment of chloride using
3 these data results in the same conclusions as are presented above for the mass-balance approach
4 (Appendix 8G, Table CI-8 and Table CI-10).

5 Commensurate with the decrease in chloride concentrations exported to the San Joaquin Valley for
6 agricultural irrigation, an improvement in lower San Joaquin River chloride would also be
7 anticipated to occur because chloride loading from agricultural drainage would be reduced. While
8 difficult to predict, the relative decrease in overall loading of chloride to the SWP/CVP Export
9 Service Areas would likely alleviate or lessen any expected increase in chloride at Vernalis related to
10 decreased annual average San Joaquin River flows (see discussion of Upstream of the Delta).

11 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
12 contribute a substantial change in existing sources of chloride in the affected environment.
13 Maintenance activities would not be expected to cause any substantial change in chloride such that
14 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
15 affected.

16 **NEPA Effects:** In summary, relative to the No Action Alternative, Alternative 1A would result in
17 increased water quality degradation and frequency of exceedance of the 150 mg/L objective at
18 Contra Costa Pumping Plant #1 and Antioch, the 250 mg/L municipal and industrial objective at
19 interior and western Delta locations on a monthly average chloride basis, and could contribute
20 measureable water quality degradation relative to the 303(d) impairment in Suisun Marsh. The
21 predicted chloride increases constitute an adverse effect on water quality (see Mitigation Measure
22 WQ-7 below; implementation of this measure along with a separate, other commitment relating to
23 the potential increased chloride treatment costs would reduce these effects). Additionally, the
24 predicted changes relative to the No Action Alternative indicate that implementation of CM1 and
25 CM4 under Alternative 1A would contribute substantially to the adverse water quality effects (i.e.,
26 impacts are not wholly attributable to the effects of climate change/sea level rise).

27 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
29 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
30 constituent. For additional details on the effects assessment findings that support this CEQA impact
31 determination, see the effects assessment discussion that immediately precedes this conclusion.

32 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
33 thus river flow rate and reservoir storage reductions that would occur under the Alternative 1A,
34 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
35 chloride levels. Additionally, relative to Existing Conditions, the Alternative 1A would not result in
36 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
37 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
38 watershed.

39 Relative to Existing Conditions, Alternative 1A would result in substantially increased chloride
40 concentrations in the Delta such that frequency of exceedances of the 150 mg/L Bay-Delta WQCP
41 objective would approximately double. Moreover, the frequency of exceedance of the 250 mg/L Bay-
42 Delta WQCP objective would increase at Antioch (by 8%) and at Mallard Slough (by 2%) which
43 could result in significant impacts on the municipal and industrial water supply beneficial use at
44 these locations (see Mitigation Measure WQ-7 below; implementation of this measure along with a

1 separate, other commitment relating to the potential increased chloride treatment costs would
2 reduce these effects). Additionally, further long-term degradation would occur at Antioch, Mallard
3 Slough, and Contra Costa Canal at Pumping Plant #1 locations when chloride concentrations would
4 be near, or exceed, the objectives, thus increasing the risk of exceeding objectives. Relative to the
5 Existing Conditions, the modeled increased chloride concentrations and degradation in the western
6 Delta could further contribute, at measurable levels to the existing 303(d) listed impairment due to
7 chloride in Suisun Marsh for the protection of fish and wildlife. However, based on sensitivity
8 analyses conducted to date (see Appendix 8H, *Electrical Conductivity*, Attachment 1), it is expected
9 that implementation of Mitigation Measure WQ-7d would reduce impacts on chloride in Suisun
10 Marsh to a less-than-significant level.

11 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
12 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
13 River.

14 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
15 1A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
16 Alternative 1A maintenance would not result in any substantial changes in chloride concentration
17 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
18 this impact would be significant due to increased chloride concentrations and degradation at
19 western Delta locations and its impacts on municipal and industrial water supply and fish and
20 wildlife beneficial uses.

21 Implementation of Mitigation Measure WQ-7 along with a separate, other commitment relating to
22 the potential increased costs associated with chloride-related changes would reduce these effects.
23 Although it is not known whether implementation of WQ-7 will be able to feasibly reduce water
24 quality degradation in the western Delta, implementation of Mitigation Measure WQ-7 is
25 recommended to attempt to reduce the effect that increased chloride concentrations may have on
26 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
27 feasible measures for reducing these water quality effects is uncertain, this impact is considered to
28 remain significant and unavoidable. As mentioned above, it is expected that implementation of
29 Mitigation Measure WQ-7d would reduce impacts on chloride in Suisun Marsh to a less-than-
30 significant level.

31 In addition to and to supplement Mitigation Measure WQ-7, the project proponents have
32 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*, a
33 separate, other commitment to address the potential increased water treatment costs that could
34 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
35 operations. Potential options for making use of this financial commitment include funding or
36 providing other assistance towards acquiring alternative water supplies or towards modifying
37 existing operations when chloride concentrations at a particular location reduce opportunities to
38 operate existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental*
39 *Commitments*, for the full list of potential actions that could be taken pursuant to this commitment in
40 order to reduce the water quality treatment costs associated with water quality effects relating to
41 chloride, electrical conductivity, and bromide.

1 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
2 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

3 It is currently unknown whether the effects of increased chloride levels, and potential adverse
4 effects on municipal and industrial water supply and fish and wildlife beneficial uses associated
5 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), can be
6 mitigated through modifications to initial operations and/or site-specific design of tidal
7 restoration areas under CM4. Therefore, the proposed mitigation measures require a series of
8 actions to identify and evaluate potentially feasible actions, to achieve reduced chloride levels in
9 order to reduce or avoid impacts to beneficial uses.

10 Regarding exceedance of Bay Delta WQCP water quality objectives for chloride, staff from DWR
11 and Reclamation shall continue to monitor Delta water quality conditions and adjust operations
12 of the SWP and CVP in real time as necessary to meet water quality objectives. These decisions
13 take into account real-time conditions and are able to account for many factors that the best
14 available models cannot simulate. DWR and Reclamation have a good history of compliance with
15 water quality objectives (see Sections 8.1.3.4 and 8.1.3.7 for more detail). Considering these
16 real-time actions, the good history of compliance with objectives, and the uncertainty inherent
17 in the modeling approach (as discussed in Sections 8.3.1.1, *Models Used and Their Linkages*, and
18 8.3.1.3, *Plan Area*), it is likely that objective exceedance, should any be predicted to occur, could
19 be avoided through real-time operation of the SWP and CVP.

20 Nevertheless, water quality degradation could occur that may not be addressed through real-
21 time operations. The development and implementation of any mitigation actions shall be
22 focused on those incremental effects attributable to implementation of Alternative 1A
23 operations only. Development of mitigation actions for the incremental chloride effects
24 attributable to climate change/sea level rise are not required because these changed conditions
25 would occur with or without implementation of Alternative 1A.

26 **Mitigation Measure WQ-7a: Conduct Additional Evaluation of Operational Ability to**
27 **Reduce or Eliminate Water Quality Degradation in Western Delta Incorporating Site-**
28 **Specific Restoration Areas and Updated Climate Change/Sea Level Rise Projections, if**
29 **Available**

30 The project proponents will conduct additional evaluations and develop additional modeling (as
31 necessary) to define the extent to which modified operations of the SWP and CVP could reduce
32 or eliminate water quality degradation relative to the 250 mg/L Bay-Delta WQCP objective for
33 chloride currently modeled to occur under Alternative 1A. The additional evaluations will be
34 conducted to consider specifically the changes in Delta hydrodynamic conditions associated
35 with tidal habitat restoration under CM4 once the specific restoration locations and timing of
36 their construction are identified and designed. The evaluations will also consider up-to-date
37 estimates of climate change and sea level rise, if and when such information is available. These
38 evaluations will be conducted concurrently with Mitigation Measure WQ-7b. Together, findings
39 from WQ-7a and WQ-7b will indicate whether sufficient flexibility to prevent or offset chloride
40 increases is feasible under Alternative 1A.

1 **Mitigation Measure WQ-7b: Site and Design Restoration Sites to Reduce or Eliminate**
 2 **Water Quality Degradation in the Western Delta**

3 The project proponents shall consider effects of site-specific restoration areas proposed under
 4 CM4 on chloride concentrations in the western Delta. Design and siting of restoration areas shall
 5 attempt to reduce water quality degradation with respect to the 250 mg/L chloride objective in
 6 the western Delta to the extent possible without compromising proposed benefits of the
 7 restoration areas. These evaluations will be conducted concurrently with Mitigation Measure
 8 WQ-7a. Together, findings from WQ-7a and WQ-7b will indicate whether sufficient flexibility to
 9 prevent or offset chloride increases is feasible under Alternative 1A.

10 **Mitigation Measure WQ-7c: Consult with Delta Water Purveyors to Identify Means to**
 11 **Avoid, Minimize, or Offset for Reduced Seasonal Availability of Water That Meets**
 12 **Applicable Water Quality Objectives**

13 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
 14 chloride concentrations as shown in modeling estimates to occur to municipal and industrial
 15 water purveyors at the Antioch, Mallard Slough, and Contra Costa Canal at Pumping Plant #1
 16 locations, the project proponents will consult with the purveyors to identify any feasible
 17 operational means to either avoid, minimize, or offset for reduced seasonal availability of water
 18 that either meets applicable water quality objectives or that results in levels of degradation that
 19 do not substantially increase the risk of adversely affecting the municipal and industrial
 20 beneficial use. Any such action will be developed following, and in conjunction with, the
 21 completion of the evaluation and development of any potentially feasible actions described in
 22 Mitigation Measure WQ-7a and WQ-7b.

23 **Mitigation Measure WQ-7d: Site and Design Restoration Sites and consult with**
 24 **CDFW/USFWS, and Suisun Marsh Stakeholders to Identify Potential Actions to Avoid or**
 25 **Reduce Chloride Concentration Increases in the Marsh**

26 The project proponents shall consider effects of site-specific restoration areas proposed under
 27 CM4 on chloride concentrations in Suisun Marsh. Design and siting of restoration areas shall
 28 attempt to reduce potential effects to the extent possible without compromising proposed
 29 benefits of the restoration areas. The project proponents will also consult with CDFW/USFWS,
 30 and Suisun Marsh stakeholders, to identify potential actions to avoid or minimize the chloride
 31 increases in the marsh, with the goal of maintaining chloride at levels that would not further
 32 impair fish and wildlife beneficial uses in Suisun Marsh. Potential actions may include
 33 modifications of the existing Suisun Marsh Salinity Control Gates for effective salinity control
 34 and evaluation of the efficacy of additional physical salinity control facilities or operations for
 35 the marsh to reduce the effects of increased chloride levels. These actions are identical to the
 36 actions discussed in Mitigation Measure WQ-11b regarding levels of electrical conductivity in
 37 Suisun Marsh.

38 **Mitigation Measure WQ-7e: Implement Terms of the Contra Costa Water District**
 39 **Settlement Agreement**

40 DWR and Contra Costa Water District (CCWD) entered into a settlement agreement
 41 (Agreement) for reducing potential impacts to water supply in the Delta related to construction
 42 and operation of the BDCP/California WaterFix. This mitigation measure includes conveyance of
 43 water to CCWD that meets specified water quality requirements, in quantities and on a schedule

1 defined in the Agreement. The Agreement ensures that the quality of the water CCWD delivers
 2 to its customers is not impacted as a result of the BDCP/California WaterFix. The Agreement
 3 does not increase the total amount of water that CCWD would otherwise be entitled to divert.

4 DWR would convey mitigation water to CCWD in one of two ways: 1) the primary method of
 5 conveying the water would be through the existing Freeport Regional Water Authority Intake
 6 (Freeport Intake) and the existing interconnection between EBMUD's Mokelumne Aqueduct and
 7 CCWD's Los Vaqueros Pipeline; and 2) the secondary method of conveying the water would be
 8 through the BDCP/California WaterFix's northern intakes and new Interconnection Facilities
 9 between the water conveyance facilities and existing CCWD facilities. Two different options for
 10 the new Interconnection Facilities are being considered: one on Victoria Island between the
 11 water conveyance facilities and the existing CCWD Middle River pipeline; and one at Clifton
 12 Court Forebay between the Clifton Court Forebay and the CCWD Los Vaqueros pipeline. No new
 13 facilities are required for the EBMUD/Freeport Intake conveyance method. DWR would be
 14 responsible for design and construction of the Victoria Island or Clifton Court Forebay facilities.

15 The Agreement requires an initial conveyance to CCWD of 30 TAF of water. For each year after
 16 the initial conveyance, a specified amount of water based on the prior year's operations would
 17 be conveyed in arrears. Under the Agreement, CCWD would take the same quantity of water that
 18 it would take absent the agreement, but the location and timing of diversions would change.
 19 Annual average diversions of mitigation water would be on the order of 30 TAF, and the rate of
 20 diversion of the mitigation water would be 150 cfs, with a maximum rate of diversion of 250 cfs
 21 upon mutual agreement between DWR and CCWD.

22 Additional description of the Agreement actions and analysis of the potential effects of this
 23 mitigation measures are provided in Appendix 31B. Terms of the Agreement are presented in
 24 Attachment 1 to Appendix 31B.

25 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2- 26 CM21**

27 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21), of which
 28 most do not involve land disturbance, present no new direct sources of chloride to the affected
 29 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/ CVP Export
 30 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 31 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
 32 hydrodynamic conditions is addressed above in the discussion of Impact WQ-8. The potential
 33 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
 34 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-8. CM3 and CM11
 35 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
 36 themselves, affect chloride levels in the Delta. CM12–CM21 involve actions that target reduction in
 37 other stressors at the species level involving actions such as methylmercury reduction management
 38 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
 39 treatment (CM19). None of CM12–CM21 would contribute to substantially increasing chloride levels
 40 in the Delta. Consequently, as they pertain to chloride, implementation of CM2–CM21 would not be
 41 expected to adversely affect any of the beneficial uses of the affected environment. Moreover, some
 42 habitat restoration conservation measures (CM4–CM10) would occur on lands within the Delta
 43 currently used for irrigated agriculture, thus replacing agricultural land uses with restored tidal
 44 wetlands, floodplain, and related channel margin and off-channel habitats. The potential reduction

1 in irrigated lands within the Delta may result in reduced discharges of agricultural field drainage
2 with elevated chloride concentrations, which would be considered an improvement compared to
3 Existing Conditions.

4 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 1A would not present new or
5 substantially changed sources of chloride to the affected environment upstream of the Delta, within
6 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
7 with habitat restoration conservation measures may result in some reduction in discharge of
8 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
9 quality conditions. Based on these findings, this impact is considered to be less than significant. No
10 mitigation is required.

11 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 12 **Maintenance (CM1)**

13 ***Upstream of the Delta***

14 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
15 substantial decreases in DO levels in the rivers and reservoirs upstream of the Delta relative to
16 Existing Conditions and the No Action Alternative. Any minor decreases in DO levels that could
17 occur under Alternative 1A would not be of sufficient frequency, magnitude, and geographic extent
18 to result in adverse effects on beneficial uses within the Upstream of the Delta Region, or
19 substantially degrade the quality of these water bodies, with regard to DO.

20 ***Delta***

21 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
22 substantial decreases in DO levels in the Delta relative to Existing Conditions and the No Action
23 Alternative. Any minor decreases in DO levels that could occur under Alternative 1A would not be of
24 sufficient frequency, magnitude, and geographic extent to result in adverse effects on beneficial uses
25 in the Plan Area, or substantially degrade the quality of these water bodies, with regard to DO.

26 ***SWP/CVP Export Service Areas***

27 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
28 Conditions as it would consist of water directly withdrawn from the Delta at the current export
29 pumps and water diverted from the Sacramento River at Hood. DO levels in the vicinity of the south
30 Delta export pumps may be reduced occasionally, but would not be anticipated to be substantially
31 lower at this location on a long-term basis, relative to Existing Conditions. The DO levels in water
32 entering the canals from the new facilities that diverted the water from the Sacramento River at
33 Hood would be expected to be equal to or higher than DO levels at the south Delta export pumps,
34 and would be expected to have similar or lower levels of oxygen demanding substances. Hence, the
35 typical DO level of water entering the SWP/CVP Export Service Areas waters would not be expected
36 to be substantially lower than that under Existing Conditions. DO dynamics within the exposed
37 canals and the downstream reservoirs would remain similar to that under Existing Conditions.
38 Consequently, effects on DO levels in the SWP/CVP Export Service Areas would not be adverse
39 under Alternative 1A relative to Existing Conditions.

1 **NEPA Effects:** For the same reasons given above, substantial adverse effects on DO levels in the
2 SWP/CVP Export Service Areas are not expected to occur under Alternative 1A relative to the No
3 Action Alternative. The effects on DO from implementing CM1 would not be adverse.

4 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 1A would be similar to those discussed
5 for the No Action Alternative, and are summarized here, then compared to the CEQA thresholds of
6 significance (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA
7 impact determination for this constituent. For additional details on the effects assessment findings
8 that support this CEQA impact determination, see the effects assessment discussion under the No
9 Action Alternative.

10 Reservoir storage reductions that would occur under Alternative 1A, relative to Existing Conditions,
11 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
12 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
13 Similarly, river flow rate reductions that would occur would not be expected to result in a
14 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
15 flows would remain within the ranges historically seen under Existing Conditions and the affected
16 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
17 water temperature would not be expected to cause DO levels to be outside of the range seen
18 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
19 change sufficiently to affect DO levels.

20 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
21 Delta source water percentages under this alternative or substantial degradation of these water
22 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
23 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
24 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
25 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
26 the reaeration of Delta waters would not be expected to change substantially.

27 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
28 Export Service Areas waters under Alternative 1A, relative to Existing Conditions, because the
29 biochemical oxygen demand of the exported water would not be expected to substantially differ
30 from that under Existing Conditions (due to ever increasing water quality regulations), canal
31 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
32 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
33 downstream reservoirs.

34 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
35 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
36 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
37 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
38 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
39 because no substantial decreases in DO levels would be expected, greater degradation and DO-
40 related impairment of these areas would not be expected. This impact would be less than significant.
41 No mitigation is required.

1 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

2 **NEPA Effects:** CM2–CM21 would not be expected to contribute to adverse DO levels in the Delta. The
3 increased habitat provided by CM2–CM11 could contribute to an increased biochemical or sediment
4 demand, through contribution of organic carbon and the action of plants decaying. However, similar
5 habitat exists currently in the Delta and is not identified as contributing to adverse DO conditions.
6 Although additional DOC loading to the Delta may occur (see impact WQ-18), only a fraction of the
7 DOC is available to microorganisms that would consume oxygen as part of the decay and
8 mineralization process. Since decreases in dissolved organic carbon are not typically observed in
9 Delta waterways due to these processes, any increase in DOC is unlikely to contribute to adverse DO
10 levels in the Delta. CM13 proposes to use a variety of methods to control invasive aquatic plants, of
11 which herbicide spraying is one option. The area of treatment that would be funded by the
12 conservation measure would be 1,700–3,300 acres (see Section 3.6.3.2 of Chapter 3, *Description of*
13 *Alternatives*), a limited area relative to the entire area of the Delta surface waters. Further, as
14 described in Section 3.6.3.2 of Chapter 3, avoidance and minimization measures would be adopted
15 and would likely be similar to those conditions identified in the existing California Department of
16 Boating and Waterways (CDBW) program (including the associated biological opinion and EIR),
17 which restrict where and when herbicide treatment may occur, establish allowable chemical
18 concentrations in treated areas and adjacent water, and require extensive water quality monitoring.
19 Thus, based on the size of the area to be treated and the measures to be used, this conservation is
20 not considered to have an adverse effect on DO in the Delta that would adversely affect beneficial
21 uses. CM14, an oxygen aeration facility in the Stockton Deep Water Ship Channel to meet TMDL
22 objectives established by the Central Valley Water Board, would maintain DO levels above those that
23 impair fish species when covered species are present. CM19, which would fund projects to
24 contribute to reducing pollutant discharges in stormwater, would be expected to reduce biochemical
25 oxygen demand load and, thus, would not adversely affect DO levels. The remaining conservation
26 measures would not be expected to affect DO levels because they are actions that do not affect the
27 presence of oxygen-demanding substances. The effects on DO from implementing CM2–CM21 would
28 not be adverse.

29 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
30 or in the SWP/CVP Export Service Areas following implementation of CM2–CM21 under Alternative
31 1A would not be substantially different from existing DO conditions. Therefore, this alternative is
32 not expected to cause additional exceedance of applicable water quality objectives by frequency,
33 magnitude, and geographic extent that would result in significant impacts on any beneficial uses
34 within affected water bodies. Because no substantial changes in DO levels would be expected, long-
35 term water quality degradation would not be expected, and, thus, beneficial uses would not be
36 adversely affected. Various Delta waterways are 303(d)-listed for low DO, but because no
37 substantial decreases in DO levels would be expected, greater degradation and impairment of these
38 areas would not be expected. Implementation of CM14 would have a net beneficial effect on DO
39 conditions in the Stockton Deep Water Ship Channel. This impact would be less than significant. No
40 mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 5 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 6 the San Joaquin River upstream of the Delta under Alternative 1A are not expected to be outside the
 7 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 8 minor changes in EC levels that may occur under Alternative 1A in water bodies upstream of the
 9 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 10 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 16 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 17 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 18 more information.

19 Relative to Existing Conditions, modeling indicates that Alternative 1A would result in an increase in
 20 the number of days when Bay-Delta WQCP compliance locations would exceed EC objectives or be
 21 out of compliance with the EC objectives at the Sacramento River at Emmaton and San Joaquin River
 22 at Jersey Point (fish and wildlife objective) in the western Delta, the San Joaquin River at San
 23 Andreas Landing in the interior Delta, and Brandt Bridge in the southern Delta (Appendix 8H,
 24 *Electrical Conductivity*, Table EC-1).

25 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
 26 (1976–1991) would increase from 6% under Existing Conditions to 31% under Alternative 1A.
 27 Further, the percentage of days out of compliance at Emmaton would increase from 11% under
 28 Existing Conditions to 45% under Alternative 1A.

29 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
 30 from 1% under Existing Conditions to 3% under Alternative 1A. Further, the percentage of days out
 31 of compliance with the EC objective would increase from 1% under Existing Conditions to 6% under
 32 Alternative 1A. Sensitivity analyses were performed for Alternative 4 Scenario H3, and indicated
 33 that many similar exceedances were modeling artifacts, and the small number of remaining
 34 exceedances were small in magnitude, lasted only a few days, and could be addressed with real time
 35 operations of the SWP and CVP (see Section 8.3.1.1, *Models Used and Their Linkages*, for a
 36 description of real time operations of the SWP and CVP). Due to similarities in the nature of the
 37 exceedances between alternatives, the findings from these analyses can be extended to this
 38 alternative as well.

39 At Jersey Point, relative to the fish and wildlife objective, the percentage of days of EC objective
 40 exceedance and days out of compliance would increase from 0% under Existing Conditions to 3%
 41 under Alternative 1A, which represents a very small increase for this objective. Further discussion of
 42 EC increases relative to this objective can be found in Appendix 8H Attachment 2.

1 At Brandt Bridge, the increase in days of EC objective exceedance and days out of compliance would
 2 be <1%. Average EC levels at the western and southern Delta compliance locations, except at
 3 Emmaton in the western Delta, would decrease from 1–27% for the entire period modeled and 2–
 4 28% during the drought period modeled (1987–1991) (Appendix 8H, Table EC-12). At Emmaton,
 5 average EC would increase 16% for both the entire period modeled and the drought period
 6 modeled. Also, at the two interior Delta compliance locations, there would be increases in average
 7 EC: the S. Fork Mokelumne River at Terminous average EC would increase 4% for the entire period
 8 modeled and 3% during the drought period modeled; and San Joaquin River at San Andreas Landing
 9 average EC would increase 12% for the entire and drought periods modeled. On average, EC would
 10 increase at Emmaton during all months except October and November. Average EC would increase
 11 at San Andreas Landing during all months except November. Average EC in the S. Fork Mokelumne
 12 River at Terminous would increase during all months. Average EC at Jersey Point during the months
 13 of April–May, when the fish and wildlife objective applies in all but critical water year types, would
 14 increase 15% for the entire period modeled (Appendix 8H, Table EC-12; further discussion of EC
 15 increases relative to this objective can be found in Appendix 8H Attachment 2). Of the Clean Water
 16 Act Section 303(d) listed sections of the Delta—western, northwestern, and southern—the
 17 Sacramento River at Emmaton would have a modest increase in exceedance of the Bay-Delta WQCP
 18 EC objectives (25%) and the San Joaquin River at Brandt Bridge in the southern Delta would have a
 19 slight increase (<1%) in the exceedance of the Bay-Delta WQCP EC objectives (Appendix 8H, Table
 20 EC-1). Further, long-term average EC at Emmaton would increase by 16%, whereas the long-term
 21 average EC at Brandt Bridge would decrease by 2%, relative to Existing Conditions, for the entire
 22 period modeled (Appendix 8H, Table EC-12). Thus, Alternative 1A is not expected to contribute to
 23 additional impairment and adversely affect beneficial uses for Section 303(d) listed southern Delta
 24 waterways, relative to Existing Conditions. However, the increase in incidence of exceedance of EC
 25 objectives and increases in long-term and drought period average EC at Emmaton in the western
 26 Delta, relative to Existing Conditions, has the potential to contribute to additional impairment and
 27 potentially adversely affect beneficial uses. The comparison to Existing Conditions reflects changes
 28 in EC due to both Alternative 1A operations (including north Delta intake capacity of 15,000 cfs and
 29 numerous other components of Operational Scenario A) and climate change/sea level rise.

30 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
 31 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
 32 Jersey Point, San Andreas Landing, Brandt Bridge, and Prisoners Point; and Old River near Middle
 33 River at Tracy Bridge (Appendix 8H, *Electrical Conductivity*, Table EC-1). The increase in percentage
 34 of days exceeding the EC objective would be 2% or less and the increase in percentage of days out of
 35 compliance would be 5% or less, with the exception of Emmaton, which would have a 17% increase
 36 in percentage of days exceeding the EC objective and 20% increase in percentage of days out of
 37 compliance. Regarding exceedances at Old River at Middle River and at Tracy Bridge, as noted in
 38 Section 8.1.3.7, SWP and CVP operations have relatively little influence on salinity levels at these
 39 locations, and the elevated salinity in south Delta channels is affected substantially by local salt
 40 contributions discharged into the San Joaquin River downstream of Vernalis. Thus, the modeling has
 41 limited ability to estimate salinity accurately in this region. Average EC would increase at some
 42 compliance locations for the entire period modeled: Sacramento River at Emmaton (15%), San
 43 Joaquin River at Jersey Point (3%), S. Fork Mokelumne River at Terminous (5%), San Joaquin River
 44 at San Andreas Landing (18%), and San Joaquin River at Prisoners Point (9%) (Appendix 8H, Table
 45 EC-12). For the drought period modeled, the locations with an average EC increase would be:
 46 Sacramento River at Emmaton (5%), S. Fork Mokelumne River at Terminous (4%), San Joaquin
 47 River at San Andreas Landing (13%), San Joaquin River at Brandt Bridge (1%), Old River at Tracy

1 Bridge (1%), and San Joaquin River at Prisoners Point (4%) (Appendix 8H, Table EC-12). The
2 western and southern Delta are CWA Section 303(d) listed for elevated EC and the increased
3 incidence of exceedance of EC objectives and EC degradation that could occur in the western Delta
4 could make beneficial use impairment measurably worse. Since there would be very little change in
5 EC levels in the southern Delta and there is not expected to be an increase in frequency of
6 exceedances of objectives, this alternative is not expected to make beneficial use impairment
7 measurably worse in the southern Delta. The comparison to the No Action Alternative reflects
8 changes in EC due only to Alternative 1A operations (including north Delta intake capacity of 15,000
9 cfs and numerous other components of Operational Scenario A).

10 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
11 fish and wildlife apply. Average EC for the entire period modeled would increase under Alternative
12 1A, relative to Existing Conditions, during the months of February through May by 0.1–0.8 mS/cm in
13 the Sacramento River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would
14 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
15 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon’s Landing, with
16 long-term average EC levels increasing by 1.8–6.1 mS/cm, depending on the month, which would be
17 a doubling or tripling of long-term average EC relative to Existing Conditions (Appendix 8H, Table
18 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
19 during all months of 1.9–4.0 mS/cm (Appendix 8H, Tables EC-24 and EC-25). Modeling of this
20 alternative assumed no operation of the Montezuma Slough Salinity Control Gates, but the project
21 description assumes continued operation of the Salinity Control Gates, consistent with assumptions
22 included in the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative
23 4 Scenario H3 with the gates operational consistent with the No Action Alternative resulted in
24 substantially lower EC levels than indicated in the original Alternative 4 modeling results, but EC
25 levels were still somewhat higher than EC levels under Existing Conditions and the No Action
26 Alternative for several locations and months. Another modeling run with the gates operational and
27 restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions and the No
28 Action Alternative, indicating that design and siting of restoration areas has notable bearing on EC
29 levels at different locations within Suisun Marsh (see Appendix 8H Attachment 1 for more
30 information on these sensitivity analyses). These analyses also indicate that increases are related
31 primarily to the hydrodynamic effects of CM4, not operational components of CM1. Based on the
32 sensitivity analyses, optimizing the design and siting of restoration areas may limit the magnitude of
33 long-term EC increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the
34 EC increases between alternatives, the findings from these analyses can be extended to this
35 alternative as well.

36 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
37 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
38 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
39 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
40 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
41 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
42 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
43 certain locations could be substantial, depending on siting and design of restoration areas, and it is
44 uncertain the degree to which current management plans for the Suisun Marsh would be able to
45 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
46 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.

1 Long-term average EC increases in Suisun Marsh under Alternative 1A relative to the No Action
 2 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh is Clean
 3 Water Act Section 303(d) listed as impaired due to elevated EC, and the potential increases in long-
 4 term average EC concentrations could contribute to additional impairment.

5 ***SWP/CVP Export Service Areas***

6 At the Banks and Jones pumping plants, Alternative 1A would result in no exceedances of the Bay-
 7 Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
 8 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 9 Areas using water pumped at this location under Alternative 1A.

10 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 1A
 11 would decrease 22% for the entire period modeled and 18% during the drought period modeled.
 12 Relative to the No Action Alternative, average EC levels would decrease by 16% for the entire period
 13 modeled and 13% during the drought period modeled. (Appendix 8H, Table EC-12)

14 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 1A
 15 would decrease 19% for the entire period modeled and 17% during the drought period modeled.
 16 Relative to the No Action Alternative, average EC levels would decrease by 15% for the entire period
 17 modeled and 13% during the drought period modeled. (Appendix 8H, Table EC-12)

18 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 19 pumping plants, Alternative 1A would not cause degradation of water quality with respect to EC in
 20 the SWP/CVP Export Service Areas; rather, Alternative 1A would improve long-term average EC
 21 conditions in the SWP/CVP Export Service Areas.

22 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 23 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
 24 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
 25 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
 26 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
 27 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
 28 impact discussion under the No Action Alternative).

29 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
 30 elevated EC. Alternative 1A would result in lower average EC levels relative to Existing Conditions
 31 and the No Action Alternative and, thus, would not contribute to additional beneficial use
 32 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

33 ***NEPA Effects:*** In summary, the increased frequency of exceedance of EC objectives and increased
 34 long-term and drought period average EC levels that would occur at western Delta compliance
 35 locations under Alternative 1A, relative to the No Action Alternative, would contribute to adverse
 36 effects on the agricultural beneficial uses. The increased long-term period average EC levels between
 37 Jersey Point and Prisoners Point could contribute to adverse effects on fish and wildlife beneficial
 38 uses (specifically, indirect adverse effects on striped bass spawning), though there is a high degree
 39 of uncertainty associated with this impact. The western and southern Delta are CWA Section 303(d)
 40 listed as impaired due to elevated EC, and the increase in incidence of exceedance of EC objectives
 41 and increases in long-term average and drought period average EC in the western portion of the
 42 Delta have the potential to contribute to additional beneficial use impairment. The increases in long-
 43 term average EC levels that could occur in Suisun Marsh would further degrade existing EC levels

1 and could contribute to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is
2 Section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
3 average EC levels could contribute to additional beneficial use impairment. The effects on EC in the
4 western Delta, San Joaquin River at Prisoners Point, and in Suisun Marsh constitute an adverse effect
5 on water quality. Mitigation Measure WQ-11 would be available to reduce these effects
6 (implementation of this measure along with a separate, other commitment as set forth in EIR/EIS
7 Appendix 3B, *Environmental Commitments*, relating to the potential EC-related changes would
8 reduce these effects).

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
11 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
12 constituent. For additional details on the effects assessment findings that support this CEQA impact
13 determination, see the effects assessment discussion that immediately precedes this conclusion.

14 River flow rate and reservoir storage reductions that would occur under Alternative 1A, relative to
15 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
16 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
17 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
18 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
19 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
20 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
21 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
22 Delta.

23 Relative to Existing Conditions, Alternative 1A would not result in any substantial increases in long-
24 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
25 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
26 would decrease at both plants and, thus, this alternative would not contribute to additional
27 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
28 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
29 relative to Existing Conditions.

30 In the Plan Area, Alternative 1A would result in an increase in the frequency with which Bay-Delta
31 WQCP EC objectives for agricultural beneficial use protection are exceeded in the Sacramento River
32 at Emmaton (25%; western Delta) for the entire period modeled (1976–1991). For the entire and
33 drought periods modeled, average EC levels would increase by 12% at San Andreas Landing and by
34 16% at Emmaton. In addition, there would be an increase in the average EC at Jersey Point of 15%
35 (for the entire period modeled) during the months of April–May, when the fish and wildlife objective
36 applies. Because EC is not bioaccumulative, the increases in long-term average EC levels would not
37 directly cause bioaccumulative problems in aquatic life or humans. The interior Delta is not Clean
38 Water Act Section 303(d) listed for elevated EC, however, the western Delta is. The increases in
39 long-term and drought period average EC levels and increased frequency of exceedance of EC
40 objectives that would occur in the Sacramento River at Emmaton would potentially contribute to
41 adverse effects on the agricultural beneficial uses in the western Delta. The increased long-term
42 period average EC levels between Jersey Point and Prisoners Point could contribute to adverse
43 effects on fish and wildlife beneficial uses (specifically, indirect adverse effects on striped bass
44 spawning), though there is a high degree of uncertainty associated with this impact. This impact is
45 considered to be significant.

1 Further, relative to Existing Conditions, Alternative 1A could result in substantial increases in long-
 2 term average EC during the months of October through May in Suisun Marsh. The increases in long-
 3 term average EC levels that would occur in Suisun Marsh would further degrade existing EC levels
 4 and could contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
 5 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
 6 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act Section 303(d) listed for
 7 elevated EC and the increases in long-term average EC that would occur in the marsh could make
 8 beneficial use impairment measurably worse. This impact is considered to be significant. However,
 9 based on sensitivity analyses conducted to date (see Appendix 8H Attachment 1), it is expected that
 10 implementation of Mitigation Measure WQ-11d would reduce impacts on EC in Suisun Marsh to a
 11 less-than-significant level.

12 Implementation of Mitigation Measure WQ-11 along with a separate, other commitment relating to
 13 the potential increased costs associated with EC-related changes would reduce these effects.
 14 Although it is not known whether implementation of WQ-11 will be able to feasibly reduce water
 15 quality degradation in the western Delta, implementation of Mitigation Measure WQ-11 is
 16 recommended to attempt to reduce the effect that increased EC may have on Delta beneficial uses.
 17 However, because the effectiveness of this mitigation measure to result in feasible measures for
 18 reducing these water quality effects is uncertain, this impact is considered to remain significant and
 19 unavoidable. As mentioned above, it is expected that implementation of Mitigation Measure WQ-11d
 20 would reduce impacts on EC in Suisun Marsh to a less-than-significant level.

21 In addition to and to supplement Mitigation Measure WQ-11, the project proponents have
 22 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 23 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
 24 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 25 purveyor operations. Potential options for making use of this financial commitment include funding
 26 or providing other assistance towards acquiring alternative water supplies or towards modifying
 27 existing operations when EC concentrations at a particular location reduce opportunities to operate
 28 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments*,
 29 *AMMs and CMs*, for the full list of potential actions that could be taken pursuant to this commitment
 30 in order to reduce the water quality treatment costs associated with water quality effects relating to
 31 chloride, electrical conductivity, and bromide.

32 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water** 33 **Quality Conditions**

34 In order to reduce the effects of increased EC levels, and potential adverse effects on beneficial
 35 uses associated with CM1 operations (and hydrodynamic effects of tidal restoration under CM4),
 36 the proposed mitigation requires a series of phased actions to identify and evaluate feasible
 37 actions, followed by development and implementation of the actions, if determined to be
 38 necessary. The emphasis and mitigation actions would be limited to those identified as
 39 necessary to avoid, reduce, or offset adverse EC effects at Delta compliance locations and the
 40 Suisun Marsh. The development and implementation of any mitigation actions shall be focused
 41 on those incremental effects attributable to implementation of Alternative 1A operations only.
 42 Development of mitigation actions for the incremental EC effects attributable to climate
 43 change/sea level rise are not required because these changed conditions would occur with or
 44 without implementation of Alternative 1A. The goal of specific actions would be to reduce/avoid
 45 additional exceedances of Delta EC objectives and reduce long-term average concentration

1 increases to levels that would not adversely affect beneficial uses within the Delta and Suisun
2 Marsh.

3 **Mitigation Measure WQ-11a: Conduct Additional Evaluation of Operational Ability to**
4 **Reduce or Eliminate Water Quality Degradation in Western Delta Incorporating Site-**
5 **Specific Restoration Areas and Updated Climate Change/Sea Level Rise Projections, if**
6 **Available**

7 The project proponents will conduct additional evaluations and develop additional modeling (as
8 necessary) to define the extent to which modified operations of the SWP and CVP could reduce
9 or eliminate water quality degradation in the western Delta currently modeled to occur under
10 Alternative 1A. The additional evaluations will be conducted to consider specifically the changes
11 in Delta hydrodynamic conditions associated with tidal habitat restoration under CM4 once the
12 specific restoration locations and timing of their construction are identified and designed. The
13 evaluations will also consider up-to-date estimates of climate change and sea level rise, if and
14 when such information is available. These evaluations will be conducted concurrently with
15 Mitigation Measure WQ-11b. Together, findings from WQ-11a and WQ-11b will indicate
16 whether sufficient flexibility to prevent or offset EC increases is feasible under Alternative 1A.
17 These actions are identical to the actions discussed in Mitigation Measure WQ-7a regarding
18 levels of chloride in the western Delta.

19 **Mitigation Measure WQ-11b: Site and Design Restoration Sites to Reduce or Eliminate**
20 **Water Quality Degradation in the Western Delta**

21 The project proponents shall consider effects of site-specific restoration areas proposed under
22 CM4 on EC levels in the western Delta. Design and siting of restoration areas shall attempt to
23 reduce water quality degradation in the western Delta to the extent possible without
24 compromising proposed benefits of the restoration areas. These evaluations will be conducted
25 concurrently with Mitigation Measure WQ-11a. Together, findings from WQ-11a and WQ-11b
26 will indicate whether sufficient flexibility to prevent or offset EC increases is feasible under
27 Alternative 1A. These actions are identical to the actions discussed in Mitigation Measure WQ-7b
28 regarding levels of chloride in the western Delta.

29 **Mitigation Measure WQ-11c: Design Restoration Sites to Reduce Effects on Compliance**
30 **with the Fish and Wildlife EC Objective between Prisoners Point and Jersey Point,**
31 **Evaluate Striped Bass Monitoring Data, and Consult with CDFW/USFWS/NMFS to**
32 **Determine Whether Additional Actions are Warranted**

33 The project proponents shall consider effects of site-specific restoration areas proposed under
34 CM4 on compliance with the fish and wildlife EC objective between Jersey Point and Prisoners
35 point on the San Joaquin River. Design of restoration areas shall attempt to reduce potential
36 effects to the extent possible without compromising proposed benefits of the restoration areas.
37 Additionally, following commencement of initial operations of CM1, the project proponents will
38 evaluate ongoing monitoring of striped bass populations, and, specifically spawning in the San
39 Joaquin River between Jersey Point and Prisoners Point, and will conduct such monitoring if it is
40 not already being conducted by CDFW at that time. The project proponents will consult with
41 CDFW, USFWS, and NMFS to determine whether adaptive changes to Head of Old River Barrier
42 operations and/or changes in North Delta vs. South Delta exports are warranted to avoid
43 adverse impacts of salinity on striped bass spawning in the San Joaquin River. Because these

1 actions may have adverse effects on other species, consultation is required, and the changes may
 2 not be warranted depending on conditions of striped bass populations and populations of other
 3 species at that time.

4 **Mitigation Measure WQ-11d: Site and Design Restoration Sites and consult with**
 5 **CDFW/USFWS, and Suisun Marsh Stakeholders to Identify Potential Actions to Avoid or**
 6 **Reduce EC Level Increases in the Marsh**

7 The project proponents shall consider effects of site-specific restoration areas proposed under
 8 CM4 on EC levels and compliance with the fish and wildlife EC objectives for Suisun Marsh.
 9 Design and siting of restoration areas shall attempt to reduce potential effects to the extent
 10 possible without compromising proposed benefits of the restoration areas. The project
 11 proponents will also consult with CDFW/USFWS, and Suisun Marsh stakeholders, to identify
 12 potential actions to avoid or minimize the EC increases in the marsh, with the goal of
 13 maintaining EC at levels that would not further impair fish and wildlife beneficial uses in Suisun
 14 Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity Control
 15 Gates for effective salinity control and evaluation of the efficacy of additional physical salinity
 16 control facilities or operations for the marsh to reduce the effects of increased EC levels. These
 17 actions are identical to the actions discussed in Mitigation Measure WQ-7c regarding levels of
 18 chloride in Suisun Marsh.

19 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 20 **CM21**

21 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21) present no
 22 new direct sources of EC to the affected environment, including areas upstream of the Delta, within
 23 the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC, implementation of
 24 these conservation measures would not be expected to adversely affect any of the beneficial uses of
 25 the affected environment. Moreover, some habitat restoration conservation measures would occur
 26 on lands within the Delta currently used for irrigated agriculture. Such replacement or substitution
 27 of land use activity is not expected to result in new or increased sources of EC to the Delta and, in
 28 fact, could decrease EC through elimination of high EC agricultural runoff.

29 CM4 would result in substantial tidal habitat restoration that would increase the magnitude of daily
 30 tidal water exchange at the restoration areas, and alter other hydrodynamic conditions in adjacent
 31 Delta channels. The DSM2 modeling included assumptions regarding possible locations of tidal
 32 habitat restoration areas, and how restoration would affect Delta hydrodynamic conditions, and
 33 thus the effects of this restoration measure on Delta EC were included in the assessment of CM1
 34 facilities operations and maintenance.

35 Implementation of CM2–CM21 would not be expected to adversely affect EC levels in the affected
 36 environment and thus would not adversely affect beneficial uses or substantially degrade water
 37 quality with regard to EC within the affected environment. The effects on EC from implementing
 38 CM2–CM21 is determined to not be adverse.

39 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 1A would not present new or
 40 substantially changed sources of EC to the affected environment. Some conservation measures may
 41 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 42 is not expected to substantially increase or present new sources of EC, and could actually decrease
 43 EC loads to Delta waters. Thus, implementation of CM2–CM21 would have negligible, if any, adverse

1 effects on EC levels throughout the affected environment and would not cause exceedance of
 2 applicable state or federal numeric or narrative water quality objectives/criteria that would result
 3 in adverse effects on any beneficial uses within affected water bodies. Further, implementation of
 4 CM2–CM21 would not cause significant long-term water quality degradation such that there would
 5 be greater risk of adverse effects on beneficial uses. Based on these findings, this impact is
 6 considered to be less than significant. No mitigation is required.

7 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 8 **Maintenance (CM1)**

9 ***Upstream of the Delta***

10 Under Alternative 1A, the magnitude and timing of reservoir releases and river flows upstream of
 11 the Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 12 Existing Conditions and the No Action Alternative.

13 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 14 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 15 relationships for mercury and methylmercury. No significant, predictive regression relationships
 16 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 17 (monthly or annual) (Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
 18 total mercury and flow is to be expected based on the association of mercury with suspended
 19 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 20 Sacramento River under Alternative 1A relative to Existing Conditions and the No Action Alternative
 21 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
 22 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
 23 In addition, even though it may be flow-affected, total mercury concentrations remain well below
 24 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
 25 the water bodies of the affected environment located upstream of the Delta would not be of
 26 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 27 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
 28 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
 29 remain above guidance levels at upstream of Delta locations, but will not change substantially
 30 relative to Existing Conditions or the No Action Alternative due to changes in flows under
 31 Alternative 1A.

32 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 33 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 34 Mercury Control Program. These projects will target specific sources of mercury and methylation
 35 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 36 The implementation of these projects could help to ensure that upstream of Delta environments will
 37 not be substantially degraded for water quality with respect to mercury or methylmercury.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 42 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 43 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
2 more information.

3 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
4 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
5 change in assimilative capacity of waterborne total mercury relative to the 25 ng/L ecological risk
6 benchmark of Alternative 1A showed the greatest decrease to be 1% at Franks Tract and Old River
7 relative to Existing Conditions, and 1.1% at Franks Tract relative to the No Action Alternative
8 (Figures 8-53a and 8-54a). These changes are not expected to result in adverse effects to beneficial
9 uses. Similarly, changes in methylmercury concentration were very small. The greatest annual
10 average methylmercury concentration for drought conditions was 0.167 ng/L for the San Joaquin
11 River at Buckley Cove, which was slightly higher than Existing Conditions and the same as the No
12 Action Alternative (Appendix 8I, *Mercury*, Table I-6). All modeled input concentrations exceeded the
13 methylmercury TMDL guidance objective of 0.06 ng/L, therefore percentage change in assimilative
14 capacity was not evaluated for methylmercury.

15 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
16 annual average concentrations for mercury at the Delta locations. The greatest increase was at
17 Mokelumne River (South Fork) at Staten Island (8% relative to Existing Conditions and 10% relative
18 to the No Action Alternative) (Figures 8-55a and 8-55b; Appendix 8I, *Mercury*, Table I-8b). Because
19 these increases are relatively small, and it is not evident that substantive increases are expected at
20 numerous locations throughout the Delta, these changes are expected to be within the uncertainty
21 inherent in the modeling approach, and would likely not be measurable in the environment. See
22 Appendix 8I for a discussion of the uncertainty associated with the fish tissue estimates.

23 ***SWP/CVP Export Service Areas***

24 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
25 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
26 methylmercury concentrations for Alternative 1A are projected to be lower than Existing Conditions
27 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-2 and
28 I-3). Therefore, mercury and methylmercury show increased assimilative capacity at these locations
29 (Figures 8-53a and 8-54a).

30 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
31 Alternative 1A, at any location within the Delta relative to Existing Conditions and the No Action
32 Alternative are expected for the export pump locations (specifically, at Banks Pumping plant, 9%
33 improvement relative to Existing Conditions, 11% relative to the No Action Alternative) (Figures 8-
34 55a and 8-55b; Appendix 8I, *Mercury*, Tables I-8a, b).

35 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
36 comparison of Alternative 1A to the No Action Alternative (as waterborne and bioaccumulated
37 forms) are not considered to be adverse.

38 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
40 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
41 constituent. For additional details on the effects assessment findings that support this CEQA impact
42 determination, see the effects assessment discussion that immediately precedes this conclusion.

1 Under Alternative 1A, greater water demands and climate change would alter the magnitude and
 2 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
 3 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
 4 methylmercury upstream of the Delta will not be substantially different relative to Existing
 5 Conditions due to the lack of important relationships between mercury/methylmercury
 6 concentrations and flow for the major rivers.

7 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
 8 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
 9 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
 10 mercury concentrations show almost no differences would occur among sites for Alternative 1A as
 11 compared to Existing Conditions for Delta sites.

12 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
 13 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
 14 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
 15 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 1A as
 16 compared to Existing Conditions.

17 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 18 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 19 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
 20 not expected to increase substantially, no long-term water quality degradation is expected to occur
 21 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
 22 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
 23 or fish tissue mercury concentrations would not make any existing mercury-related impairment
 24 measurably worse. In comparison to Existing Conditions, Alternative 1A would not increase levels of
 25 mercury by frequency, magnitude, and geographic extent such that the affected environment would
 26 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
 27 substantially increasing the health risks to wildlife (including fish) or humans consuming those
 28 organisms. This impact is considered to be less than significant. No mitigation is required.

29 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-**
 30 **CM21**

31 **NEPA Effects:** Some habitat restoration activities under Alternative 1A would occur on lands in the
 32 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 33 Alternative 1A have the potential to increase water residence times and increase accumulation of
 34 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 35 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 36 possible but uncertain depending on the specific restoration design implemented at a particular
 37 Delta location. Increased methylmercury due to the restoration areas would constitute an additional
 38 loading of methylmercury to the Delta, independent of effects of the hydrodynamics associated with
 39 the restoration areas. Models to estimate the potential for methylmercury formation in restored
 40 areas are not currently available. However, DSM2 modeling for Alternative 1A operations does
 41 incorporate assumptions for certain habitat restoration activities proposed under CM2 and CM4
 42 (see Section 8.3.1.3, *Plan Area*) that result in changes to Delta hydrodynamics compared to the No
 43 Action Alternative. These modeled restoration assumptions provide some insight into potential
 44 hydrodynamic changes that could be expected related to implementing CM2 and CM4 and are

1 considered in the evaluation of the potential for increased mercury and methylmercury
2 concentrations under Alternative 1A.

3 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
4 activities and acknowledges the uncertainties associated with mitigating or minimizing this
5 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
6 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
7 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
8 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 9 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
10 better inform restoration design,
- 11 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
12 techniques,
- 13 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
14 organic material at a restoration site (this approach could limit the benefit of restoration areas
15 by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some cases,
16 this would run directly counter to the goals and objectives of the BDCP. This approach should
17 not be implemented in such a way that it reduces the benefits to the Delta ecosystem provided
18 by restoration areas),
- 19 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
20 biologically unavailable, inorganic form of mercury,
- 21 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 22 • Considering capping mercury laden sediments, where possible to reduce methylation potential
23 at a site.

24 Because of the uncertainties associated with site-specific estimates of methylmercury
25 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
26 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
27 need to be evaluated separately for each restoration effort, as part of design and implementation.
28 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
29 potential effect of implementing CM2–CM21 is considered adverse.

30 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
31 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
32 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
33 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
34 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
35 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
36 measurable increase in methylmercury concentrations would make existing mercury-related
37 impairment measurably worse. Because mercury is bioaccumulative, increases in waterborne
38 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
39 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
40 Design of restoration sites under Alternative 1A would be guided by CM12 which requires
41 development of site specific mercury management plans as restoration actions are implemented.
42 The effectiveness of minimization and mitigation actions implemented according to the mercury
43 management plans is not known at this time although the potential to reduce methylmercury

1 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 2 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 3 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 4 impact being considered significant. No mitigation measures would be available until specific
 5 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 6 unavoidable.

7 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
 8 **Maintenance (CM1)**

9 ***Upstream of the Delta***

10 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
 11 any, adverse effects on nitrate concentrations in the rivers and reservoirs upstream of the Delta in
 12 the Sacramento River watershed, relative to Existing Conditions and the No Action Alternative.

13 Under Alternative 1A, modeling indicates that long-term annual average flows on the San Joaquin
 14 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 15 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
 16 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 17 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 18 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 19 affected, if at all, by changes in flow rates under Alternative 1A.

20 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 21 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 22 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 23 water bodies, with regards to nitrate.

24 ***Delta***

25 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 26 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 27 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 28 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 29 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 30 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 31 more information.

32 Results of the mixing calculations indicate that under Alternative 1A, relative to Existing Conditions,
 33 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 34 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Table 7 and 8). Although
 35 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 36 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 37 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 38 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
 39 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 40 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 41 concentration would be somewhat reduced under Alternative 1A, relative to Existing Conditions,
 42 and would be nearly the same (i.e., any increase would be negligible) as that under the No Action

1 Alternative. No additional exceedances of the MCL are anticipated at any location (Appendix 8J,
 2 Table 7). On a monthly average basis and on a long term annual average basis, for all modeled years
 3 and for the drought period (1987–1991) only, use of assimilative capacity available under Existing
 4 Conditions, and the No Action Alternative, relative to the drinking water MCL of 10 mg/L-N, was low
 5 or negligible (i.e., <4%) for all locations and months (Appendix 8J, Table 9).

6 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 7 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 8 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 9 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 10 the modeling.

- 11 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 12 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 13 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 14 the increase becoming greater with increasing distance downstream. However, the increase in
 15 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 16 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 17 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Regional
 18 Water Quality Control Board 2010a:32).
- 19 • Under Alternative 1A, the planned upgrades to the SRWTP, which include nitrification/partial
 20 denitrification, would substantially decrease ammonia concentrations in the discharge, but
 21 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
 22 higher than under Existing Conditions.
- 23 • Overall, under Alternative 1A, the nitrogen load from the SRWTP discharge is expected to
 24 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 25 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
 26 of the facility are expected to be higher than modeling results indicate for both Existing
 27 Conditions and Alternative 1A, the increase is expected to be greater under Existing Conditions
 28 than for Alternative 1A due to the upgrades that are assumed under Alternative 1A.

29 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 30 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 31 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 32 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 33 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 34 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 35 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 36 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 37 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 38 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 39 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 40 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 41 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

42 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
 43 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 44 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

1 **SWP/CVP Export Service Areas**

2 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
3 nitrate-N at the Banks and Jones pumping plants.

4 Results of the mixing calculations indicate that under Alternative 1A, relative to Existing Conditions
5 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
6 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Table 7 and 8).
7 During the late summer, particularly in the drought period assessed, concentrations are expected to
8 increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally, given the
9 many factors that contribute to potential algal blooms in the SWP and CVP canals within the Export
10 Service Area, and the lack of studies that have shown a direct relationship between nutrient
11 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
12 there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal increases in
13 nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
14 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, Table 7).
15 On a monthly average basis and on a long term annual average basis, for all modeled years and for
16 the drought period (1987–1991) only, use of assimilative capacity available under Existing
17 Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible (<4%) for
18 both Banks and Jones pumping plants (Appendix 8J, Table 9).

19 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
20 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
21 degrade the quality of exported water, with regards to nitrate.

22 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
23 CM1 are considered to be not adverse.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
26 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
27 constituent. For additional details on the effects assessment findings that support this CEQA impact
28 determination, see the effects assessment discussion that immediately precedes this conclusion.

29 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
30 substantial dilution available for point sources and the lack of substantial nonpoint sources of
31 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
32 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
33 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
34 Consequently, any modified reservoir operations and subsequent changes in river flows under
35 Alternative 1A, relative to Existing Conditions, are expected to have negligible, if any, effects on
36 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
37 watershed and upstream of the Delta in the San Joaquin River watershed.

38 In the Delta, results of the mixing calculations indicate that under Alternative 1A, relative to Existing
39 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
40 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
41 location, and use of assimilative capacity available under Existing Conditions, relative to the
42 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for all locations and months.

1 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 2 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
 3 indicate that under Alternative 1A, relative to Existing Conditions, long-term average nitrate
 4 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
 5 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
 6 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
 7 plants for all months.

8 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
 9 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 10 CVP and SWP service areas under Alternative 1A relative to Existing Conditions. As such, this
 11 alternative is not expected to cause additional exceedance of applicable water quality
 12 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 13 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
 14 expected to increase substantially, no long-term water quality degradation is expected to occur and,
 15 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
 16 affected environment and thus any increases that may occur in some areas and months would not
 17 make any existing nitrate-related impairment measurably worse because no such impairments
 18 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 19 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 20 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 21 significant. No mitigation is required.

22 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 23 CM21**

24 **NEPA Effects:** Some habitat restoration activities included in CM2–CM11 would occur on lands
 25 within the Delta formerly used for agriculture. It is expected that this will decrease nitrate
 26 concentrations in the Delta, due to less use of nitrate-based fertilizers, relative to the No Action
 27 Alternative. Modeling scenarios included assumptions regarding how certain habitat restoration
 28 activities (i.e., CM2 and CM4) would affect Delta hydrodynamics, and thus such effects of these
 29 restoration measures were included in the assessment of CM1 facilities operations and maintenance
 30 (see Impact WQ-1). In general, aside from changes in Delta hydrodynamics resulting from habitat
 31 restoration discussed in Impact WQ-1, CM2–CM11 proposed for Alternative 1A are not expected to
 32 increase nitrate concentrations in water bodies of the affected environment, relative to the No
 33 Action Alternative.

34 Because urban stormwater is a source of nitrate in the affected environment, CM19, Urban
 35 Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta, thus slightly
 36 decreasing nitrate-N concentrations relative to the No Action Alternative. Implementation of CM12–
 37 CM18 and CM20–CM21 is not expected to substantially alter nitrate concentrations in any of the
 38 water bodies of the affected environment.

39 The effects on nitrate from implementing CM2–CM21 are considered to be not adverse.

40 **CEQA Conclusion:** There would be no substantial, long-term increase in nitrate-N concentrations in
 41 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 42 CVP and SWP service areas due to implementation of CM2–CM21 under Alternative 1A, relative to
 43 Existing Conditions. Because urban stormwater is a source of nitrate in the affected environment,
 44 CM19, Urban Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta. As

1 such, implementation of these conservation measures is not expected to cause additional
 2 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 3 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
 4 Because nitrate concentrations are not expected to increase substantially due to these conservation
 5 measures, no long-term water quality degradation is expected to occur and, thus, no adverse effects
 6 to beneficial uses would occur. Nitrate is not 303(d) listed within the affected environment and thus
 7 any minor increases that may occur in some areas would not make any existing nitrate-related
 8 impairment measurably worse because no such impairments currently exist. Because nitrate is not
 9 bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to greater
 10 levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or
 11 humans. This impact is considered to be less than significant. No mitigation is required.

12 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 13 **Operations and Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Under Alternative 1A, there would be no substantial change to the sources of DOC within the
 16 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 17 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 18 system operations and resulting reservoir storage levels and river flows would not be expected to
 19 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 20 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 21 1A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
 22 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 23 substantially degrade the quality of these water bodies, with regard to DOC.

24 ***Delta***

25 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 26 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 27 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 28 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 29 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 30 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 31 more information.

32 Relative to Existing Conditions, Alternative 1A would result in small increases (i.e., between 1 and
 33 9%) in long-term average DOC concentrations at some interior Delta locations. In particular,
 34 modeled increases in long-term average DOC would be greatest at Franks Tract, with net average
 35 DOC concentration increases for the 16-year (1976–1991) hydrologic period modeled of 0.3 mg/L,
 36 equivalent to an approximate 9% relative increase (0.2 mg/L for the drought period, 8% relative
 37 increase) (Appendix 8K, *Organic Carbon*, DOC Table 2). Long-term increases of not greater than 0.3
 38 mg/L ($\leq 8\%$) would be predicted to occur at Staten Island, Rock Slough, and Contra Costa PP No. 1
 39 as well. At all 11 assessment locations, modeled long-term average DOC concentrations exceed 2 mg/L
 40 92-100% of the time. However, increases in long-term average DOC in the Delta interior would
 41 result in more frequent exceedances of the 3 mg/L concentration threshold, with the largest
 42 magnitude effect occurring at Rock Slough and Contra Costa PP No. 1. At Rock Slough, the frequency
 43 long-term average DOC concentrations would exceed 3 mg/L would increase from 52% under

1 Existing Conditions to 66% under Alternative 1A (an increase from 47% to 63% for the drought
2 period). At Contra Costa PP No. 1, the frequency long-term average DOC concentrations would
3 exceed 3 mg/L would increase from 52% under Existing Conditions to 68% under Alternative 1A
4 (an increase from 45% to 67% for the drought period). In contrast, however, the relative frequency
5 long-term average DOC concentrations would exceed 4 mg/L at Rock Slough and Contra Costa PP
6 No. 1 would be small. At Rock Slough, an increase in the frequency long-term average DOC would
7 exceed 4 mg/L would only occur for the drought period, increasing from 32% under Existing
8 Conditions to 40% under Alternative 1A, while at Contra Costa PP No.1 the modeled exceedance
9 frequency for the 16-year hydrologic period would rise from 32% to 34% (an increase from 35% to
10 42% for the drought period). Concentration threshold exceedances at the other assessment
11 locations would be similar or less. While Alternative 1A would generally lead to slightly higher long-
12 term average DOC concentrations (≤ 0.3 mg/L) within the Delta interior and some municipal water
13 intakes, the predicted change would not be expected to adversely affect MUN beneficial uses, or any
14 other beneficial use. This comparison to Existing Conditions reflects changes in DOC due to both
15 Alternative 1A operations (including north Delta intake capacity of 15,000 cfs and numerous other
16 components of Operational Scenario A) and climate change/sea level rise.

17 In comparison, Alternative 1A relative to the No Action Alternative would generally result in a
18 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
19 increases of not greater than 0.3 mg/L DOC (i.e., $\leq 9\%$) would be predicted at Staten Island, Franks
20 Tract, Rock Slough, and Contra Costa PP No. 1 (Appendix 8K, *Organic Carbon*, DOC Table 2).
21 Threshold concentration exceedance frequency trends would also be similar to those discussed for
22 the existing condition comparison, with exception to the predicted 4 mg/L exceedance frequency at
23 Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average
24 DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 33% (42% to
25 62% for the modeled drought period). While the Alternative 1A would generally lead to slightly
26 higher long-term average DOC concentrations at some Delta assessment locations when compared
27 to the No Action Alternative, the predicted change would not be expected to adversely affect MUN
28 beneficial uses, or any other beneficial use, particularly when considering the relatively small
29 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
30 this comparison to the No Action Alternative reflects changes in DOC due to only Alternative 1A
31 operations.

32 The Stage 1 Disinfectants and Disinfection Byproduct Rule adopted by U.S. EPA in 1998, as part of
33 the Safe Drinking Water Act, requires drinking water utilities to reduce TOC concentrations by
34 specified percentages prior to disinfection. EPA's action thresholds begin at 2–4 mg/L TOC and,
35 depending on source water alkalinity, may require a drinking water utility to employ treatment to
36 achieve as much as a 35% reduction in TOC. These requirements were adopted because organic
37 carbon, such as DOC, can react with disinfectants during the water treatment disinfection process to
38 form DBPs, such as THMs which pose potential lifetime carcinogenic risks to humans. Moreover, a
39 CUWA convened expert panel reviewed Delta source water quality and DBP formation potential in
40 an effort to develop Delta source water quality targets for treated drinking water. This panel found
41 that source water between 4 and 7 mg/L TOC would allow continued flexibility in treatment
42 technology necessary to achieve existing drinking water criteria for DBPs.

43 Water treatment plants that utilize Delta water are currently designed and operated to meet EPA's
44 1998 requirements based on the ambient concentrations and seasonal variability that currently
45 exists in the Delta. Substantial changes in ambient DOC concentrations would need to occur for
46 significant changes in plant design or operations to be triggered. The increases in long-term average

1 DOC concentrations estimated to occur at various Delta locations under Alternative 1A are of
 2 sufficiently small magnitude that they would not require existing drinking water treatment plants to
 3 substantially upgrade treatment for DOC removal above levels currently employed.

4 Relative to Existing Conditions and No Action Alternative conditions, Alternative 1A would lead to
 5 predicted improvements in long-term average DOC concentrations at Barker Slough, as well as
 6 Banks and Jones pumping plants (discussed below). At Barker Slough, long-term average DOC
 7 concentrations would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline
 8 conditions comparison and modeling period.

9 **SWP/CVP Export Service Areas**

10 Under Alternative 1A, modeled long-term average DOC concentrations would decrease at Banks and
 11 Jones pumping plants, relative to Existing Conditions and the No Action Alternative. Relative to
 12 Existing Conditions, long-term average DOC concentrations would be predicted to decrease by 0.4
 13 mg/L at both pumping plants, although in drought years the decrease would be 0.1 mg/L at Banks
 14 pumping plant and <0.1 mg/L at Jones pumping plant (Appendix 8K, *Organic Carbon*, DOC Table 2).
 15 Such decreases in long-term average DOC would result in generally lower exceedance frequencies
 16 for concentration thresholds, although the frequency of exceedance during the modeled drought
 17 period (i.e., 1987–1991) would be predicted to increase. For the Banks pumping plant during the
 18 drought period, exceedance of the 3 mg/L threshold would increase from 57% under Existing
 19 Conditions to 88% under Alternative 1A, while at the Jones pumping plant, exceedance frequency
 20 would increase from 72% to 87%. There would be comparatively fewer increases in the frequency
 21 of exceeding the 4 mg/L threshold at Banks, while at Jones pumping plant the exceedance frequency
 22 for the 4 mg/L threshold would decrease. Comparisons to the No Action Alternative yield similar
 23 trends, but with slightly small magnitude drought period changes. Overall, modeling results for the
 24 SWP/CVP Export Service Areas predict an overall improvement in Export Service Areas water
 25 quality, although somewhat more frequent exports of >3mg/L DOC water would likely occur for
 26 drought periods.

27 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 28 facilities under Alternative 1A would not be expected to create new sources of DOC or contribute
 29 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
 30 would not be expected to cause any substantial change in long-term average DOC concentrations
 31 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

32 **NEPA Effects:** In summary, Alternative 1A, relative to the No Action Alternative, would not cause a
 33 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
 34 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
 35 decrease by as much as 0.5 mg/L, while long-term average DOC concentrations for some Delta
 36 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.3 mg/L.
 37 The increase in long-term average DOC concentration that could occur within the Delta interior
 38 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
 39 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
 40 DOC is determined not to be adverse.

41 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 43 *Determination of Effects*) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 While greater water demands under the Alternative 1A would alter the magnitude and timing of
4 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
5 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
6 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
7 flows would not be expected to cause a substantial long-term change in DOC concentrations
8 upstream of the Delta.

9 Relative to Existing Conditions, Alternative 1A would result in relatively small increases (i.e., $\leq 9\%$)
10 in long-term average DOC concentrations at some Delta interior locations, including Franks Tract,
11 Staten Island, Rock Slough, and Contra Costa PP No. 1. However, these increases would not
12 substantially increase the frequency with which long-term average DOC concentrations exceeds 2, 3,
13 or 4 mg/L. While Alternative 1A would generally lead to slightly higher long-term average DOC
14 concentrations (≤ 0.3 mg/L) within the Delta interior and some municipal water intakes, the
15 predicted change would not be expected to adversely affect MUN beneficial uses, or any other
16 beneficial use.

17 The assessment of Alternative 1A effects on DOC in the SWP/CVP Export Service Areas is based on
18 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
19 Existing Conditions, long-term average DOC concentrations would decrease by as much as 0.4 mg/L
20 at Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
21 predicted during periods of drought. Nevertheless, an overall improvement in DOC-related water
22 quality would be predicted in the SWP/CVP Export Service Areas.

23 Based on the above, Alternative 1A operation and maintenance would not result in any substantial
24 change in long-term average DOC concentration upstream of the Delta or result in substantial
25 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
26 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
27 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
28 (i.e., $\leq 9\%$ relative increase), with long-term average concentrations estimated to remain at or below
29 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
30 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
31 Cove are predicted to remain the same during the drought period, relative to Existing Conditions.
32 The increases in long-term average DOC concentration that could occur within the Delta would not
33 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
34 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
35 increases in long-term average DOC concentrations would not cause bioaccumulative problems in
36 aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus is not 303(d)
37 listed for any water body within the affected environment. Thus, the increases in long-term average
38 DOC that could occur at various locations would not make any beneficial use impairment
39 measurably worse. Because long-term average DOC concentrations are not expected to increase
40 substantially, no long-term water quality degradation with respect to DOC is expected to occur and,
41 thus, no adverse effects on beneficial uses would occur. This impact is considered to be less than
42 significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
2 **Implementation of CM2–CM21**

3 **NEPA Effects:** The mostly non-land disturbing CM12–CM21 present no new sources of DOC to the
4 affected environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP
5 Export Service Area. Implementation of methylmercury control measures (CM12) and urban
6 stormwater treatment measures (CM19) may result in beneficial effects, to the extent that control
7 measures treat or reduce organic carbon loading from tidal wetlands and urban land uses. Control of
8 nonnative aquatic vegetation (CM13) may include killing mature aquatic vegetation in place, leading
9 to their decay and contribution to DOC in Delta channels. However, this measure is not expected to
10 be a significant source of long-term DOC loading as vegetation control would be sporadic and on an
11 as needed basis, with decreasing need for treatments in the long-term as nonnative vegetation is
12 eventually controlled and managed. Implementation of CM12–CM21 would not be expected to have
13 substantial, if even measurable, effect on DOC concentrations upstream of the Delta, within the
14 Delta, and in the SWP/CVP service areas. Consequently, any negligible increases in DOC levels in
15 these areas of the affected environment are not expected to be of sufficient frequency, magnitude
16 and geographic extent that they would adversely affect the MUN beneficial use, or any other
17 beneficial uses, of the affected environment, nor would potential increases substantially degrade
18 water quality with regards to DOC.

19 For CM2–CM11, effects on DOC concentrations can generally be considered in terms of: (1)
20 alternative-caused change in Delta hydrodynamics, and (2) alternative-caused change in Delta DOC
21 sources. Change in Delta hydrodynamics involves a two part process, including the conveyance
22 facilities and operational scenarios of CM1, as well as the change in Delta channel geometry and
23 open water areas that would occur as a consequence of implementing tidal wetland restoration
24 measures such as that described for CM4. Modeling scenarios included assumptions regarding how
25 these habitat restoration activities would affect Delta hydrodynamics, and thus the effects of these
26 restoration measures, via their effects on delta hydrodynamics, were included in the assessment of
27 CM1 facilities operations and maintenance (see Impact WQ-17). The potential for these same
28 conservation measures to change Delta DOC sources are addressed below.

29 CM2, CM3, CM8, CM9, and CM11 could include activities that would target increasing primary
30 production (i.e., algae growth) within the Delta. Algae currently are not estimated to be a major
31 source of DOC in the Delta (CALFED Bay-Delta Program 2008a: 4, 6), and comprise mostly the
32 particulate fraction of TOC. Conventional drinking water treatment removes much of the POC from
33 raw source water; therefore, conservation measure activities targeted at increased algae production
34 are not expected to contribute substantial amounts of new DOC, or adversely affect MUN beneficial
35 use, or any other beneficial uses, of the affected environment.

36 CM4–CM7 and CM10 include land disturbing restoration activities known to be sources of DOC.
37 Research within the Delta has focused primarily on non-tidal wetlands and flooding of Delta island
38 peat soils. The dynamics of DOC production and export from wetlands and seasonally flooded soils is
39 complex, as well as highly site and circumstance specific. Age and configuration of a wetland
40 significantly affects the amount of DOC that may be generated in a wetland. In a study of a
41 permanently flooded non-tidal constructed wetland on Twitchell Island, initial DOC loading was
42 determined to be much greater (i.e., approximately 10 times greater) than equivalent area of
43 agricultural land, but trends in annual loading led researchers to estimate that loading from the
44 wetland would be equivalent to that of agriculture within about 15 years (Fleck et. al. 2007: 18). It
45 was observed that the majority of the wetland load originated from seepage through peat soils.

1 Trends in declining load were principally associated with flushing of mobile DOC from submerged
2 soils, the origins of which were related to previous agricultural activity prior to restoration to
3 wetland. Peaks in annual loading, however, would be different, where peaks in agricultural drainage
4 occur in winter months while peaks in wetland loading occur in spring and summer months. As
5 such, age, configuration, location, operation, and season all factor into DOC loading, and long-term
6 average DOC concentrations in the Delta.

7 Available evidence suggests that restoration activities establishing new tidal and non-tidal wetlands,
8 new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources
9 of localized DOC loading within the Delta. If established in areas presently used for agriculture, these
10 restoration activities could result in a substitution and temporary increase in localized DOC loading
11 for years. Presently, the specific design, operational criteria, and location of these activities are not
12 well established. Depending on localized hydrodynamics, such restoration activities could
13 contribute substantial amounts of DOC to municipal raw water if established near municipal intakes.
14 Substantially increased DOC concentrations in municipal source water may create a need for
15 existing drinking water treatment plants to upgrade treatment systems in order to achieve EPA
16 Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While treatment
17 technologies sufficient to achieve the necessary DOC removals exist, implementation of such
18 technologies would likely require substantial investment in new or modified infrastructure.

19 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 1A would
20 present new localized sources of DOC to the study area, and in some circumstances would substitute
21 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
22 proximity to municipal drinking water intakes, such restoration activities could contribute
23 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
24 DOC could necessitate changes in water treatment plant operations or require treatment plant
25 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
26 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

27 **CEQA Conclusion:** Implementation of CM2, CM3, CM8, CM9, and CM11–CM21 would not present
28 new or substantially changed sources of organic carbon to the affected environment of the Delta,
29 and thus would not contribute substantially to changes in long-term average DOC concentrations in
30 the Delta. Therefore, related long-term water quality degradation would not be expected to occur
31 and, thus, no adverse effects on beneficial uses would occur through implementation of CM2, CM3,
32 CM8, CM9, and CM11–CM21. Furthermore, DOC is not bioaccumulative, therefore changes in DOC
33 concentrations would not cause bioaccumulative problems in aquatic life or humans. Nevertheless,
34 implementation of CM4–CM7 and 10 would present new localized sources of DOC to the study area,
35 and in some circumstances would substitute for existing sources related to replaced agriculture.
36 Depending on localized hydrodynamics and proximity to municipal drinking water intakes, such
37 restoration activities could contribute substantial amounts of DOC to municipal raw water. The
38 potential for substantial increases in long-term average DOC concentrations related to the habitat
39 restoration elements of CM4–CM7 and 10 could contribute to long-term water quality degradation
40 with respect to DOC and, thus, adversely affect MUN beneficial uses. The impact is considered to be
41 significant and mitigation is required. It is uncertain whether implementation of Mitigation Measure
42 WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact remains
43 significant and unavoidable.

44 In addition to and to supplement Mitigation Measure WQ-18, the project proponents have
45 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,

1 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
 2 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 3 operations. Potential options for making use of this financial commitment include funding or
 4 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 5 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 6 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 7 water quality effects relating to DOC.

8 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 9 **Effects on Municipal Intakes**

10 Design wetland and riparian habitat features taking into consideration effects on Delta
 11 hydrodynamics and impacts on municipal intakes. Locate restoration features such that impacts
 12 on municipal intakes are minimized and habitat benefits are maximized. Incorporate design
 13 features to control the load and/or timing of DOC exports from habitat restoration features. This
 14 could include design elements to control seepage from non-tidal wetlands (e.g., incorporation of
 15 slurry walls into levees), and features to increase retention time and decrease tidal exchange in
 16 tidal wetlands and riparian and channel margin habitat designs. For restoration features directly
 17 connected to open channel waters, this could include designing wetlands with only channel
 18 margin exchanges to decrease DOC loading. Stagger construction of wetlands and channel
 19 margin/riparian sites both spatially and temporally so as to allow aging of the restoration
 20 features and associated decreased creation of localized “hot spots” and net Delta loading.

21 Establish measures to help guide the design and creation of the target wetland habitats. At a
 22 minimum, the measures should limit potential increases in long-term average DOC
 23 concentrations, and thus guide efforts to site, design, and maintain wetland and riparian habitat
 24 features, consistent with the biological goals and objectives of the BDCP. For example,
 25 restoration activities could be designed and located with the goal of preventing, consistent with
 26 the biological goals and objectives of the BDCP, net long-term average DOC concentration
 27 increases of greater than 0.5 mg/L at any municipal intake location within the Delta.

28 However, it must be noted that some of these measures could limit the benefit of restoration
 29 areas by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some
 30 cases, these measures would run directly counter to the goals and objectives of the BDCP. This
 31 mitigation measure should not be implemented in such a way that it reduces the benefits to the
 32 Delta ecosystem provided by restoration areas. As mentioned above, the project proponents
 33 have incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental*
 34 *Commitments, AMMs, and CMs*, a separate, other commitment to address the potential increased
 35 water treatment costs that could result from DOC concentration effects on municipal and
 36 industrial water purveyor operations.

37 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 38 **(CM1)**

39 ***Upstream of the Delta***

40 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
 41 substantial, and would likely result in immeasurable, increases in pathogen concentrations in the
 42 rivers and reservoirs upstream of the Delta, relative to Existing Conditions and the No Action

1 Alternative. Effects due to the operation and maintenance of the conveyance facilities are expected
2 to be immeasurable, on an annual and long-term average basis.

3 **Delta**

4 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
5 substantial, and would likely result in immeasurable, increases in pathogen concentrations in the
6 Delta region relative to Existing Conditions and the No Action Alternative. Effects due to the
7 operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
8 annual and long-term average basis.

9 **SWP/CVP Export Service Areas**

10 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
11 Conditions and the No Action Alternative, as it would consist of water diverted from the Sacramento
12 River at Hood in addition to the water directly withdrawn from the Delta at the current export
13 pumps.

14 The Pathogens Conceptual Model (Tetra Tech 2007, Figure 3-7) reports the median *E. coli*
15 concentration in the Sacramento River at Hood is the same order of magnitude (10^1) as the median
16 *E. coli* concentration at the Contra Costa Water District's Pumping Plant #1 and the Delta Pumping
17 Plant Headworks (referred to herein as the Banks pumping plant), with the median Banks pumping
18 plant concentrations being higher than the Sacramento River and Pumping Plant #1 median
19 concentrations (data for comparison of total coliforms and fecal coliforms is not presented in Tetra
20 Tech 2007 and, thus, only *E. coli* is discussed). Based on the Pathogen Conceptual Model's findings
21 that Delta *E. coli* concentrations appear to be largely influenced by localized sources and that
22 Sacramento River *E. coli* concentrations are lower than Delta concentrations, the diversion of
23 Sacramento River water at Hood is not expected to measurably increase the *E. coli* concentration in
24 the SWP/CVP Export Service Areas waters.

25 Furthermore, the following average pathogen concentrations for the Sacramento River at River Mile
26 44 (which is upstream of Hood and downstream of the Sacramento Regional Wastewater Treatment
27 Plant) are reported in the Pathogens Conceptual Model (Tetra Tech 2007, Figure 3-4):

28 *Cryptosporidium*: 0.12 oocysts/L (31% of samples detected)

29 *Giardia*: 0.9 cysts/L ml (66% of samples detected)

30 Pathogen concentrations in SWP/CVP Export Service Areas waters, particularly *Giardia* and
31 *Cryptosporidium* concentrations, are of concern because the concentration of these pathogens
32 dictates the level treatment required for the drinking water supply. The *California State Water*
33 *Project Sanitary Survey, 2006 Update* (State Water Project Contractors Authority 2007) reported
34 *Giardia* and *Cryptosporidium* concentrations for locations throughout the SWP. These pathogens
35 were not frequently detected and the concentrations reported were such that the waters would be
36 classified as "Bin 1" under the Long Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR),
37 meaning no additional treatment required under the Rule, though some waters required additional
38 monitoring to confirm this classification. Based on the levels of *Cryptosporidium* in the Sacramento
39 River, this alternative would not be expected to adversely affect the municipal and domestic water
40 supply uses in the service areas, as the water would be classified as "Bin 1" with respect to the
41 LT2ESWTR, meaning no additional treatment required.

1 With respect to the remaining beneficial uses in the service area (e.g., recreation), an increased
2 proportion of water coming from the Sacramento River would not adversely affect those uses in the
3 SWP/CVP Export Service Areas. As described above, the pathogen levels in the Sacramento River are
4 similar to or lower than the water diverted at the Delta export pumps. Further, it is localized sources
5 of pathogens that appear to have the greatest influence on concentrations (Tetra Tech 2007). Thus,
6 an increased proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas
7 would result in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

8 For the same reasons stated for the No Action Alternative, Alternative 1A is expected to have
9 minimal effects on pathogen concentrations in SWP/CVP Export Service Areas waters relative to
10 Existing Conditions and No Action Alternative.

11 **NEPA Effects:** The effects on pathogens from implementing CM1 is determined to not be adverse.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
14 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
15 constituent. For additional details on the effects assessment findings that support this CEQA impact
16 determination, see the effects assessment discussion that immediately precedes this conclusion.

17 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
18 (water facilities and operations) under Alternative 1A, relative to Existing Conditions, would not be
19 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
20 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
21 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
22 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
23 related regulations.

24 It is expected there would be no substantial change in Delta pathogen concentrations in response to
25 a shift in the Delta source water percentages under this alternative or substantial degradation of
26 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
27 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
28 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
29 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
30 and livestock-related uses, would continue under this alternative.

31 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
32 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
33 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
34 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
35 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
36 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
37 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

38 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
39 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
40 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
41 expected to increase substantially, no long-term water quality degradation for pathogens is
42 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
43 River in the Stockton Deep Water Ship Channel is Clean Water Act Section 303(d) listed for

1 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
2 are expected to occur on a long-term basis, further degradation and impairment of this area is not
3 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
4 considered to be less than significant. No mitigation is required.

5 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

6 **NEPA Effects:** CM2–CM11 would involve habitat restoration actions, and CM21 involves waterfowl
7 and shorebird areas. Tidal wetlands are known to be sources of coliforms originating from aquatic,
8 terrestrial, and avian wildlife that inhabit these areas (Desmarais et al. 2001, Grant et al. 2001,
9 Evanson and Ambrose 2006, Tetra Tech 2007). Specific locations of restoration areas for this
10 alternative have not yet been established. However, most low-lying land suitable for restoration is
11 unsuitable for livestock. Therefore, it is likely that the majority of land to be converted to wetlands
12 would be crop-based agriculture or fallow/idle land. Because of a great deal of scientific uncertainty
13 in the loading of coliforms from these various sources, the resulting change in coliform loading is
14 uncertain, but it is anticipated that coliform loading to Delta waters would increase. Based on
15 findings from the Pathogens Conceptual Model that pathogen concentrations are greatly influenced
16 by the proximity to the source, this could result in localized increases in wildlife-related coliforms
17 relative to the No Action Alternative. The Delta currently supports similar habitat types and, with
18 the exception of the Clean Water Act Section 303(d) listing for the Stockton Deep Water Ship
19 Channel, is not recognized as exhibiting pathogen concentrations that rise to the level of adversely
20 affecting beneficial uses. As such, the potential increase in wildlife-related coliform concentrations
21 due to tidal habitat creation is not expected to adversely affect beneficial uses.

22 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
23 would be expected to reduce pathogen load relative to the No Action Alternative. The remaining
24 conservation measures would not be expected to affect pathogen levels, because they are actions
25 that do not affect the presence of pathogen sources. The effects on pathogens from implementing
26 CM2–CM21 is determined to not be adverse.

27 **CEQA Conclusion:** Based on findings from the Pathogens Conceptual Model that pathogen
28 concentrations are greatly influenced by the proximity to the source, implementation of CM2–CM11
29 and CM21 could result in localized increases in wildlife-related coliforms relative to Existing
30 Conditions. The Delta currently supports similar habitat types and, with the exception of the Clean
31 Water Act Section 303(d) listing for the Stockton Deep Water Ship Channel, is not recognized as
32 exhibiting pathogen concentrations that rise to the level of adversely affecting beneficial uses. As
33 such, the potential increase in wildlife-related coliform concentrations due to tidal habitat creation
34 is not expected to adversely affect beneficial uses. Therefore, this alternative is not expected to cause
35 additional exceedance of applicable water quality objectives by frequency, magnitude, and
36 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
37 environment. Because pathogen concentrations are not expected to increase substantially, no long-
38 term water quality degradation for pathogens is expected to occur and, thus, no adverse effects on
39 beneficial uses would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is Clean
40 Water Act Section 303(d) listed for pathogens. Because no measurable increase in Deep Water Ship
41 Channel pathogen concentrations are expected to occur on a long-term basis, further degradation
42 and impairment of this area is not expected to occur. Finally, pathogens are not bioaccumulative
43 constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 1A no specific
 5 operations or maintenance activity of the SWP or CVP would substantially drive a change in
 6 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
 7 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
 8 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
 9 Joaquin Rivers.

10 Under Alternative 1A, winter (November–March) and summer (April–October) season average flow
 11 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito,
 12 and the San Joaquin River at Vernalis would change. Averaged over the entire period of record,
 13 seasonal average flow rates on the Sacramento would decrease no more than 7% during the
 14 summer and 2% during the winter relative to Existing Conditions (Appendix 8L, *Pesticides*, Tables
 15 1–4). On the Feather River, average flow rates would decrease by as much as 5% during the
 16 summer, but would increase by as much as 12% in the winter, while on the American River average
 17 flow rates would decrease by as much as 16% in the summer but would increase by as much as 9%
 18 in the winter. Seasonal average flow rates on the San Joaquin River would decrease by as much as
 19 12% in the summer, but increase by as much as 1% in the winter relative to Existing Conditions. In
 20 comparison to the No Action Alternative, the relative magnitude change in seasonal average flows
 21 would be similar, with exception to the estimated change on the American River and San Joaquin
 22 River relative to No Action Alternative. In comparison to No Action Alternative, there would be no
 23 estimated change in season average flows on the San Joaquin River (i.e., 0% summer and winter
 24 change) and there would only be a 1% decrease of summer average flows on the American River.

25 For the same reasons stated for the No Action Alternative, decreased seasonal average flow of $\leq 16\%$
 26 is not considered to be of sufficient magnitude to substantially increase pesticide concentrations or
 27 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
 28 beneficial uses of water bodies upstream of the Delta.

29 ***Delta***

30 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 31 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 32 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

33 Under Alternative 1A, the distribution and mixing of Delta source waters would change. Percentage
 34 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
 35 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 36 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 37 fractions. Relative to Existing Conditions, under Alternative 1A modeled San Joaquin River fractions
 38 would increase greater than 10% at Franks Tract, Rock Slough, and Contra Costa PP No. 1 (Appendix
 39 8D, *Source Water Fingerprinting Results*). At Franks Tract, source water fractions when modeled for
 40 the 16-year hydrologic period would increase 13–15% during February and March. San Joaquin
 41 River source water fractions when modeled for the 16-year hydrologic period would increase 14–
 42 16% during February and March at Rock Slough and 13–17% during March and April at Contra
 43 Costa PP No. 1. Sacramento River fractions would increase greater than 10% at Buckley Cove as

1 well. At Buckley Cove, Sacramento River source water fractions when modeled for the 16-year
 2 hydrologic period would increase by 11% during August, and 11–14% during July and August
 3 during the modeled drought period. Relative to Existing Conditions, there would be no modeled
 4 increases in Delta agricultural fractions greater than 7%. These modeled changes in the source
 5 water fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient
 6 magnitude to substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor
 7 adversely affect other beneficial uses of the Delta. This comparison to Existing Conditions reflects
 8 changes in Delta source water fractions due to both Alternative 1A operations (including north Delta
 9 intake capacity of 15,000 cfs and numerous other components of Operational Scenario A) and
 10 climate change/sea level rise.

11 When compared to the No Action Alternative, changes in source water fractions would be similar in
 12 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
 13 to Buckley Cove. At Buckley Cove, modeled drought period San Joaquin River fractions would
 14 increase 15% in July and 26% in August when compared to No Action Alternative (Appendix 8D,
 15 *Source Water Fingerprinting Results*). These increases would primarily balance through decreases in
 16 Sacramento River water and eastside tributary waters. Nevertheless, the San Joaquin River would
 17 only account for 37% of the total source water volume at Buckley Cove in July and August during the
 18 modeled drought period. As such, these modeled changes in the source water fractions of
 19 Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to substantially
 20 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
 21 beneficial uses of the Delta. Unlike the comparison to Existing Conditions, the comparison to the No
 22 Action Alternative reflects changes in Delta source water fractions due only to Alternative 1A
 23 operations.

24 ***SWP/CVP Export Service Areas***

25 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 26 the Banks and Jones pumping plants. Under Alternative 1A, Sacramento River source water fractions
 27 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
 28 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). Source water
 29 fractions would generally increase from 13–53% for the period of December through June for the
 30 modeled 16-year hydrologic period and 13–40% from the period of March through May for the
 31 modeled drought period. These increases in Sacramento source water fraction would primarily
 32 balance through equivalent decreases in San Joaquin River fraction. Based on the general
 33 observation that San Joaquin River, in comparison to the Sacramento River, is a greater contributor
 34 of OP insecticides in terms of greater frequency of incidence and presence at concentrations
 35 exceeding water quality benchmarks, modeled increases in Sacramento River fraction at Banks and
 36 Jones would generally represent an improvement in export water quality respective to pesticides.

37 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
 38 American, and San Joaquin Rivers, under Alternative 1A relative to the No Action Alternative, are of
 39 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
 40 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
 41 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
 42 substantially alter the long-term risk of pesticide-related water quality degradation and related
 43 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
 44 operations and maintenance (CM1) are determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
2 provided above are summarized here, and are then compared to the CEQA thresholds of significance
3 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
4 determination for this constituent. For additional details on the effects assessment findings that
5 support this CEQA impact determination, see the effects assessment discussion that immediately
6 precedes this conclusion.

7 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
8 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
9 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
10 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
11 substantially increase the long-term risk of pesticide-related water quality degradation and related
12 toxicity to aquatic life in these water bodies upstream of the Delta.

13 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
14 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
15 and maintenance activities would not affect these sources, changes in Delta source water fraction
16 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
17 Alternative 1A, however, modeled changes in source water fractions relative to Existing Conditions
18 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
19 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
20 any other beneficial uses of Delta waters.

21 The assessment of Alternative 1A effects on pesticides in the SWP/CVP Export Service Areas is
22 based on assessment of changes predicted at Banks and Jones pumping plants. As just discussed
23 regarding effects to pesticides in the Delta, modeled changes in source water fractions at the Banks
24 and Jones pumping plants are of insufficient magnitude to substantially alter the long-term risk of
25 pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies
26 of the SWP and CVP export service area.

27 Based on the above, Alternative 1A would not result in any substantial change in long-term average
28 pesticide concentration or result in substantial increase in the anticipated frequency with which
29 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
30 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
31 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
32 affected environment, and while some of these pesticides may be bioaccumulative, those present-
33 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
34 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
35 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
36 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
37 throughout the affected environment that name pesticides as the cause for beneficial use
38 impairment, the modeled changes in upstream river flows and Delta source water fractions would
39 not be expected to make any of these beneficial use impairments measurably worse. Because long-
40 term average pesticide concentrations are not expected to increase substantially, no long-term
41 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
42 effects on beneficial uses would occur. This impact is considered to be less than significant. No
43 mitigation is required.

1 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–**
 2 **CM21**

3 With the exception of CM13, the mostly non-land disturbing CM12–CM21 present no new sources of
 4 pesticides to the affected environment, including areas Upstream of the Delta, within the Plan Area,
 5 and the SWP/CVP Export Service Area. Implementation of urban stormwater treatment measures
 6 (CM19) may result in beneficial effects, to the extent that control measures treat or reduce pesticide
 7 loading from urban land uses. However, control of nonnative aquatic vegetation (CM13) associated
 8 with tidal habitat restoration efforts would include killing invasive and nuisance aquatic vegetation
 9 through direct application of herbicides or through alternative mechanical means. Use and selection
 10 of type of herbicides would largely be circumstance specific, but would follow existing control
 11 methods used by CDBW. The CDBW's use of herbicides is regulated by permits and regulatory
 12 agreements with the Central Valley Water Board, US Fish and Wildlife Service, and National Marine
 13 Fisheries Service and is guided by research conducted on the efficacy of vegetation control in the
 14 Delta through herbicide use. Through a program of adaptive management and assessment, the
 15 CDBW has employed a program of herbicide use that reduces potential environmental impacts,
 16 nevertheless, the CDBW found that impacts on water quality and associated aquatic beneficial uses
 17 would continue to occur and could not be avoided, including non-target impacts on aquatic
 18 invertebrates and beneficial aquatic plants (California Department of Boating and Waterways 2006).

19 In addition to the potential beneficial and adverse effects of CM19 and CM13, respectively, the
 20 various restoration efforts of CM2–CM11 could involve the conversion of active or fallow
 21 agricultural lands to natural landscapes, such as wetlands, grasslands, floodplains, and vernal pools.
 22 In the long-term, conversion of agricultural land to natural landscapes could possibly result in a
 23 limited reduction in pesticide use throughout the Delta. In the short-term, tidal and non-tidal
 24 wetland restoration, as well as seasonal floodplain restoration (i.e., CM4, CM5, and CM10) over
 25 former agricultural lands may include the contamination of water with pesticide residues contained
 26 in the soils. Present use pesticides typically degrade fairly rapidly, and in such cases where pesticide
 27 containing soils are flooded, dissipation of those pesticides would be expected to occur rapidly.
 28 Moreover, seasonal floodplain restoration (CM5) and Yolo Bypass enhancements (CM2) may be
 29 managed alongside continuing agriculture, where pesticides may be used on a seasonal basis and
 30 where water during flood events may come in contact with residues of these pesticides. Similarly,
 31 however, rapid dissipation would be expected, particularly in the large volumes of water involved in
 32 flooding. During these flooding events, pesticides potentially suspended in water would not be
 33 expected to cause toxicity to aquatic life or cause substantial adverse effects on any other beneficial
 34 uses of these water bodies.

35 **NEPA Effects:** In summary, CM13 of Alternative 1A proposes the use of herbicides to control
 36 invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to water
 37 could adversely affect non-target aquatic life, such as aquatic invertebrates and beneficial aquatic
 38 plants. Use of herbicides could potentially exceed aquatic life toxicity objectives with sufficient
 39 frequency and magnitude such that beneficial uses would be adversely affected, thus constituting an
 40 adverse effect on water quality. Mitigation Measure WQ-22 would be available to reduce this effect.

41 **CEQA Conclusion:** With the exception of CM13, implementation of CM2–CM21 would not present
 42 new or substantially increased sources of pesticides in the Plan Area. In the long-term,
 43 implementation of conservation measures could possibly result in a limited reduction in pesticide
 44 use throughout the Delta through the potential repurposing of active or fallow agricultural land for
 45 natural habitat purposes. In the short-term, the repurposing of agricultural land associated with

1 CM4, CM5, and CM10 may expose water used for habitat restoration to pesticide residues. Moreover,
 2 CM2 and CM5 may be managed alongside continuing agriculture, where pesticides may be used on a
 3 seasonal basis and where water during flood events may come in contact with residues of these
 4 pesticides. However, rapid dissipation would be expected, particularly in the large volumes of water
 5 involved in flooding, such that aquatic life toxicity objectives would not be exceeded by frequency,
 6 magnitude, and geographic extent whereby significant effects on beneficial uses would be expected.
 7 CM2–CM21 do not include the use of pesticides known to be bioaccumulative in animals or humans,
 8 nor do the conservation measures propose the use of any pesticide currently named in a Section
 9 303(d) listing of the affected environment. CM13 proposes the use of herbicides to control invasive
 10 aquatic vegetation around habitat restoration sites. Herbicides directly applied to water could
 11 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
 12 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency
 13 and magnitude such that beneficial uses would be impacted. Potential environmental effects related
 14 only to CM13 are considered significant and unavoidable. Mitigation Measure WQ-22 is available to
 15 partially reduce this impact of pesticides on water quality; however, no feasible mitigation is
 16 available that would reduce it to a level that would be less than significant. This impact is therefore
 17 considered significant and unavoidable.

18 **Mitigation Measure WQ-22: Implement Principals of Integrated Pest Management**

19 Implement the principals of integrated pest management (IPM) in the management of invasive
 20 aquatic vegetation under CM13, including the selective use of pesticides applied in a manner
 21 that minimizes risks to human health, nontarget organisms and the aquatic ecosystem. In doing
 22 so, the project proponents will consult with the Central Valley Water Board, USFWS, NMFS, and
 23 CDBW to obtain effective IPM strategies such as selective application of pesticides, timing of
 24 applications in order to minimize tidal dispersion, and timing to target the invasive plant species
 25 at the most vulnerable times such that less herbicide can be used or the need for repeat
 26 applications can be reduced.

27 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 28 **and Maintenance (CM1)**

29 As described under Impact WQ-29, facilities operations and maintenance is not expected to result in
 30 substantial changes in TSS and Turbidity under the project alternative relative to Existing
 31 Conditions in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service
 32 Areas. Thus in these areas, long-term changes in the levels of suspended sediment-bound
 33 phosphorus are not expected. Additional factors that may affect phosphorus levels are discussed
 34 below.

35 ***Upstream of the Delta***

36 The conveyance facilities operations and maintenance (CM1) for Alternative 1A will not contribute
 37 additional sources of phosphorus to the water bodies upstream of the Delta. Because phosphorus
 38 loading to waters upstream of the Delta is not anticipated to change under Alternative 1A, and
 39 because changes in flows do not necessarily result in changes in concentrations or loading of
 40 phosphorus to these water bodies, as discussed for the No Action Alternative, substantial changes in
 41 phosphorus concentration are not anticipated in any of the water bodies of the affected
 42 environment located upstream of the Delta under Alternative 1A, relative to Existing Conditions or
 43 the No Action Alternative. Any negligible changes in phosphorus concentrations that may occur in

1 these water bodies would not be of frequency, magnitude and geographic extent that would exceed
 2 adopted phosphorus objectives/criteria (because there are none), adversely affect any beneficial
 3 uses, or substantially degrade the quality of these water bodies, with regards to phosphorus.

4 ***Delta***

5 As discussed for the No Action Alternative, because phosphorus concentrations in the major source
 6 waters to the Delta are similar for much of the year, phosphorus concentrations in the Delta are not
 7 anticipated to change substantially on a long term-average basis. Additionally, activities associated
 8 with CM1 will not contribute additional sources of phosphorus to the Delta. Phosphorus
 9 concentrations may increase during January through March at locations where the source fraction of
 10 San Joaquin River water increases, due to the higher concentration of phosphorus in the San Joaquin
 11 River during these months compared to Sacramento River water or San Francisco Bay water. Based
 12 on the DSM2 fingerprinting results (see Appendix 8D, *Source Water Fingerprinting Results*), together
 13 with source water concentrations show in Figure 8-56, the magnitude of increase during these
 14 months may range from negligible up to approximately 0.05 mg/L. However, there are no state or
 15 federal objectives for phosphorus, and because algal growth rates are limited by availability of light
 16 in the Delta, and thus increases or decreases in nutrient levels are, in general, expected to have little
 17 effect on productivity, any changes in phosphorus concentrations that may occur at certain locations
 18 within the Delta are not anticipated to be of frequency, magnitude and geographic extent that would
 19 adversely affect any beneficial uses or substantially degrade the water quality at these locations,
 20 with regards to phosphorus.

21 ***SWP/CVP Export Service Areas***

22 Assessment of effects of phosphorus in the SWP and CVP Export Service Areas is based on effects on
 23 phosphorus at the Banks and Jones pumping plants.

24 Based on the DSM2 fingerprinting results (see Appendix 8D), together with source water
 25 concentrations show in Figure 8-56, long-term average monthly and annual phosphorus
 26 concentrations at Banks and Jones pumping plants are anticipated to decrease as a result of
 27 Sacramento River water replacing San Joaquin River water in exports. During drought conditions,
 28 phosphorus concentrations may increase during certain months, but these increases are expected to
 29 be negligible (<0.01 mg/L). There are no state or federal objectives for phosphorus. Moreover, given
 30 the many factors that contribute to potential algal blooms in the SWP and CVP canals within the
 31 Export Service Area, and the lack of studies that have shown a direct relationship between nutrient
 32 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
 33 there is no basis to conclude that any seasonal increases in phosphorus concentrations at the levels
 34 expected under this alternative, should they occur, would increase the potential for problem algal
 35 blooms in the SWP and CVP Export Service Area.

36 Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones
 37 pumping plants are not expected to result in adverse effects to beneficial uses of exported water or
 38 substantially degrade the quality of exported water, with regards to phosphorus.

39 ***NEPA Effects:*** The effects on phosphorus from implementing CM1 are determined to not be adverse.

40 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
 41 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 42 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact

1 determination for this constituent. For additional details on the effects assessment findings that
 2 support this CEQA impact determination, see the effects assessment discussion that immediately
 3 precedes this conclusion.

4 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 5 because changes in flows do not necessarily result in changes in concentrations or loading of
 6 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
 7 Delta are not anticipated for Alternative 1A, relative to Existing Conditions.

8 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
 9 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
 10 long term-average basis under Alternative 1A, relative to Existing Conditions. Algal growth rates are
 11 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
 12 that may occur at some locations and times within the Delta would be expected to have little effect
 13 on primary productivity in the Delta.

14 The assessment of effects of phosphorus under Alternative 1A in the SWP and CVP Export Service
 15 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
 16 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
 17 anticipated to change substantially on a long term-average basis.

18 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
 19 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 20 CVP and SWP service areas under the Alternative 1A relative to Existing Conditions. As such, this
 21 alternative is not expected to cause additional exceedance of applicable water quality
 22 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 23 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 24 are not expected to increase substantially, no long-term water quality degradation is expected to
 25 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 26 within the affected environment and thus any minor increases that may occur in some areas would
 27 not make any existing phosphorus-related impairment measurably worse because no such
 28 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 29 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 30 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 31 than significant. No mitigation is required.

32 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 33 **CM2–CM21**

34 **NEPA Effects:** CM2–CM11 include activities that create additional aquatic habitat within the affected
 35 environment, and therefore may increase the total amount of algae and plant-life within the Delta.
 36 These activities would not affect phosphorus loading to the affected environment, but may affect
 37 phosphorus dynamics and speciation. For example, water column concentrations of total
 38 phosphorus may increase or decrease in localized areas as a result of increased or decreased
 39 suspended solids, while ortho-phosphate concentrations may be locally altered as a result of
 40 changing planktonic and macroinvertebrate species contributing to the cycling of phosphorus
 41 within the affected environment. Additionally, depending on age, configuration, location, operation,
 42 and season, some of the restoration measures included under these conservation measures may
 43 function to remove or sequester phosphorus, but since presently, the specific design, operational
 44 criteria, and location of these activities are not well established, the degree to which this would

1 occur is unknown. Overall, phosphorus concentrations are not expected to change substantially in
 2 the affected environment as a result of CM2–CM21. Because increases or decreases in phosphorus
 3 levels are, in general, expected to have little effect on productivity, any changes in phosphorus
 4 concentrations that may occur at certain locations within the affected environment are not
 5 anticipated to be of frequency, magnitude and geographic extent that would adversely affect any
 6 beneficial uses or substantially degrade the water quality at these locations, with regards to
 7 phosphorus.

8 Because urban stormwater is a source of phosphorus in the affected environment, CM19, Urban
 9 Stormwater Treatment, is expected to slightly reduce phosphorus loading to the Delta, thus slightly
 10 decreasing phosphorus concentrations relative to the No Action Alternative. Implementation of
 11 CM12–CM18 and CM20–CM21 is not expected to substantially alter phosphorus concentrations in
 12 the affected environment.

13 The effects on phosphorus from implementing CM2–CM21 are considered to be not adverse.

14 **CEQA Conclusion:** There would be no substantial, long-term increase in phosphorus concentrations
 15 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 16 CVP and SWP service areas due to implementation of CM2–CM21 under Alternative 1A relative to
 17 Existing Conditions. Because urban stormwater is a source of phosphorus in the affected
 18 environment, CM19, Urban Stormwater Treatment, is expected to slightly reduce phosphorus
 19 loading to the Delta. As such, implementation of these conservation measures is not expected to
 20 cause adverse effects on any beneficial uses of waters in the affected environment. Because
 21 phosphorus concentrations are not expected to increase substantially due to these conservation
 22 measures, no long-term water quality degradation is expected to occur and, thus, no adverse effects
 23 to beneficial uses would occur. Phosphorus is not 303(d) listed within the affected environment and
 24 thus any minor increases that may occur in some areas would not make any existing phosphorus-
 25 related impairment measurably worse because no such impairments currently exist. Because
 26 phosphorus is not bioaccumulative, minor increases that may occur in some areas would not
 27 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
 28 risks to fish, wildlife, or humans. This impact is considered to be less than significant. No mitigation
 29 is required.

30 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 31 **Maintenance (CM1)**

32 ***Upstream of the Delta***

33 For the same reasons stated for the No Action Alternative, Alternative 1A would have negligible, if
 34 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 35 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 36 concentrations that could occur in the water bodies of the affected environment upstream of the
 37 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
 38 beneficial uses or substantially degrade the quality of these water bodies, with regard to selenium.

39 ***Delta***

40 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 41 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 42 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are

1 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
2 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
3 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
4 more information.

5 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
6 locations under Alternative 1A, relative to Existing Conditions and the No Action Alternative, are
7 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-11 and M-21 for most biota
8 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
9 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
10 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
11 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
12 water at each modeled assessment location for all years. Appendix 8M, Figure M-21 provides more
13 detail in the form of monthly patterns of selenium concentrations in water during the modeling
14 period.

15 Alternative 1A would result in little to no changes in long-term average selenium concentrations in
16 water at all modeled Delta assessment locations relative to Existing Conditions and the No Action
17 Alternative (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some
18 interior and western Delta locations would increase by 0.01–0.02 µg/L for the entire period
19 modeled (1976–1991). These small increases in selenium concentrations in water would result in
20 small reductions (2% or less) in available assimilative capacity for selenium, relative to the 1.3 µg/L
21 USEPA draft water quality criterion (Figures 8-59a and 8-60a). The long-term average selenium
22 concentrations in water for Alternative 1A (range 0.09–0.38 µg/L) would be similar to those for
23 Existing Conditions (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L),
24 and all would be below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table 9a).

25 Relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in very
26 small changes (1% or less) in estimated selenium concentrations in most biota (whole-body fish,
27 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout the Delta, with little
28 difference among locations (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*, Table M-21).
29 Level of Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern
30 benchmarks) for selenium concentrations in those biota for all years and for drought years are less
31 than 1.0 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
32 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
33 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
34 predicted to increase by about 12% relative to Existing Conditions and to the No Action Alternative
35 in all years (from about 4.7 to 5.3 mg/kg dry weight), and those for sturgeon in the Sacramento
36 River at Mallard Island are predicted to increase by about 7% in all years (from about 4.4 to 4.7
37 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31). Selenium concentrations in sturgeon
38 during drought years are expected to increase by only 2% or 3% at those locations (Appendix 8M,
39 Tables M-30 and M-31). Detection of small changes in whole-body sturgeon such as those estimated
40 for the western Delta would require very large sample sizes because of the inherent variability in
41 fish tissue selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium
42 concentrations in sturgeon in the western Delta would exceed 1.0 (indicating a higher probability
43 for adverse effects) for drought years at both locations (as they do for Existing Conditions and the
44 No Action Alternative), and would increase slightly, from 0.94 to 1.1, for all years in the San Joaquin
45 River at Antioch (Appendix 8M, Table M-32).

1 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
2 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
3 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
4 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
5 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
6 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
7 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
8 the two western Delta locations and used literature-derived uptake factors and trophic transfer
9 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
10 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
11 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
12 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
13 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
14 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
15 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
16 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
17 waterborne selenium concentration at the two locations in different time periods.

18 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
19 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
20 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
21 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
22 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
23 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
24 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
25 most areas of the Delta.

26 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
27 Alternative 1A would be greater in the East Delta than in other sub-regions. Relative to Existing
28 Conditions, annual average residence times for Alternative 1A in the East Delta are expected to
29 increase by more than 8 days (Table 8-60a). Relative to the No Action Alternative, annual average
30 residence times for Alternative 1A in the Cache Slough are expected to increase by up to 10 days.
31 Increases in residence times for other sub-regions would be smaller, especially as compared to
32 Existing Conditions and the No Action Alternative (which are longer than those modeled for the East
33 Delta). As mentioned above, these results incorporate hydrodynamic effects of both CM1 and CM2
34 and CM4, and the effects of CM1 cannot be distinguished from the effects of CM2 and CM4. However,
35 it is expected that CM2 and CM4 are substantial drivers of the increased residence time.

36 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
37 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
38 concentrations in particulates, as the lowest level of the food chain, relative to the waterborne
39 concentration], and associated tissue concentrations [especially in clams and their consumers, such
40 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
41 (73,732 cfs in June 1998 to 12, 251 cfs in October 1998), residence time doubled (from 11 to 22
42 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
43 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
44 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

1 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
 2 as related to residence time, but the effects of residence time are incorporated in the
 3 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
 4 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
 5 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
 6 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
 7 concentrations are currently low and not approaching thresholds of concern (which, as discussed
 8 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
 9 residence time alone would not be expected to cause them to then approach or exceed thresholds of
 10 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
 11 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
 12 sparse, the most likely area in which biota tissues would be at levels high enough that additional
 13 bioaccumulation due to increased residence time from restoration areas would be a concern is the
 14 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
 15 increase in residence time estimated in the western Delta is 2 days relative to Existing Conditions,
 16 and 5 days relative to the No Action Alternative. Given the available information, these increases are
 17 small enough that they are not expected to substantially affect selenium bioaccumulation in the
 18 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
 19 residence times, further discussion is included in Impact WQ-26 below.

20 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 1A would
 21 result in essentially no change in selenium concentrations throughout the Delta for most biota
 22 (approximately 1% or less), although increases in selenium concentrations are predicted for
 23 sturgeon in the western Delta. Concentrations of selenium in sturgeon would exceed only the lower
 24 benchmark, indicating a low potential for adverse effects. The modeling of bioaccumulation for
 25 sturgeon is less calibrated to site-specific conditions than that for other biota, which was calibrated
 26 on a robust dataset for modeling of bioaccumulation in largemouth bass as a representative species
 27 for the Delta. Overall, Alternative 1A would not be expected to substantially increase the frequency
 28 with which applicable benchmarks would be exceeded in the Delta (there being only a small
 29 increase for sturgeon relative to the low benchmark and no exceedance of the high benchmark) or
 30 substantially degrade the quality of water in the Delta, with regard to selenium.

31 ***SWP/CVP Export Service Areas***

32 Alternative 1A would result in small (0.05–0.06 $\mu\text{g}/\text{L}$) decreases in long-term average selenium
 33 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
 34 the No Action Alternative, for the entire period modeled (Appendix 8M, Table M-9a). These
 35 decreases in selenium concentrations in water would result in increases in available assimilative
 36 capacity for selenium at these pumping plants of 6–7%, relative to the 1.3 $\mu\text{g}/\text{L}$ benchmark (Figures
 37 8-59a and 8-60a). Furthermore, the long-term average selenium concentrations in water for
 38 Alternative 1A (range 0.15–0.2 $\mu\text{g}/\text{L}$) would be well below the USEPA draft water quality criterion of
 39 1.3 $\mu\text{g}/\text{L}$ (Table M-9a in Appendix 8M).

40 Relative to Existing Conditions and the No Action Alternative, Alternative 1A would result in very
 41 small changes (less than 1%) in estimated selenium concentrations in biota (whole-body fish, bird
 42 eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Figures 8-61a through 8-64b;
 43 Appendix 8M, *Selenium*, Table M-21) at the Banks and Jones pumping plants. Concentrations in biota
 44 would not exceed any selenium benchmarks for Alternative 1A (Figures 8-61a through 8-64b).

1 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
2 bioaccumulated in biota) from Alternative 1A are not considered to be adverse.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
4 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
5 *Determination of Effects*) for the purpose of making the CEQA impact determination for selenium.
6 For additional details on the effects assessment findings that support this CEQA impact
7 determination, see the effects assessment discussion that immediately precedes this conclusion.

8 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
9 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
10 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
11 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
12 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
13 Valley Water Board [2010d] and State Water Board [2010b, 2010c]) that are expected to result in
14 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
15 modified reservoir operations and subsequent changes in river flows under Alternative 1A, relative
16 to Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
17 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
18 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
19 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
20 water bodies as related to selenium.

21 Relative to Existing Conditions, modeling estimates indicate that Alternative 1A would result in
22 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
23 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
24 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
25 would increase slightly, from 0.94 for Existing Conditions to 1.1 for Alternative 1A. Concentrations
26 of selenium in sturgeon would exceed only the lower benchmark, indicating a low potential for
27 adverse effects. Overall, Alternative 1A would not be expected to substantially increase the
28 frequency with which applicable benchmarks would be exceeded in the Delta (there being only a
29 small exceedance relative to the low benchmark for sturgeon and no exceedance of the high
30 benchmark) or substantially degrade the quality of water in the Delta, with regard to selenium.

31 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
32 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
33 Alternative 1A would cause no increase in the frequency with which applicable benchmarks would
34 be exceeded, and would slightly improve the quality selenium concentrations of water in at the
35 Banks and Jones pumping plants.

36 Based on the above, selenium concentrations that would occur in water under Alternative 1A would
37 not cause additional exceedances of applicable state or federal numeric or narrative water quality
38 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
39 (Appendix 8M; Table 8-54), by frequency, magnitude, and geographic extent that would result in
40 adverse effects to one or more beneficial uses within affected water bodies. In comparison to
41 Existing Conditions, water quality conditions under this alternative would not increase levels of
42 selenium by frequency, magnitude, and geographic extent such that the affected environment would
43 be expected to have measurably higher body burdens of selenium in aquatic organisms, thereby
44 substantially increasing the health risks to wildlife (including fish) or humans consuming those

1 organisms. Water quality conditions under this alternative with respect to selenium would not cause
2 long-term degradation of water quality in the affected environment, and therefore would not result
3 in use of available assimilative capacity such that exceedances of water quality objectives/criteria
4 would be likely and would result in substantially increased risk for adverse effects to one or more
5 beneficial uses. This alternative would not further degrade water quality by measurable levels, on a
6 long-term basis, for selenium and, thus, cause the CWA Section 303(d)-listed impairment of
7 beneficial use to be made discernibly worse. This impact is considered to be less than significant. No
8 mitigation is required.

9 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–** 10 **CM21**

11 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
12 from habitat restoration, CM2–CM21 would not substantially increase selenium concentrations in
13 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
14 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
15 thus such effects of these restoration measures were included in the assessment of CM1 facilities
16 operations and maintenance (see Impact WQ-25).

17 As discussed in Impact WQ-25, implementation of these conservation measures may increase water
18 residence time within the restoration areas. Increased restoration area water residence times could
19 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
20 egg concentrations of selenium (see residence time discussion in Appendix 8M, *Selenium*, and
21 Presser and Luoma [2010b]). Models are not available to quantitatively estimate the level of changes
22 in selenium bioaccumulation as related to residence time, but the effects of residence time are
23 incorporated in the bioaccumulation modeling for selenium that was based on higher K_d values for
24 drought years in comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in
25 fish tissue or bird egg selenium were to occur, the increases would likely be of concern only where
26 fish tissues or bird eggs are already elevated in selenium to near or above thresholds of concern.
27 That is, where biota concentrations are currently low and not approaching thresholds of concern
28 (which, as discussed above, is the case throughout the Delta, except for sturgeon in the western
29 Delta), changes in residence time alone would not be expected to cause them to then approach or
30 exceed thresholds of concern. In consideration of this factor, although the Delta as a whole is a CWA
31 Section 303(d)-listed water body for selenium, and although monitoring data of fish tissue or bird
32 eggs in the Delta are sparse, the most likely area in which biota tissues would be at levels high
33 enough that additional bioaccumulation due to increased residence time from restoration areas
34 would be a concern is the western Delta and Suisun Bay for sturgeon, as discussed above. As shown
35 in Table 8-60a, the overall increase in residence time estimated in the western Delta is 2 days
36 relative to Existing Conditions, and 5 days relative to the No Action Alternative. Given the available
37 information, these increases are small enough that they are not expected to substantially affect
38 selenium bioaccumulation in the western Delta.

39 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
40 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. The San
41 Francisco Bay Water Board is conducting a TMDL project to address selenium toxicity in the North
42 San Francisco Bay (North Bay), defined to include a portion of the Delta, Suisun Bay, Carquinez
43 Strait, San Pablo Bay, and the Central Bay (State Water Resources Control Board 2011). The North
44 Bay selenium TMDL will identify and characterize selenium sources to the North Bay and the
45 processes that control the uptake of selenium by wildlife. The TMDL will quantify selenium loads,

1 develop and assign waste load and load allocations among sources, and include an implementation
2 plan designed to achieve the TMDL and protect beneficial uses. Nonpoint sources of selenium in the
3 San Joaquin Valley that contribute selenium to the San Joaquin River, and thus the Delta and Suisun
4 Bay, will be controlled through a TMDL developed by the Central Valley Water Board (2001) for the
5 lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
6 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources
7 Control Board 2010b and 2010c) that are expected to result in decreasing discharges of selenium
8 from the San Joaquin River to the Delta.

9 The South Delta receives elevated selenium loads from the San Joaquin River, and as Table 8-60a
10 shows, residence times in this area are expected to increase on an annual average by 11 days
11 relative to Existing Conditions, and 9 days relative to the No Action Alternative. However, as
12 discussed in Impact WQ-25, biota concentrations in the South Delta are not approaching levels of
13 concern. Furthermore, in contrast to Suisun Bay and possibly the western Delta in the future, the
14 South Delta lacks the overbite clam (*Corbula [Potamocorbula] amurensis*), which is considered a key
15 driver of selenium bioaccumulation in Suisun Bay, due to its high bioaccumulation of selenium and
16 its role in the benthic food web that includes long-lived sturgeon. The South Delta does have
17 *Corbicula fluminea*, another bivalve that bioaccumulates selenium, but to a lesser degree than the
18 overbite clam (Lee et al. 2006). Also, as mentioned above, nonpoint sources of selenium in the San
19 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
20 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
21 Grassland Bypass Project, and Basin Plan objectives (Central Valley Regional Water Quality Control
22 Board 2010d; State Water Resources Control Board 2010b and 2010c) that are expected to result in
23 decreasing discharges of selenium from the San Joaquin River to the Delta. Further, if selenium
24 levels in the San Joaquin River are not sufficiently reduced via these efforts, it is expected that the
25 State Water Board and Central Valley Water Board would initiate additional TMDLs to further
26 control nonpoint sources of selenium. Given the available information, these increases are small
27 enough that they are not expected to cause selenium concentrations in biota in the south Delta to
28 approach or exceed thresholds of concern.

29 Wetland restoration areas will not be designed such that water flows in and does not flow out.
30 Exchange of water between the restoration areas and existing Delta channels is an important design
31 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
32 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, *Biological Goals and Objectives*).
33 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
34 residence times associated with BDCP restoration could increase, they are not expected to increase
35 without bound, and selenium concentrations in the water column would not continue to build up
36 and be recycled in sediments and organisms as may be the case within a closed system.

37 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
38 proposed avoidance and minimization measures would require evaluating risks of selenium
39 exposure at a project level for each restoration area, minimizing to the extent feasible potential risk
40 of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to establish
41 whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
42 *Environmental Commitments, AMMs, and CMs*, for a description of the environmental commitment
43 project proponents are making with respect to Selenium Management; and Appendix 3.C of the
44 BDCP for additional detail on this avoidance and minimization measure (AMM27). Data generated as
45 part of the avoidance and minimization measures will assist the State and Regional Water Boards in
46 determining whether beneficial uses are being impacted by selenium, and thus will provide the data

1 necessary to support regulatory actions (including additional TMDL development), should such
2 actions be warranted.

3 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
4 waterborne selenium that could occur in some areas as a result of increased water residence time
5 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
6 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
7 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
8 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
9 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
10 bird eggs such that the beneficial use impairment would be made discernibly worse.

11 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
12 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
13 and minimization measures that are designed to further minimize and evaluate the risk of such
14 increases, the effects of WQ-26 are considered not adverse.

15 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
16 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
17 to the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing
18 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
19 water quality objectives/criteria.

20 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
21 waterborne selenium that could occur in some areas as a result of increased water residence times
22 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
23 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
24 would not substantially increase risk for adverse effects to beneficial uses. CM2–CM21 would not
25 cause long-term degradation of water quality resulting in sufficient use of available assimilative
26 capacity such that occasionally exceeding water quality objectives/criteria would be likely. Also,
27 CM2–CM21 would not result in substantially increased risk for adverse effects to any beneficial uses.
28 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
29 the assessment above, it is unlikely that restoration areas would result in measurable increases in
30 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
31 discernibly worse.

32 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
33 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
34 and minimization measures that are designed to further minimize and evaluate the risk of such
35 increases (see Appendix 3.C of the BDCP for more detail on AMM27) also described as the Selenium
36 Management environmental commitment (see Appendix 3B, *Environmental Commitments, AMMs,*
37 *and CMs*), this impact is considered less than significant. No mitigation is required.

38 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 39 **and Maintenance (CM1)**

40 ***Upstream of the Delta***

41 For the same reasons stated for the No Action Alternative, Alternative 1A would result in negligible,
42 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs

1 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 2 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 3 annual and long-term average basis. As such, Alternative 1A would not be expected to substantially
 4 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
 5 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
 6 degrade the quality of these water bodies, with regard to trace metals.

7 ***Delta***

8 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
 9 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
 10 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
 11 are expected to be negligible, on a long-term average basis. As such, Alternative 1A would not be
 12 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
 13 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
 14 regard to trace metals.

15 ***SWP/CVP Export Service Areas***

16 For the same reasons stated for the No Action Alternative, Alternative 1A would not result in
 17 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
 18 from the Sacramento River through the proposed conveyance facilities. As such, there is not
 19 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
 20 area waters under Alternative 1A, relative to Existing Conditions and the No Action Alternative. As
 21 such, Alternative 1A would not be expected to substantially increase the frequency with which
 22 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
 23 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
 24 water bodies, with regard to trace metals.

25 ***NEPA Effects:*** In summary, Alternative 1A, relative to the No Action Alternative, would not cause a
 26 substantial increase in long-term average trace metals concentrations within the affected
 27 environment, nor would it cause an increased frequency of water quality objective/criteria
 28 exceedances within the affected environment. The effect on trace metals is determined not to be
 29 adverse.

30 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 32 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 33 constituent. For additional details on the effects assessment findings that support this CEQA impact
 34 determination, see the effects assessment discussion that immediately precedes this conclusion.

35 While greater water demands under the Alternative 1A would alter the magnitude and timing of
 36 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
 37 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
 38 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
 39 therefore, changes in river flows would not be expected to cause a substantial long-term change in
 40 trace metal concentrations upstream of the Delta.

41 Average and 95th percentile trace metal concentrations are very similar across the primary source
 42 waters to the Delta. Given this similarity, very large changes in source water fraction would be

1 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 2 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 3 waters are all below their respective water quality criteria, including those that are hardness-based
 4 without a WER adjustment. No mixing of these three source waters could result in a metal
 5 concentration greater than the highest source water concentration, and given that trace metals do
 6 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
 7 not be expected to occur under the Alternative 1A.

8 The assessment of the Alternative 1A effects on trace metals in the SWP/CVP Export Service Areas is
 9 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
 10 As just discussed regarding similarities in Delta source water trace metal concentrations, the
 11 Alternative 1A is not expected to result in substantial changes in trace metal concentrations in Delta
 12 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
 13 in the SWP/CVP Export Service Area are expected to be negligible.

14 Based on the above, there would be no substantial long-term increase in trace metal concentrations
 15 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
 16 service area waters under Alternative 1A relative to Existing Conditions. As such, this alternative is
 17 not expected to cause additional exceedance of applicable water quality objectives by frequency,
 18 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 19 in the affected environment. Because trace metal concentrations are not expected to increase
 20 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
 21 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
 22 trace metal concentrations that may occur in water bodies of the affected environment would not be
 23 expected to make any existing beneficial use impairments measurably worse. The trace metals
 24 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 25 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
 26 significant. No mitigation is required.

27 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 28 **CM2–CM21**

29 **NEPA Effects:** Implementation of CM2–CM21 present no new sources of trace metals to the affected
 30 environment, including areas upstream of the Delta, within the Delta, or in the SWP and CVP service
 31 areas. However, CM19, which would fund projects to contribute to reducing pollutant discharges in
 32 stormwater, would be expected to reduce trace metal loading to surface waters of the affected
 33 environment. The remaining conservation measures would not be expected to affect trace metal
 34 levels, because they are actions that do not affect the presence of trace metal sources. As they
 35 pertain to trace metals, implementation of these conservation measures would not be expected to
 36 adversely affect beneficial uses of the affected environment or substantially degrade water quality
 37 with respect to trace metals.

38 In summary, implementation of CM2–CM21 under Alternative 1A, relative to the No Action
 39 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 40 metals from implementing CM2–CM21 is determined not to be adverse.

41 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 1A would not cause substantial
 42 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 43 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 44 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and

1 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 2 environment. Because trace metal concentrations are not expected to increase substantially, no
 3 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 4 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 5 concentrations that may occur throughout the affected environment would not be expected to make
 6 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 7 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 8 problems in aquatic life or humans. This impact is considered to be less than significant. No
 9 mitigation is required.

10 **ImpactWQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 For the same reasons stated for the No Action Alternative, Alternative 1A is expected to have
 14 minimal effect on TSS concentrations and turbidity levels (highs, lows, typical conditions) in
 15 reservoirs and rivers upstream of the Delta relative to Existing Conditions and the No Action
 16 Alternative. Any minor increases in TSS concentrations and turbidity levels that may occur under
 17 Alternative 1A would not be of sufficient frequency, magnitude, and geographic extent that would
 18 result in adverse effects on beneficial uses within the Upstream of the Delta Region, or substantially
 19 degrade the quality of these water bodies, with regard to TSS and turbidity.

20 ***Delta***

21 The TSS concentrations and turbidity levels of Delta inflows under operational and maintenance
 22 conditions of Alternative 1A are not expected to be substantially different from those occurring
 23 under Existing Conditions or would occur under the No Action Alternative. However, the
 24 implementation of this alternative would change the quantity of Delta inflows, which would affect
 25 Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels. Localized
 26 changes in TSS concentrations and turbidity levels could occur, depending on how rapidly the Delta
 27 hydrodynamics are altered and the channels equilibrate with the new tidal flux regime, after
 28 implementation of this alternative. The magnitude of increases in TSS concentrations and turbidity
 29 levels in the affected channels due to higher potential of erosion cannot be readily quantified.
 30 However, geomorphic changes associated with sediment transport and deposition are usually
 31 gradual, occurring over years. Because the diversions would not substantially affect flows in high
 32 storm events, it is expected that the TSS concentrations and turbidity levels in the affected channels
 33 would not be substantially different from the levels under Existing Conditions or the No Action
 34 Alternative. Consequently, any notable increases in TSS concentrations and turbidity levels that may
 35 occur under Alternative 1A would likely be short-term in nature and long-term changes under this
 36 alternative would not be of sufficient frequency, magnitude and geographic extent that would result
 37 in adverse effects on beneficial uses in the Delta region, or substantially degrade the quality of these
 38 water bodies, with regard to TSS and turbidity.

39 ***SWP/CVP Export Service Areas***

40 The water delivered to the SWP/CVP Export Service Areas would differ from that under Existing
 41 Conditions and the No Action Alternative, as it would consist of water diverted directly from the
 42 Sacramento River at Hood in addition to water withdrawn from the Delta at the current export
 43 pumps. Historical median turbidity levels in the Sacramento River at Hood (11 NTU) and in the Delta

1 waters at the Harvey O. Banks Pumping Plant Headworks (11 NTU) are similar (Figure 8-47) and
2 mean turbidity levels differ by 5 NTU (13 NTU at Banks pumping plant and 18 NTU in the
3 Sacramento River at Hood). Thus, it is expected that the TSS concentrations and turbidity levels in
4 the vicinity of the south Delta export pumps would not be substantially different from the levels
5 under the Existing Conditions or the No Action Alternative. Consequently, the increases in TSS
6 concentrations and turbidity levels that may occur under Alternative 1A would not be of sufficient
7 frequency, magnitude, and geographic extent that would result in adverse effects on beneficial uses
8 within the SWP/CVP Export Service Areas or substantially degrade the quality of these water bodies,
9 with regard to TSS and turbidity.

10 **NEPA Effects:** The effects on TSS and turbidity from implementing CM1 is determined to not be
11 adverse.

12 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
13 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
14 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
15 constituent. For additional details on the effects assessment findings that support this CEQA impact
16 determination, see the effects assessment discussion that immediately precedes this conclusion.

17 Changes river flow rate and reservoir storage that would occur under Alternative 1A, relative to
18 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
19 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
20 suspended sediment concentrations are more affected by season than flow. Site-specific and
21 temporal exceptions may occur due to localized temporary construction activities, dredging
22 activities, development, or other land use changes would be site-specific and temporal, which would
23 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
24 than substantial levels.

25 Within the Delta, geomorphic changes associated with sediment transport and deposition are
26 usually gradual, occurring over years, and high storm event inflows would not be substantially
27 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
28 would not be substantially different from the levels under Existing Conditions. Consequently, this
29 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
30 region, relative to Existing Conditions.

31 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
32 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 1A, relative to
33 Existing Conditions, because this alternative is not expected to result in substantial changes in TSS
34 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

35 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
36 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
37 concentrations and turbidity levels are not expected to be substantially different, long-term water
38 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
39 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act Section 303(d)
40 listed constituents. This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

2 **NEPA Effects:** Creation of habitat and open water through implementation of CM2–CM11 could
 3 affect Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels.
 4 The magnitude of increases in TSS concentrations and turbidity levels in the affected channels due
 5 to higher potential of erosion cannot be readily quantified. The increases in TSS concentrations and
 6 turbidity levels in the affected channels could be substantial in localized areas, depending on how
 7 rapidly the Delta hydrodynamics are altered and the channels equilibrate with the new tidal flux
 8 regime, after implementation of this alternative. However, geomorphic changes associated with
 9 sediment transport and deposition are usually gradual, occurring over years. Within the
 10 reconfigured channels there could be localized increases in TSS concentrations and turbidity levels,
 11 but within the greater Plan Area it is expected that the TSS concentrations and turbidity levels
 12 would not be substantially different from the levels under the No Action Alternative.

13 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
 14 would be expected to reduce TSS and turbidity in urban discharges relative to the No Action
 15 Alternative. The remaining conservation measures (i.e., CM12–CM18, CM20–CM21) would not be
 16 expected to affect TSS concentrations and turbidity levels, because they are actions that do not affect
 17 the presence of TSS and turbidity sources.

18 The effects on TSS and turbidity from implementing CM2–CM21 is determined to not be adverse.

19 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
 20 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of CM2–CM21
 21 under Alternative 1A would not be substantially different relative to Existing Conditions, except
 22 within localized areas of the Delta modified through creation of habitat and open water. Therefore,
 23 this alternative is not expected to cause additional exceedance of applicable water quality objectives
 24 where such objectives are not exceeded under Existing Conditions. Because TSS concentrations and
 25 turbidity levels Upstream of the Delta, in the greater Plan Area, and in the SWP/CVP Export Service
 26 Areas are not expected to be substantially different, long-term water quality degradation is not
 27 expected relative to TSS and turbidity, and, thus, beneficial uses are not expected to be adversely
 28 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act Section 303(d)
 29 listed constituents. This impact is considered to be less than significant. No mitigation is required.

30 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 31 **(CM1–CM21)**

32 This section addresses construction-related water quality effects to constituents of concern other
 33 than effects caused by changes in the operations and maintenance of CM1–CM21, which are
 34 addressed in terms of constituent-specific impact assessments elsewhere in this chapter. Under
 35 Alternative 1A, the majority of construction-related activities for CM1–CM21 would occur within the
 36 Delta. Few, if any, of the CM1–CM21 actions involve construction work in the SWP and CVP Service
 37 Area or areas upstream of the Delta. The conservation measures, or components of measures, that
 38 are anticipated to be constructed in areas upstream of the Delta would be limited to: 1) *CM2 Yolo*
 39 *Bypass Fisheries Enhancement* (i.e., the Fremont Weir component of the action), 2) *CM18*
 40 *Conservation Hatcheries* (i.e., the new hatchery facility), and 3) *CM19 Urban Stormwater Treatment*.

41 Within the Delta, the construction-related activities for Alternative 1A would be most extensive for
 42 CM1 involving the new water conveyance facilities. Construction of water conveyance facilities
 43 would involve vegetation removal, material storage and handling, excavation, overexcavation for

1 facility foundations, surface grading, trenching, road construction, levee construction, construction
 2 site dewatering, soil stockpiling, reusable tunnel material (RTM) dewatering basin construction and
 3 storage operations, and other general facility construction activities (i.e., concrete, steel, carpentry,
 4 and other building trades) over approximately 7,500 acres during the course of constructing the
 5 facilities. Vegetation would be removed (via grubbing and clearing) and grading and other
 6 earthwork would be conducted at the intakes, pumping plants, the intermediate forebay, the Byron
 7 Tract Forebay, canal and gates between the Byron Tract Forebay tunnel shafts and the approach
 8 canal to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and
 9 transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts
 10 and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations,
 11 bridge abutments, barge unloading facilities, and laydown areas. Construction of each intake would
 12 take nearly 4 years to complete.

13 Habitat restoration activities in the Delta (i.e., CM4–CM10), including restored tidal wetlands,
 14 floodplain, and related channel margin and off-channel habitats, also would involve substantial in-
 15 water construction-related activities across widespread areas of the Delta. Construction activities
 16 also would occur for CM2 in the Yolo Bypass to implement fish enhancement features. Anticipated
 17 construction activities that may occur under CM11–CM21, if any, would involve relatively minor
 18 disturbances, and thus would not be anticipated to result in substantial discharges of any
 19 constituents of concern.

20 **NEPA Effects:** The types of potential construction-related materials used, soil and vegetation
 21 disturbance activities, potential contaminants associated with implementation of CM1–CM21 under
 22 Alternative 1A would result in similar potential contaminant discharges to water bodies and
 23 associated water quality effects to those discussed above for the No Action Alternative. Construction
 24 activities also may result in temporary or permanent changes in stormwater drainage and runoff
 25 patterns (i.e., velocity, volume, and direction) that may cause or contribute to soil erosion and offsite
 26 sedimentation. However, relative to Existing Conditions and the No Action Alternative conditions,
 27 these additional major land and in-water disturbances and related site development activities would
 28 be more widespread than non-BDCP projects, and therefore would increase the potential to cause
 29 direct discharges and stormwater runoff of contaminants to adjacent water bodies, particularly
 30 during the rainy season (generally October to April in California).

31 Land surface grading and excavation activities, or exposure of disturbed sites immediately following
 32 construction and prior to stabilization, could result in rainfall- and stormwater-related soil erosion,
 33 runoff, and offsite sedimentation in surface water bodies. The initial runoff following construction,
 34 or return of seasonal rains to previously disturbed sites, can result in runoff with peak pollutant
 35 levels and is referred to as “first flush” storm events. Soil erosion and runoff can also result in
 36 increased concentrations and loading of organic matter, nutrients (nitrogen and phosphorus), and
 37 other contaminants contained in the soil such as trace metals, pesticides, or animal-related
 38 pathogens. Graded and exposed soils also can be compacted by heavy machinery, resulting in
 39 reduced infiltration of rainfall and runoff, thus increasing the rate of runoff (and hence
 40 contaminants) to downstream water bodies. Construction activities necessary to develop the new
 41 habitat restoration areas for CM2 and CM4–CM10 would likely involve a variety of extensive
 42 conventional clearing and grading activities on relatively dry sites that are currently separated from
 43 the Delta channels by levees, construction of extensive new setback levees, excavation and soil
 44 placement for new wetland and other habitat feature development, and a variety of potential in-
 45 water construction activities such as excavation, sediment dredging, levee breaching, and hauling
 46 and placement or disposal of excavated sediment or dredge material. Construction activities for the

1 proposed restoration sites, due to the direct connectivity with Delta channels, have the potential to
 2 result in direct discharge of eroded soil and construction-related contaminants, or indirectly
 3 through erosion and site inundation during the weeks or months following construction prior to
 4 stabilization of newly contoured and restored landforms and colonization by vegetation.

5 Construction activities also would be anticipated to involve the transport, handling, and use of a
 6 variety of hazardous substances and non-hazardous materials that may adversely affect water
 7 quality if discharged inadvertently to construction sites or directly to water bodies. Typical
 8 construction-related contaminants include petroleum products for refueling and maintenance of
 9 machinery (e.g., fuel, oils, solvents), concrete, paints and other coatings, cleaning agents, debris and
 10 trash, and human wastes. Construction activities also would involve large material storage and
 11 laydown areas, and occasional accidental spills of hazardous materials stored and used for
 12 construction may occur. Contaminants released or spilled on bare soil also may result in
 13 groundwater contamination. Construction would involve extensive excavation/trenching and other
 14 subsurface construction activities, trenching, or work in or near Delta channels requiring site-
 15 dewatering operations to isolate the construction site from surface and groundwater. Dewatering
 16 operations may contain elevated levels of suspended sediment or other constituents that may cause
 17 water quality degradation.

18 The intensity of construction activity along with the fate and transport characteristics of the
 19 chemicals used, would largely determine the magnitude, duration, and frequency of construction-
 20 related discharges and resulting concentrations and degradation associated with the specific
 21 constituents of concern. The potential water quality concerns associated with the major categories
 22 of contaminants that might be discharged as a result of construction activity include the following.

- 23 • Suspended sediment: May increase turbidity (i.e., reduce water clarity) that can affect aquatic
 24 organisms and increase the costs and effort of removal in municipal/industrial water supplies.
 25 Downstream sedimentation can affect aquatic habitat, or cause a nuisance if it affects functions
 26 of agricultural or municipal intakes, or boat navigation.
- 27 • Organic matter: May contribute turbidity and oxygen demanding substances (i.e., reduce DO
 28 levels) that can affect aquatic organisms. Organic carbon may increase the potential for
 29 disinfection byproduct formation in municipal drinking water supplies.
- 30 • Nutrients: May contribute nitrogen, phosphorus, and other key nutrients that can contribute to
 31 nuisance biostimulation of algae and vascular aquatic plants, which may affect municipal water
 32 supplies, recreation, aquatic life, and aesthetics.
- 33 • Petroleum hydrocarbons: May contribute toxic compounds to aquatic life, and oily sheens may
 34 reduce oxygen/gas transfer in water, foul aquatic habitats, and reduce water quality for
 35 municipal supplies, recreation, and aesthetics.
- 36 • Trace constituents (metals, pesticides, synthetic organic compounds): Compounds in eroded soil
 37 or construction-related materials (e.g., paints, coatings, cleaning agents) may be toxic to aquatic
 38 life.
- 39 • Pathogens: Bacteria, viruses, and protozoans may affect aquatic life and increase human health
 40 risks via municipal water supplies, reduced recreational water quality, or contaminated shellfish
 41 beds.

- Other inorganic compounds: Construction-related materials can contain inorganic compounds such as acidic/basic materials which can change pH and may adversely affect aquatic life and habitats. Concrete contains lime which can increase pH levels, and drilling fluids may alter pH.

Construction-related activities may contribute to the discharge of contaminants such as PAHs which may be bioaccumulative in aquatic organisms, and construction-related disturbances may contribute to discharge of contaminants in soils and sediments in the Delta that are associated with existing impairments identified for Delta water bodies on the state's Section 303(d) list.

For the purposes of this assessment, it is assumed that construction activities conducted for Alternative 1A would be conducted in conformance to applicable federal and state regulations pertaining to grading and erosion control, and contaminant spill control and response measures. The construction-related environmental commitments for water quality protection, as identified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, would be implemented by the project proponents. The environmental commitments for construction-related water quality protection would be specifically designed as a part of the final design, included in construction contracts as a required element, and would be implemented for Alternative 1A to avoid, prevent, and minimize the potential discharges of constituents of concern to water bodies and associated adverse water quality effects and comply with state water quality regulations. Additionally, temporary and permanent changes in stormwater drainage and runoff would be minimized and avoided through construction of new or modified drainage facilities, as described in the Chapter 3, *Description of Alternatives*. Alternative 1A would include installation of temporary drainage bypass facilities, long-term cross drainage, and replacement of existing drainage facilities that would be disrupted due to construction of new facilities.

In particular, construction-related activities under Alternative 1A would be conducted in accordance with the environmental commitment to develop and implement BMPs for all activities that may result in discharge of soil, sediment, or other construction-related contaminants from facilities related to construction to surface water bodies, and obtain authorization for the construction activities under the State Water Board's NPDES Stormwater General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002). This General Construction NPDES Permit requires the preparation and implementation of SWPPPs, which are the principal plans within the required Permit Registration Documents (PRDs) that identify the proposed erosion control and pollution prevention BMPs that would be used to avoid and minimize construction-related erosion and contaminant discharges. The development of the SWPPPs, and applicability of other provisions of this General Construction Permit depends on the "risk" classification for the construction which is determined based on the potential for erosion to occur as well as the susceptibility of the receiving water to potential adverse effects of construction. While the determination of project risk level, and planning and development of the SWPPPs and BMPs to be implemented, would be completed as a part of final design and contracting for the work, the responsibility for compliance with the provisions of the General Construction Permit necessitates that BMPs are applied to all disturbance activities. In addition to the BMPs, the SWPPPs would include BMP inspection and monitoring activities, and identify responsibilities of all parties, contingency measures, agency contacts, and training requirements and documentation for those personnel responsible for installation, inspection, maintenance, and repair of BMPs. The General Construction Permit contains Numeric Action Levels (NALs) for pH and turbidity, and specifies storm event water quality monitoring to determine if construction is resulting in elevated discharges of these constituents, and monitoring for any non-visible contaminants determined to have been potentially released. If an NAL is

1 determined to have been exceeded, the General Construction Permit requires the discharger to
 2 conduct a construction site and run-on evaluation to determine whether contaminant sources
 3 associated with the site's construction activity may have caused or contributed to the exceedance
 4 and immediately implement corrective actions if they are needed.

5 The BMPs that are routinely implemented in the construction industry and have proven successful
 6 at reducing adverse water quality effects include, but are not limited to, the following broad
 7 categories of actions (letters refer to categories of specific BMPs identified in Appendix 3B,
 8 *Environmental Commitments, AMMs, and CMs*), for which Appendix 3B identifies specific BMPs
 9 within these categories (See commitments to Develop and Implement Stormwater Pollution
 10 Prevention Plans and Develop and Implement Erosion and Sediment Control Plans):

- 11 ● Waste Management and Spill Prevention and Response (BMP categories A.2 and A.3): Waste
 12 management BMPs are designed to minimize exposure of waste materials at all construction
 13 sites and staging areas such as waste collection and disposal practices, containment and
 14 protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention
 15 and response BMPs involve planning, equipment, and training for personnel for emergency
 16 event response.
- 17 ● Erosion and Sedimentation Control (BMP categories A.4 and A.5): Erosion control BMPs are
 18 designed to prevent erosion processes or events including scheduling work to avoid rain events,
 19 stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff
 20 before it leaves the site; and slow runoff rates across construction sites. Identification of
 21 appropriate temporary and long-term seeding, mulching, and other erosion control measures as
 22 necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion
 23 has occurred involving drainage controls, perimeter controls, detention/sedimentation basins,
 24 or other containment features.
- 25 ● Good Housekeeping and Non-Stormwater Discharge Management (BMP category A.6 and A.7):
 26 Good housekeeping BMPs are designed to reduce exposure of construction sites and materials
 27 storage to stormwater runoff including truck tire tracking control facilities; equipment washing;
 28 litter and construction debris; and designated refueling and equipment inspection/maintenance
 29 practices Non-stormwater discharge management BMPs involve runoff measures for
 30 contaminants not directly associated with rain or wind including vehicle washing and street
 31 cleaning operations.
- 32 ● Construction Site Dewatering and Pipeline Testing (BMP category A.8). Dewatering BMPs
 33 involve actions to prevent discharge of contaminants present in dewatering of groundwater
 34 during construction, discharges of water from testing of pipelines or other facilities, or the
 35 indirect erosion that may be caused by dewatering discharges.
- 36 ● BMP Inspection and Monitoring (BMP category A.9): Identification of clear objectives for
 37 evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring
 38 procedures, environmental awareness training, contractor and agency roles and responsibilities,
 39 reporting procedures, and communication protocols.

40 In addition to the Category "A" BMPs for surface land disturbances identified in the environmental
 41 commitments (Appendix 3B, *Environmental Commitments, AMMs, and CMs*), BMPs implemented for
 42 Alternative 1A also would include the Category "B" BMPs for tunnel/pipeline construction that
 43 involves actions primarily to avoid and minimize sediment and contaminant discharges associated
 44 with RTM excavation, hauling, and RTM dewatering operations. Additionally, habitat restoration

1 activities under CM2 and CM4–CM10 would be subject to implementation of the Category “C” BMPs
 2 (In-Water Construction BMPs) and Category “D” BMPs (Tidal and Wetland Restoration) designed to
 3 minimize disturbance and direct discharge of turbidity/suspended solids to the water during in-
 4 water construction activities. Category “E” BMPs identify general permanent post-construction
 5 actions that would be implemented for all terrestrial, in-water, and habitat restoration activities and
 6 would involve planning, design, and development of final site stabilization, revegetation, and
 7 drainage control features.

8 Finally, acquisition of applicable environmental permits may be required for specific conservation
 9 measures, which as described for the No Action Alternative, may include specific WDRs or CWA
 10 Section 401 water quality certifications from the appropriate Regional Water Boards, CDFW
 11 Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits. These other
 12 permit processes may include requirements to implement additional action-specific BMPs that may
 13 reduce potential adverse discharge effects of constituents of concern.

14 The potential construction-related contaminant discharges that could result from projects defined
 15 under Alternative 1A would not be anticipated to result in adverse water quality effects at a
 16 magnitude, frequency, or regional extent that would cause substantial adverse effects to aquatic life.
 17 Relative to Existing Conditions, this assessment indicates the following.

- 18 • Projects would be managed under state water quality regulations and project-defined actions to
 19 avoid and minimize contaminant discharges.
- 20 • Individual projects would generally be dispersed, and involve infrequent and temporary
 21 activities, thus not likely resulting in substantial exceedances of water quality standards or long-
 22 term degradation.
- 23 • Potential construction-related contaminant discharges under the Alternative 1A would not
 24 cause additional exceedance of applicable water quality objectives where such objectives are not
 25 exceeded under Existing Conditions. Long-term water quality degradation is not anticipated,
 26 and hence would not be expected to adversely affect beneficial uses.
- 27 • By the intermittent and temporary frequency of construction-related activities and potential
 28 contaminant discharges, the constituent-specific effects would not be of substantial magnitude
 29 or duration to contribute to long-term bioaccumulation processes, or cause measureable long-
 30 term degradation such that existing 303(d) impairments would be made discernibly worse or
 31 TMDL actions to reduce loading would be adversely affected.

32 Consequently, because the construction-related activities for the conservation measures would be
 33 conducted with implementation of environmental commitments, including but not limited to those
 34 identified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, with respect to the Existing
 35 Conditions and No Action Alternative conditions, Alternative 1A would not be expected to cause
 36 constituent discharges of sufficient frequency and magnitude to result in a substantial increase of
 37 exceedances of water quality objectives/criteria, or substantially degrade water quality with respect
 38 to the constituents of concern, and thus would not adversely affect any beneficial uses in the Delta.

39 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 40 construction-related water quality effects are considered to be not adverse.

1 **CEQA Conclusion:** In summary, with implementation of environmental commitments in Appendix
 2 3B, *Environmental Commitments, AMMs, and CMs*, the potential construction-related water quality
 3 effects with respect to the Existing Conditions are considered to be less than significant. No
 4 mitigation is required.

5 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations**
 6 **and Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Impacts from *Microcystis* upstream of the Delta have only been documented in lakes such as Clear
 9 Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over other
 10 phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
 11 characterized by low nutrient concentrations, where other phytoplankton outcompete
 12 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
 13 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
 14 Joaquin River upstream of the Delta, under Existing Conditions and the No Action Alternative, bloom
 15 development is limited by high water velocity and low residence times. These conditions are not
 16 expected to change under Alternative 1A. Consequently, any modified reservoir operations under
 17 Alternative 1A are not expected to promote *Microcystis* production upstream of the Delta, relative to
 18 Existing Conditions and the No Action Alternative.

19 ***Delta***

20 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 21 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 22 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 23 included in this assessment of operations-related changes of water residence times and its effects on
 24 *Microcystis* production (i.e., CM1). Other effects of CM2 through CM21 not attributable to
 25 hydrodynamics are discussed within the impact header for CM2 through CM21.

26 Under Alternative 1A, modeled residence times in the six Delta sub-regions during the *Microcystis*
 27 bloom season of June through October show varying levels of change, depending on sub-region and
 28 timeframe (Table 8-60a). Although an increase in residence time throughout the Delta is expected
 29 under the No Action Alternative, relative to Existing Conditions, because of climate change and sea
 30 level rise, the change is fairly small in most areas of the Delta. Below, residence times under
 31 Alternative 1A is compared to residence times under the No Action Alternative to remove the effect
 32 of climate change and sea level rise, thereby revealing the effect due to CM1 (i.e., operations) and the
 33 effect of the CM2 and CM4 restoration areas, which were accounted for in the modeling performed
 34 for CM1.

35 Water residence time in the North Delta and West Delta are projected to increase in both the
 36 summer and fall periods by 11 and 8 days, respectively, compared to the No Action Alternative.
 37 During the summer period, residence time for the Cache Slough, East Delta, and South Delta sub-
 38 regions are projected to increase by 25, 14, and 6 days, respectively, compared to the No Action
 39 Alternative. During the fall period, residence time in these sub-regions is projected to decrease
 40 slightly. Water residence time in Suisun Marsh is projected to decrease 21 days in the summer and
 41 increase 20 days in the fall, relative to No Action Alternative.

1 The summer and fall period average residence times provide a general direction in which residence
2 time may change under Alternative 1A compared to the No Action Alternative. The changes in
3 residence time are driven by a number of factors accounted for in the modeling, including the
4 hydrodynamic effects of restoration actions planned under CM2 and CM4, diversion of Sacramento
5 River water at the proposed north Delta intake facility, as well as changes in net Delta outflows.
6 Variability in local residence times is expected within any Delta sub-region because major portions
7 of the Delta are comprised of complex networks of intertwining channels, shallow back water areas,
8 and submerged islands. Siting and design of restoration areas has substantial influence on the
9 magnitude of residence time increases that would occur under Alternative 1A. However, the
10 expected residence time changes under Alternative 1A, compared to the No Action Alternative, are
11 in a direction and of magnitude that could lead to an increase in the frequency, magnitude, and
12 geographic extent of *Microcystis* blooms throughout the Delta.

13 The relationship between Delta water temperatures, climate change, and changes in water
14 deliveries from upstream reservoirs are discussed in Appendix 29C, *Climate Change and the Effects*
15 *of Reservoir Operations on Water Temperatures in the Study Area*. In short, ambient meteorological
16 conditions are the primary driver of Delta water temperatures, meaning that climate warming and
17 not water operations will determine future water temperatures in the Delta. Climate projections for
18 the Central Valley discussed in Appendix 5A Section D indicate substantial warming of ambient air
19 temperatures with a median increase in annual temperature of about 1.1°C (2.0°F) by 2025 and
20 2.2°C (4.0°F) by 2060. The projected water temperature change ranges from 0.7 to 1.4°C (1.3 to
21 2.5°F) by 2025 and 1.6 to 2.7°C (2.9–4.9°F) by 2060. Increasing water temperatures could lead to
22 earlier attainment of the water temperature threshold of 19°C required to initiate *Microcystis* bloom
23 formation, and thus earlier occurrences of *Microcystis* blooms in the Delta, relative to Existing
24 Conditions. Warmer water temperatures could also increase bloom duration and magnitude,
25 relative to Existing Conditions. Elevated ambient water temperatures in the Delta, and thus an
26 increase in *Microcystis* bloom duration and magnitude, are expected under Alternative 1A, relative
27 to Existing Conditions, but these impacts are due entirely to climate change and not the project
28 alternative. Because climate change is assumed under the No Action Alternative, potential water
29 temperature-driven increases in *Microcystis* blooms in the Delta, relative to Existing Conditions, also
30 would occur under the No Action Alternative. Therefore, no water temperature-driven increases in
31 *Microcystis* blooms would occur in the Delta under Alternative 1A, relative to the No Action
32 Alternative.

33 ***SWP/CVP Export Service Areas***

34 The assessment of effects from *Microcystis* in the SWP/CVP Export Service Areas is based on the
35 assessment of *Microcystis* production in source waters to Banks and Jones Pumping plants, and upon
36 the effects of residence time and water temperature on the potential for *Microcystis* blooms to occur
37 in the Export Service Area.

38 Under Alternative 1A, exports from Banks and Jones pumping plants will consist of a mixture of
39 Sacramento River water diverted around the Delta, with water quality characteristic of both
40 upstream Sacramento River water, and Sacramento and San Joaquin River water that has flowed
41 through various portions of the North, South, and West Delta. Water diverted from the Sacramento
42 River in the North Delta is expected to be unaffected by *Microcystis* and microcystins. However, the
43 fraction of water flowing through the Delta that reaches the existing south Delta intakes is expected
44 to be influenced by an increase in the frequency, magnitude, and geographic extent of *Microcystis*
45 blooms discussed in the *Delta* Section above. Therefore, relative to Existing Conditions and the No

1 Action Alternative, the addition of Sacramento River water from the North Delta under Alternative
2 1A serves to dilute *Microcystis* and microcystins in water diverted from the South Delta with water
3 that is not expected to contain them. Because the degree to which *Microcystis* blooms, and thus
4 microcystins concentrations, will increase in source water from the South Delta is unknown, it
5 cannot be determined whether Alternative 1A will result in increased or decreased levels of
6 microcystins in the mixture of source waters exported from Banks and Jones pumping plants,
7 relative to Existing Conditions and the No Action Alternative.

8 *Microcystis* blooms have not occurred in the Export Service Areas even though source waters to the
9 SWP and CVP have been affected. Conditions in the Export Service Areas under Alternative 1A may
10 become more conducive to *Microcystis* bloom formation, relative to Existing Conditions, because
11 water temperatures will increase in the Export Service Areas due to the expected increase in
12 ambient air temperatures resulting from climate change. Residence times in this area are not
13 expected to substantially change under Alternative 1A, relative to Existing Conditions. Conditions in
14 the Export Service Areas under Alternative 1A are not expected to become more conducive to
15 *Microcystis* bloom formation, relative to the No Action Alternative, because neither water residence
16 time nor water temperatures will increase in the Export Service Areas.

17 **NEPA Effects:** In summary, Alternative 1A operations and maintenance, relative to the No Action
18 Alternative, would result in long-term increases in hydraulic residence time of various Delta sub-
19 regions during the summer and fall *Microcystis* bloom period. During this period, the increased
20 residence time could result in a concurrent increase in the frequency, magnitude, and geographic
21 extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta. As a result,
22 Alternative 1A operation and maintenance activities would cause further degradation to water
23 quality with respect to *Microcystis* in the Delta. Under Alternative 1A, relative to No Action
24 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
25 affected source water from the south Delta intakes and unaffected source water from the
26 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
27 and maintenance under Alternative 1A will result in increased or decreased levels of *Microcystis* and
28 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
29 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
30 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
31 *Microcystis* from implementing CM1 is determined to be adverse.

32 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
33 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
34 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
35 constituent. For additional details on the effects assessment findings that support this CEQA impact
36 determination, see the effects assessment discussion that immediately precedes this conclusion.

37 Under Alternative 1A additional impacts from *Microcystis* in the reservoirs and watersheds
38 upstream of the Delta are not expected, relative to Existing Conditions. Operations and maintenance
39 occurring under Alternative 1A is not expected to change nutrient levels in upstream reservoirs or
40 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
41 conducive to *Microcystis* production.

42 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
43 expected to increase under Alternative 1A, resulting in an increase in the frequency, magnitude and
44 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality

1 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
2 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
3 throughout the Delta during the summer and fall bloom period, due in small part to climate change
4 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
5 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
6 production expected within any Delta sub-region is unknown because conditions will vary across
7 the complex networks of intertwining channels, shallow back water areas, and submerged islands
8 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
9 to Alternative 1A. Consequently, it is possible that increases in the frequency, magnitude, and
10 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
11 maintenance of Alternative 1A and the hydrodynamic impacts of restoration (CM2 and CM4).

12 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
13 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
14 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
15 Under Alternative 1A, relative to Existing Conditions, the potential for *Microcystis* to occur in the
16 Export Service Area is expected to increase due to increasing water temperature, but this impact is
17 driven entirely by climate change and not Alternative 1A. Water exported from the Delta to the
18 Export Service Area is expected to be a mixture of *Microcystis*-affected source water from the south
19 Delta intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
20 determined whether operations and maintenance under Alternative 1A, relative to existing
21 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
22 of source waters exported from Banks and Jones pumping plants.

23 Based on the above, this alternative would not be expected to cause additional exceedance of
24 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
25 would cause significant impacts on any beneficial uses of waters in the affected environment.
26 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
27 increases that could occur in some areas would not make any existing *Microcystis* impairment
28 measurably worse because no such impairments currently exist. However, because it is possible that
29 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
30 occur due to the operations and maintenance of Alternative 1A and the hydrodynamic impacts of
31 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
32 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
33 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
34 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
35 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
36 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
37 the effects on *Microcystis* from implementing CM1 is determined to be significant.

38 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
39 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
40 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
41 remain significant and unavoidable.

1 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 2 ***Microcystis* Blooms**

3 It remains to be determined whether, or to what degree, *Microcystis* production will increase in
 4 Delta areas as a result of increased residence times associated with the implementation of the
 5 project alternative. Mitigation actions shall be focused on those incremental effects attributable
 6 to implementation of operations under the project alternative only. Development of mitigation
 7 actions for the incremental increase in *Microcystis* effects attributable to water temperature and
 8 residence time increases driven by climate change and sea level rise is not required because
 9 these changed conditions would occur with or without implementation of the project
 10 alternative. The goal of specific actions would be to reduce/avoid additional degradation of
 11 Delta water quality conditions with respect to occurrences of *Microcystis* blooms.

12 Additional evaluation will be conducted as part of the development of tidal habitat restoration
 13 areas to determine the feasibility of using site placement and design criteria to reduce or
 14 eliminate local conditions conducive to *Microcystis* production. Design criteria would be
 15 developed to provide guidelines for developing restoration areas to discourage *Microcystis*
 16 growth by maintaining adequate flushing, while maintaining the benefits of habitat restoration
 17 in terms of zooplankton production, fish food quality, and fish feeding success. For example, a
 18 target range of typical summer/fall hydraulic residence time that is long enough to promote
 19 phytoplankton growth, but not so long as to promote growth of *Microcystis*, could be used to aid
 20 restoration site design. However, currently there is not sufficient scientific certainty to evaluate
 21 whether or not longer residence times would result in greater *Microcystis* production, and also
 22 whether longer residence times might produce greater benefits to fish and other aquatic life
 23 than shorter residence times. This mitigation measure requires that residence time
 24 considerations be incorporated into restoration area site design for CM2 and CM4 using best
 25 available science at the time of design. It is possible that through these efforts, increases in
 26 *Microcystis* attributable to the project alternative, relative to Existing Conditions, could be
 27 mitigated. However, there may be instances where this design consideration may not be
 28 feasible, and thus, achieving *Microcystis* reduction pursuant to this mitigation measure would
 29 not be feasible.

30 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 31 **Water Residence Time**

32 Because it is not known where, when, and to what extent *Microcystis* will be more abundant
 33 under CM1 than under Existing Conditions, specific mitigation measures cannot be described.
 34 However, this mitigation measure requires the project proponents to monitor for *Microcystis*
 35 abundance in the Delta and use appropriate statistical methods to determine whether increases
 36 in abundance are significant. This mitigation measure also requires that if *Microcystis* abundance
 37 increases, relative to Existing Conditions, the project proponents will investigate and evaluate
 38 measures that could be taken to reduce residence time in the affected areas of the Delta.
 39 Operational actions could include timing of temporary or operable barrier openings and
 40 closings, reservoir releases, and location of Delta exports (i.e., North Delta vs. South Delta
 41 pumping facilities). Depending on the location and severity of the increases, one or more of
 42 these actions may be feasible for reducing residence times. If so, these actions could mitigate
 43 increases in *Microcystis* under CM1 attributable to the project alternative, relative to Existing
 44 Conditions. However, it is possible that these actions would not be feasible because they would
 45 conflict with other project commitments, would cause their own environmental impacts, or

1 would not be expected to reduce or mitigate increases in *Microcystis*. In this case, achieving
 2 *Microcystis* reduction pursuant to this mitigation measure would not be feasible.

3 **Impact WQ-33: Effects on *Microcystis* Bloom Formation Resulting from Other Conservation** 4 **Measures (CM2–CM21)**

5 Implementation of CM3 and CM6–CM21 is unlikely to affect *Microcystis* abundance in the rivers and
 6 reservoirs upstream of the Delta, in the Delta region, or the waters exported to the CVP and SWP
 7 service areas. Implementation of CM5, Seasonally Inundated Floodplain Restoration, could result in
 8 increased local water temperatures in areas near restored seasonally inundated floodplains.
 9 However, floodplain inundation typically occurs during spring and winter months when *Microcystis*
 10 growth is limited in general by low water temperatures and by insufficient surface water irradiance,
 11 and water temperatures would not increase sufficiently due to floodplain inundation such that
 12 effects on *Microcystis* growth would occur. Therefore, implementation of CM5 is unlikely to affect
 13 *Microcystis* blooms in the project area. Implementation of CM13, Invasive Aquatic Vegetation
 14 Control, may increase turbidity and flow velocity, particularly in restored aquatic habitats, which
 15 could discourage *Microcystis* growth in these areas. To the extent that IAV removal would affect
 16 turbidity and water velocity, it is possible that IAV removal could, to some degree, help offset the
 17 increase in *Microcystis* production expected under Alternative 1A, relative to the No Action
 18 Alternative.

19 As discussed in detail in Impact WQ-32, development of restoration areas which will occur under
 20 CM2 and CM4 could possibly increase the frequency, magnitude, and geographic extent of
 21 *Microcystis* blooms due to the hydrodynamic impacts that are expected to increase water residence
 22 times throughout various areas of the Delta relative to Existing Conditions and the No Action
 23 Alternative. Additionally, restoration activities that create shallow backwater areas, due to
 24 implementation of CM2 and CM4, could result in local warmer water that may encourage *Microcystis*
 25 growth during the summer bloom forming season and result in further degradation of water quality.
 26 Mitigation to specifically address the effects of local increases in water temperatures on *Microcystis*
 27 in the vicinity of such restoration areas is not available. Regardless of elevated water temperatures,
 28 sufficient residence time is required for *Microcystis* bloom formation. Thus, the combined effect on
 29 *Microcystis* from increased local water temperatures and increased water residence times may be
 30 reduced by implementation of Mitigation Measure WQ-32a. The effectiveness of the mitigation
 31 measure to result in feasible measures for reducing water quality effects is uncertain.

32 **NEPA Effects:** Although there is considerable uncertainty regarding this impact, the effects on
 33 *Microcystis* from implementing CM2–CM21 are determined to be adverse.

34 **CEQA Conclusions:** Based on the above, this alternative would not be expected to cause additional
 35 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 36 extent that would cause significant impacts on any beneficial uses of waters in the affected
 37 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 38 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 39 impairment measurably worse because no such impairments currently exist. Because restoration
 40 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
 41 create local areas of warmer water during the bloom season, it is possible that increases in the
 42 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
 43 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
 44 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*

1 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 2 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 3 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
 4 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 5 determined to be significant.

6 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 7 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 8 measures for reducing water quality effects is uncertain, this impact is considered to remain
 9 significant and unavoidable.

10 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 11 ***Microcystis* Blooms**

12 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

13 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 14 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

15 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 16 that Alternative 1A would have a less than significant impact/no adverse effect on the following
 17 constituents in the Delta:

- 18 • Boron
- 19 • Dissolved Oxygen
- 20 • Pathogens
- 21 • Pesticides
- 22 • Trace Metals
- 23 • Turbidity and TSS

24 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 25 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 26 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 27 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 28 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 29 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 30 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 31 quality of the of San Francisco Bay.

32 The effects of Alternative 1A on bromide, chloride, and DOC, in the Delta were determined to be
 33 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 34 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 35 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 36 adversely affect any beneficial uses of San Francisco Bay.

37 Elevated EC, as assessed for this alternative, is of concern for its effects on the agricultural supply
 38 AGR beneficial use and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does
 39 not have an AGR beneficial use designation. Further, as discussed for the No Action Alternative,

1 changes in Delta salinity would not contribute to measurable changes in Bay salinity, as the change
2 in Delta outflow, which would be the primary driver of salinity changes, would be two to three
3 orders of magnitude lower than (and thus minimal compared to) the Bay's tidal flow.

4 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
5 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
6 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
7 Suisun Bay.

8 While effects of Alternative 1A on the nutrients ammonia, nitrate, and phosphorus were determined
9 to be less than significant/not adverse, these constituents are addressed further below because the
10 response of the seaward bays to changed nutrient concentrations/loading may differ from the
11 response of the Delta. Selenium and mercury are discussed further, because they are
12 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
13 and exports are of concern.

14 **Nutrients: Ammonia, Nitrate, and Phosphorus**

15 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 1A would be
16 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
17 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
18 decrease by 31%, relative to Existing Conditions, and increase by 1%, relative to the No Action
19 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1); thus there would be little to no
20 degradation of water quality with regard to total nitrogen. The change in nitrogen loading to Suisun
21 and San Pablo Bays under Alternative 1A would not adversely impact primary productivity in these
22 embayments because light limitation and grazing currently limit algal production in these
23 embayments. To the extent that algal growth increases in relation to a change in ammonia
24 concentration, this would have net positive benefits, because current algal levels in these
25 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
26 cyanobacteria levels in the North Bay.

27 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 1A is
28 estimated to decrease by 2% relative to Existing Conditions and 7% relative to the No Action
29 Alternative (Appendix 80, Table O-1); thus there would be no degradation of water quality with
30 regard to total phosphorus. The only postulated effect of changes in phosphorus loads to Suisun and
31 San Pablo Bays is related to the influence of nutrient stoichiometry on primary productivity.
32 However, there is uncertainty regarding the impact of nutrient ratios on phytoplankton community
33 composition and abundance. Any effect on phytoplankton community composition would likely be
34 small compared to the effects of grazing from introduced clams and zooplankton in the estuary
35 (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the projected change in total
36 nitrogen and phosphorus loading that would occur in Delta outflow to San Francisco Bay is not
37 expected to result in adverse effects to beneficial uses or substantially degrade the water quality
38 with regard to nutrients.

39 **Mercury**

40 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
41 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
42 are estimated to change relatively little due to changes in source water fractions and net Delta
43 outflow that would occur under Alternative 1A. Mercury load to the Bay, is estimated to be the same

1 relative to Existing Conditions, and to decrease by 3 kg/year (1%) relative to the No Action
2 Alternative. Methylmercury load is estimated to decrease by 0.04 kg/year (1%), relative to Existing
3 Conditions, and by 0.13 kg/year (4%) relative to the No Action Alternative. The estimated total
4 mercury load to the Bay is 260 kg/year, which would be less than the San Francisco Bay mercury
5 TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and methylmercury
6 loads would be within the overall uncertainty associated with the estimates of long-term average
7 net Delta outflow and the long-term average mercury and methylmercury concentrations in Delta
8 source waters. The estimated changes in mercury load under the alternative would also be
9 substantially less than the considerable differences among estimates in the current mercury load to
10 San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006; David et al.
11 2009).

12 Given that the estimated incremental increases of mercury and methylmercury loading to San
13 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
14 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
15 Francisco Bay due to Alternative 1A are not expected to result in adverse effects to beneficial uses or
16 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
17 303(d) impairment measurably worse.

18 **Selenium**

19 Changes in source water fraction and net Delta outflow under Alternative 1A, relative to Existing
20 Conditions, are projected to cause the total selenium load to the North Bay to increase by 4%
21 relative to Existing Conditions; relative to the No Action Alternative there would essentially be no
22 change in load (Appendix 80, Table O-3). Changes in long-term average selenium concentrations of
23 the North Bay are assumed to be proportional to changes in North Bay selenium loads. Under
24 Alternative 1A, the long-term average total selenium concentration of the North Bay is estimated to
25 be 0.13 µg/L and the dissolved selenium concentration is estimated to be 0.11 µg/L, which would be
26 the same as Existing Conditions and the No Action Alternative (Appendix 80, Table O-3). The
27 dissolved water column selenium concentration would be below the target of 0.202 µg/L developed
28 by Presser and Luoma (2013) to correspond to a white sturgeon whole-body fish tissue selenium
29 concentration not greater than 8 mg/kg in the North Bay. The incremental increase in dissolved
30 selenium concentrations in the North Bay, relative to Existing Conditions, would be negligible (0.00
31 µg/L) under this alternative. Thus, the estimated changes in selenium loads in Delta exports to San
32 Francisco Bay due to Alternative 1A are not expected to result in adverse effects to beneficial uses or
33 substantially degrade the water quality with regard to selenium, or make the existing CWA Section
34 303(d) impairment measurably worse.

35 **NEPA Effects:** Based on the discussion above, Alternative 1A, relative to the No Action Alternative,
36 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
37 DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia, nitrate, phosphorus), trace
38 metals, or turbidity and TSS in the San Francisco Bay. Further, changes in these constituent
39 concentrations in Delta outflow would not be expected to cause changes in Bay concentrations of
40 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses. In
41 summary, based on the discussion above, effects on the San Francisco Bay from implementation of
42 CM1–CM21 are considered to be not adverse.

1 **CEQA Conclusion:** Based on the above, Alternative 1A would not be expected to cause long-term
 2 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
 3 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
 4 would result in substantially increased risk for adverse effects to one or more beneficial uses.
 5 Further, based on the above, this alternative would not be expected to cause additional exceedance
 6 of applicable water quality objectives/criteria in the San Francisco Bay by frequency, magnitude,
 7 and geographic extent that would cause significant impacts on any beneficial uses of waters in the
 8 affected environment. Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay
 9 would not adversely affect beneficial uses, because the uses most affected by changes in these
 10 parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial changes in DO,
 11 pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta, relative to
 12 Existing Conditions; therefore, no substantial changes these constituents' levels in the Bay are
 13 anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay salinity, as
 14 the change in Delta outflow would two to three orders of magnitude lower than (and thus minimal
 15 compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in the Delta
 16 would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant of the
 17 Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 31%
 18 decrease in total nitrogen load and 2% decrease in phosphorus load, relative to Existing Conditions,
 19 are expected to have minimal effect on water quality degradation, primary productivity, or
 20 phytoplankton community composition. The estimated no change in mercury load (0 kg/year; 0%)
 21 and decrease in methylmercury load (0.04 kg/year; 1%), relative to Existing Conditions, is within
 22 the level of uncertainty in the mass load estimate and not expected to contribute to water quality
 23 degradation, make the CWA Section 303(d) mercury impairment measurably worse or cause
 24 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
 25 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
 26 load would be 4%, but estimated total and dissolved selenium concentrations under this alternative
 27 would be the same as Existing Conditions, and less than the target associated with white sturgeon
 28 whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium load is not
 29 expected to contribute to water quality degradation, or make the CWA Section 303(d) selenium
 30 impairment measurably worse or cause selenium to bioaccumulate to greater levels in aquatic
 31 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 32 is considered to be less than significant.

33 **8.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and** 34 **Intakes 1–5 (15,000 cfs; Operational Scenario A)**

35 Alternative 1B would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water
 36 routed from the north Delta to the south Delta would be conveyed by gravity through a canal along
 37 the east side of the Delta instead of through pipelines/tunnels. Intakes 1 through 5 would be located
 38 on the east bank of the Sacramento River. An intermediate pumping plant north of the town of Holt
 39 would be constructed as well as a new 600-acre Byron Tract Forebay. Unlike Alternative 1A, there
 40 would be no intermediate forebay. Culvert and tunnel siphons would be utilized to divert canal
 41 water beneath existing water courses. Water supply and conveyance operations would follow the
 42 guidelines described as Scenario A, which does not include Fall X2. CM2–CM21 would be
 43 implemented under this alternative, and these conservation measures would be the same as those
 44 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.3, for additional details
 45 on Alternative 1B.

1 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

2 Alternative 1B has the same diversion and conveyance operations as Alternative 1A. The primary
 3 difference between the two alternatives is that conveyance under Alternative 1B would be in a lined
 4 or unlined canal, instead of pipeline. Because there would be no difference in conveyance capacity or
 5 operations, there would be no differences between these two alternatives in upstream of the Delta
 6 river flows or reservoir operations, Delta inflow, source fractions to various Delta locations, and
 7 hydrodynamics in the Delta. Conveyance of water in an open channel instead of a pipeline may
 8 result in differing physical properties (e.g., DO, pH, temperature) of the water upon reaching the
 9 south Delta export pumps than if the water was conveyed in a pipeline. However, the physical
 10 properties of water arriving at the south Delta export pumps would continue to change and would
 11 equilibrate to similar levels as Alternative 1A as it is conveyed throughout the SWP/CVP Export
 12 Service Areas. Because no substantial differences in water quality effects are anticipated anywhere
 13 in the affected environment under Alternative 1B compared to those described in detail for
 14 Alternative 1A, the water quality effects described for Alternative 1A also appropriately characterize
 15 effects under Alternative 1B.

16 **Water Quality Effects Resulting from Implementation of CM2–CM21**

17 Alternative 1B has the same conservation measures as Alternative 1A. Because no substantial
 18 differences in water quality effects are anticipated anywhere in the affected environment under
 19 Alternative 1B compared to those described in detail for Alternative 1A, the water quality effects
 20 described for Alternative 1A also appropriately characterize effects under Alternative 1B.

21 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 22 **(CM1–CM21)**

23 The primary difference between Alternative 1B and Alternative 1A is that under Alternative 1B, a
 24 canal would be constructed for CM1 along the eastern side of the Delta to convey the Sacramento
 25 River water south, rather than a tunnel as the primary conveyance feature. As such, construction
 26 techniques and locations of major features of the conveyance system within the Delta would be
 27 different (see Chapter 3, *Description of Alternatives*, Section 3.5.3). Consequently, Alternative 1B
 28 would involve substantial land surface construction disturbance. Construction of the canal
 29 conveyance facilities also would involve vegetation grubbing/removal, grading, excavation, soil
 30 stockpiling, levee and siphon construction, trenching, temporary access road construction, and soil
 31 hauling and storage, and other activities over approximately 21,500 acres during the course of
 32 constructing the facilities. Additionally, numerous natural drainages and constructed ditches would
 33 be rerouted to pass over, under, or around the canal, thus involving disturbance and potential work
 34 in flowing water. The remainder of the facilities constructed under Alternative 1B, including CM2–
 35 CM21, would be very similar to, or the same as, those to be constructed for Alternative 1A.

36 **NEPA Effects:** The types of potential construction-related water quality effects associated with
 37 implementation of CM1 under Alternative 1B would be similar to the effects discussed for
 38 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
 39 identical. Given the substantial differences in the conveyance features under CM1 with the
 40 construction of a canal, there would be differences in the location, magnitude, duration, and
 41 frequency of construction activities and related water quality effects. In particular, relative to the No
 42 Action Alternative conditions, construction of the major intakes and canal features for CM1 under
 43 Alternative 1B would involve extensive general construction activities, material

1 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
 2 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
 3 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
 4 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 5 *Commitments, AMMs, and CMs*, would result in the potential water quality effects being largely
 6 avoided and minimized. The specific environmental commitments that would be implemented
 7 under Alternative 1B would be similar to those described for Alternative 1A with the exception that
 8 Category “B” BMPs for RTM dewatering basin construction and operations, if necessary at all, would
 9 be much reduced. Consequently, relative to the No Action Alternative, Alternative 1B would not be
 10 expected to cause exceedance of applicable water quality objectives/criteria or substantial water
 11 quality degradation with respect to constituents of concern, and thus would not adversely affect any
 12 beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP service area.

13 In summary, with implementation of environmental commitments in Appendix 3B, *Environmental*
 14 *Commitments, AMMs, and CMs*, the potential construction-related water quality effects are
 15 considered to be not adverse.

16 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 17 1B for construction-related activities along with agency-issued permits that also contain
 18 construction related mitigation requirements to protect water quality, the construction-related
 19 effects, relative to Existing Conditions, would not be expected to cause or contribute to substantial
 20 alteration of existing drainage patterns which would result in substantial erosion or siltation on- or
 21 off-site, substantial increased frequency of exceedances of water quality objectives/criteria, or
 22 substantially degrade water quality with respect to the constituents of concern on a long-term
 23 average basis, and thus would not adversely affect any beneficial uses in water bodies upstream of
 24 the Delta, within the Delta, or in the SWP and CVP service area. Moreover, because the construction-
 25 related activities would be temporary and intermittent in nature, the construction would involve
 26 negligible discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the
 27 affected environment. As such, construction activities would not contribute measurably to
 28 bioaccumulation of contaminants in organisms or humans or cause 303(d) impairments to be
 29 discernibly worse. Based on these findings, this impact is determined to be less than significant. No
 30 mitigation is required.

31 **8.3.3.4 Alternative 1C—Dual Conveyance with West Alignment and** 32 **Intakes W1–W5 (15,000 cfs; Operational Scenario A)**

33 Alternative 1C would be nearly identical to Alternative 1A except that the up to 15,000 cfs of water
 34 routed from the north Delta to the south Delta would be conveyed through a canal/tunnel along the
 35 west side of the Delta instead of through pipelines/tunnels. Intakes 1 through 5 would be located on
 36 the west bank of the Sacramento River and diverted water would be carried by canals and tunnels to
 37 a new 600-acre forebay at Byron Tract. An intermediate pumping plant would be constructed, but
 38 there would be no intermediate forebay. Culvert and tunnel siphons would be utilized to divert
 39 canal water beneath existing water courses. Water supply and conveyance operations would follow
 40 the guidelines described as Scenario A, which does not include Fall X2. CM2–CM21 would be
 41 implemented under this alternative, and these conservation measures would be the same as those
 42 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.4, for additional details
 43 on Alternative 1C.

1 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

2 Alternative 1C has the same diversion and conveyance operations as Alternative 1A. The primary
 3 differences between the two alternatives are that conveyance under Alternative 1C would be in a
 4 lined or unlined canal, instead of pipeline, and the alignment of the canal would be along the
 5 western side of the Delta, rather than the eastern side. Because there would be no difference in
 6 conveyance capacity or operations, there would be no differences between these two alternatives in
 7 upstream of the Delta river flows or reservoir operations, Delta inflow, source fractions to various
 8 Delta locations, and hydrodynamics in the Delta. Conveyance of water in an open channel instead of
 9 a pipeline may result in differing physical properties (e.g., DO, pH, temperature) of the water upon
 10 reaching the south Delta export pumps than if the water was conveyed in a pipeline. However, the
 11 physical properties of water arriving at the south Delta export pumps would continue to change and
 12 would equilibrate to similar levels as Alternative 1A as it is conveyed throughout the SWP/CVP
 13 Export Service Areas. Because no substantial differences in water quality effects are anticipated
 14 anywhere in the affected environment under Alternative 1C compared to those described in detail
 15 for Alternative 1A, the water quality effects described for Alternative 1A also appropriately
 16 characterize effects under Alternative 1C.

17 **Water Quality Effects Resulting from Implementation of CM2–CM21**

18 Alternative 1C has the same conservation measures as Alternative 1A. Because no substantial
 19 differences in water quality effects are anticipated anywhere in the affected environment under
 20 Alternative 1C compared to those described in detail for Alternative 1A, the water quality effects
 21 described for Alternative 1A also appropriately characterize effects under Alternative 1C.

22 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 23 **(CM1–CM21)**

24 The primary difference between Alternative 1C and Alternative 1A is that under Alternative 1C, a
 25 canal would be constructed for CM1 along the western side of the Delta to convey the Sacramento
 26 River water south, in addition to similar but shorter tunnel/pipeline features. Construction of water
 27 conveyance facilities would involve vegetation removal; constructing building pads, levees, canals,
 28 and a tunnel; excavation; overexcavation for facility foundations; surface grading; trenching; road
 29 construction; spoil storage; soil stockpiling; and other activities over approximately 17,400 acres
 30 during the course of constructing the facilities. Excavation of a large volume of borrow material
 31 would be required to construct the canals. As such, construction techniques and locations of major
 32 features of the conveyance system within the Delta would be different (see Chapter 3, *Description of*
 33 *Alternatives*, Section 3.5.4). The remainder of the facilities constructed under Alternative 1C,
 34 including CM2–CM21, would be very similar to, or the same as, those to be constructed for
 35 Alternative 1A.

36 **NEPA Effects:** The types of potential construction-related water quality effects associated with
 37 implementation of CM1 under Alternative 1C would be very similar to the effects discussed for
 38 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
 39 identical. However, given the addition of extensive canal conveyance segments under CM1 in
 40 addition to the tunnel/pipeline features, there would be differences in the location, magnitude,
 41 duration, and frequency of construction activities and related water quality effects. In particular,
 42 relative to the No Action Alternative conditions, construction of the major canal features for CM1
 43 under Alternative 1C would involve extensive general construction activities, material

1 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
 2 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
 3 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
 4 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 5 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements would result
 6 in the potential water quality effects being largely avoided and minimized. The specific
 7 environmental commitments that would be implemented under Alternative 1C would be similar to
 8 those described for Alternative 1A (refer to Chapter 3, *Description of Alternatives*, and Appendix 3B
 9 for additional information regarding the environmental commitments and environmental permits).
 10 However, this alternative would involve environmental commitments associated with both
 11 tunnel/pipeline and canal construction activities. Consequently, relative to No Action Alternative
 12 conditions, Alternative 1C would not be expected to cause exceedance of applicable water quality
 13 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
 14 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
 15 SWP and CVP service area.

16 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 17 construction-related water quality effects are considered to be not adverse.

18 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 19 1C for construction-related activities, the construction-related effects, relative to Existing
 20 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 21 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 22 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 23 water quality with respect to the constituents of concern on a long-term average basis, and thus
 24 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 25 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 26 would be temporary and intermittent in nature, the construction would involve negligible
 27 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 28 environment. As such, construction activities would not contribute measurably to bioaccumulation
 29 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 30 Based on these findings, this impact is determined to be less than significant. No mitigation is
 31 required.

32 **8.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five** 33 **Intakes (15,000 cfs; Operational Scenario B)**

34 Alternative 2A would convey up to 15,000 cfs of water from the north Delta to the south Delta
 35 through pipelines/tunnels from five screened intakes on the east bank of the Sacramento River
 36 between Clarksburg and Walnut Grove i.e., (Intakes 1 through 5). A new 600-acre Byron Tract
 37 Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which would provide
 38 water to the south Delta pumping plants. In addition to the same physical/structural components
 39 described for Alternative 1A, Alternative 2A would include an operable barrier at the head of Old
 40 River and could potentially include two alternative intake and intake pumping plant locations
 41 located downstream of Steamboat and Sutter Sloughs (i.e., Intakes 6 and 7). Water supply and
 42 conveyance operations would follow the guidelines described as Scenario B, which includes Fall X2.
 43 CM2–CM21 would be implemented under this alternative, and would be the same as those under
 44 Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.5, for additional details on
 45 Alternative 2A.

1 **Effects of the Alternative on Delta Hydrodynamics**

2 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
3 substantially affect water quality within the Delta:

- 4 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
5 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
6 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
7 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
8 decreased exports of San Joaquin River water (due to increased Sacramento River water
9 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
10 also can affect water residence time and many related physical, chemical, and biological
11 variables.
- 12 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
13 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
14 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
15 and above normal water years) will decrease levels of these constituents, particularly in the
16 west Delta.

17 Under Alternative 2A, over the long term, average annual delta exports are anticipated to decrease
18 by 76 TAF relative to Existing Conditions, and increase by 628 TAF relative to the No Action
19 Alternative. Since, over the long-term, approximately 58% of the exported water will be from the
20 new North Delta intakes, average monthly diversions at the south Delta intakes would be decreased
21 because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
22 information). The result of this is increased San Joaquin River water influence throughout the south,
23 west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This
24 can be seen, for example, in Appendix 8D, ALT 2–Old River at Rock Slough for ALL years (1976–
25 1991), which shows increased SJR percentage and decreased SAC percentage under the alternative,
26 relative to Existing Conditions and the No Action Alternative.

27 Under Alternative 2A, long-term average annual Delta outflow is anticipated to increase 105 TAF
28 relative to Existing Conditions, due to both changes in operations (including north Delta intake
29 capacity of 15,000 cfs, Fall X2, and numerous other components of Operational Scenario B) and
30 climate change/sea level rise (see Chapter 5, *Water Supply*, for more information). The increase
31 relative to Existing Conditions is partially because Alternative 2A includes operations to meet Fall
32 X2, while Existing Conditions does not. Long-term average annual Delta outflow is anticipated to
33 decrease under Alternative 2A by 645 TAF relative to the No Action Alternative, due only to changes
34 in operations. The result of this is increased sea water intrusion in the west Delta. The increase in
35 sea water intrusion (represented by an increase in BAY percentage) can be seen, for example, in
36 Appendix 8D, ALT 2A–Sacramento River at Mallard Island for ALL years (1976–1991).

37 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 38 **Maintenance (CM1)**

39 ***Upstream of the Delta***

40 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
41 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
42 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
43 concentrations that could occur in the water bodies of the affected environment upstream of the

1 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
 2 beneficial uses or substantially degrade the quality of these water bodies, with regard to ammonia.

3 **Delta**

4 Assessment of the effects of ammonia under Alternative 2A is the same as discussed under
 5 Alternative 1A, Impact WQ-1, except that because flows in the Sacramento River at Freeport would
 6 be different between the two alternatives, estimated monthly average and long term annual average
 7 predicted ammonia-N concentrations in the Sacramento River downstream of Freeport are
 8 different.

9 As Table 8-65 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 10 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 2A and the
 11 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
 12 would occur during July through September, November, and January through March, and remaining
 13 months would be unchanged or have a minor decrease. A minor increase in the annual average
 14 concentration would occur under Alternative 2A, compared to the No Action Alternative. Moreover,
 15 the estimated concentrations downstream of Freeport under Alternative 2A would be similar to
 16 existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently,
 17 changes in source water fraction anticipated under Alternative 2A, relative to the No Action
 18 Alternative, would not be expected to substantially increase ammonia concentrations at any Delta
 19 locations.

20 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 21 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
 22 beneficial uses or substantially degrade the water quality at these locations, with regards to
 23 ammonia.

24 **Table 8-65. Estimated Ammonia-N (mg/L as N) Concentrations in the Sacramento River Downstream**
 25 **of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and**
 26 **Alternative 2A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 2A	0.073	0.088	0.069	0.061	0.058	0.061	0.058	0.062	0.062	0.063	0.071	0.065	0.066

27

28 **SWP/CVP Export Service Areas**

29 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 30 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 31 Alternative 1A, under Alternative 2A for areas of the Delta that are influenced by Sacramento River
 32 water, including Banks and Jones pumping plants, ammonia-N concentrations would be expected to
 33 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 34 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 35 pumps would not be expected to result in an adverse effect on beneficial uses or substantially
 36 degrade water quality of exported water, with regards to ammonia.

1 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
2 Jones pumping plants, ammonia-N concentrations would not be expected to substantially differ
3 under Alternative 2A, relative to the No Action Alternative. Any negligible increases in ammonia-N
4 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
5 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
6 degrade the water quality at these locations, with regards to ammonia.

7 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
8 of CM1 are considered to be not adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
11 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
12 constituent. For additional details on the effects assessment findings that support this CEQA impact
13 determination, see the effects assessment discussion that immediately precedes this conclusion.

14 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
15 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
16 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
17 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
18 any modified reservoir operations and subsequent changes in river flows under Alternative 2A,
19 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
20 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
21 of the Delta in the San Joaquin River watershed.

22 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
23 substantially lower under Alternative 2A, relative to Existing Conditions, due to upgrades to the
24 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
25 that are influenced by Sacramento River water are expected to decrease. At locations which are not
26 influenced notably by Sacramento River water, concentrations are expected to remain relatively
27 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
28 either of these concentrations.

29 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
30 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
31 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
32 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 2A,
33 relative to Existing Conditions.

34 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
35 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
36 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
37 alternative would not be expected to cause additional exceedance of applicable water quality
38 objectives/criteria by frequency, magnitude, and geographic extent that would cause significant
39 impacts on any beneficial uses of waters in the affected environment. Because ammonia
40 concentrations would not be expected to increase substantially, no long-term water quality
41 degradation would be expected to occur and, thus, no significant impact on beneficial uses would
42 occur. Ammonia is not 303(d) listed within the affected environment and thus any minor increases
43 that could occur in some areas would not make any existing ammonia-related impairment
44 measurably worse because no such impairments currently exist. Because ammonia-N is not

1 bioaccumulative, minor increases that could occur in some areas would not bioaccumulate to
 2 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
 3 or humans. This impact would be considered less than significant. No mitigation is required.

4 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2–**
 5 **CM21**

6 **NEPA Effects:** Effects of CM2–CM21 on ammonia under Alternative 2A would be the same as those
 7 discussed for Alternative 1A and are considered to be not adverse.

8 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 9 under Alternative 1A. As such, effects on ammonia resulting from the implementation of CM2–CM21
 10 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 11 less than significant. No mitigation is required.

12 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Effects of CM1 on boron under Alternative 2A in areas upstream of the Delta would be very similar
 16 to the effects discussed for Alternative 1A. There would be no expected change to the sources of
 17 boron in the Sacramento and eastside tributary watersheds, and resultant changes in flows from
 18 altered system-wide operations would have negligible, if any, effects on the concentration of boron
 19 in the rivers and reservoirs of these watersheds. The modeled long-term annual average lower San
 20 Joaquin River flow at Vernalis would decrease slightly compared to Existing Conditions (in
 21 association with project operations, climate change, and increased water demands), and would be
 22 similar compared to the No Action Alternative considering only changes due to Alternative 2A
 23 operations. The reduced flow would result in possible increases in long-term average boron
 24 concentrations of up to about 3% relative to the Existing Conditions (Appendix 8F, Table Bo-32).
 25 The increased boron concentrations would not increase the frequency of exceedances of any
 26 applicable objectives or criteria and would not be expected to cause further degradation at
 27 measurable levels in the lower San Joaquin River, and thus would not cause the existing impairment
 28 there to be discernibly worse. Consequently, Alternative 2A would not be expected to cause
 29 exceedance of boron objectives/criteria or substantially degrade water quality with respect to
 30 boron, and thus would not adversely affect any beneficial uses of the Sacramento River, the eastside
 31 tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 37 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 38 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 39 more information.

40 Effects of CM1 on boron under Alternative 2A in the Delta would be very similar to the effects
 41 discussed for Alternative 1A. Relative to the Existing Conditions and No Action Alternative,

1 Alternative 2A would generally result in unchanged or reduced long-term average boron
2 concentrations for the 16-year period modeled at northern and eastern Delta locations. However,
3 the average boron concentration at the eastern SJR at Buckley Cove location would increase relative
4 to Existing Conditions (8%) but decrease relative to the No Action Alternative. Concentrations
5 would increase at interior and western Delta locations (by as much as 3% at the SF Mokelumne
6 River at Staten Island, 18% at Franks Tract, and 118% at Old River at Rock Slough) (Appendix 8F,
7 *Boron*, Table Bo-8). The comparison to Existing Conditions reflects changes due to both Alternative
8 2A operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other
9 components of Operational Scenario B) and climate change/sea level rise. The comparison to the No
10 Action Alternative reflects changes due only to operations.

11 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
12 concentrations at western Delta assessment locations (more discussion of this phenomenon is
13 included in Section 8.3.1.3, *Plan Area*), and thus would not be anticipated to substantially affect
14 agricultural diversions which occur primarily at interior Delta locations. The long-term annual
15 average and monthly average boron concentrations, for either the 16-year period or drought period
16 modeled, would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or
17 500 µg/L agricultural objective at any of the eleven Delta assessment locations, which represents no
18 change from the Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-3A).
19 Reductions in long-term average assimilative capacity of up to 11% at interior Delta locations (i.e.,
20 Franks Tract and Old River at Rock Slough) and up to 12% at the SJR at Buckley Cove location
21 relative to No Action Alternative, would occur with respect to the 500 µg/L agricultural objective
22 (Appendix 8F, Table Bo-9). However, because the absolute boron concentrations would still be well
23 below the lowest 500 µg/L objective for the protection of the agricultural beneficial use under
24 Alternative 2A, the levels of boron degradation would not be of sufficient magnitude to substantially
25 increase the risk of exceeding objectives or cause adverse effects to municipal and agricultural water
26 supply beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, Figure Bo-2).

27 ***SWP/CVP Export Service Areas***

28 Effects of CM1 on boron under Alternative 2A in the Delta would be very similar to the effects
29 discussed for Alternative 1A. Under Alternative 2A, long-term average boron concentrations would
30 decrease by as much as 25% at the Banks Pumping Plant and by as much as 27% at Jones Pumping
31 Plant relative to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-8) as a result
32 of export of a greater proportion of low-boron Sacramento River water. Commensurate with the
33 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
34 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
35 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
36 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
37 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
38 Joaquin River and associated TMDL actions for reducing boron loading.

39 Maintenance of SWP and CVP facilities under Alternative 2A would not be expected to create new
40 sources of boron or contribute towards a substantial change in existing sources of boron in the
41 affected environment. Maintenance activities would not be expected to cause any substantial
42 increases in boron concentrations or degradation with respect to boron such that objectives would
43 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
44 affected environment.

1 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 2A would
 2 result in relatively small increases in long-term average boron concentrations in the Delta and not
 3 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
 4 would not be expected to cause exceedances of applicable objectives or further measurable water
 5 quality degradation, and thus would not constitute an adverse effect on water quality.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 8 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 9 constituent. For additional details on the effects assessment findings that support this CEQA impact
 10 determination, see the effects assessment discussion that immediately precedes this conclusion.

11 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
 12 river flow rate and reservoir storage reductions that would occur under the Alternative 2A, relative
 13 to Existing Conditions, would not be expected to result in a substantial adverse change in boron
 14 levels. Additionally, relative to Existing Conditions, Alternative 2A would not result in reductions in
 15 river flow rates (i.e., less dilution) or increased boron loading such that there would be any
 16 substantial increases in boron concentration upstream of the Delta in the San Joaquin River
 17 watershed.

18 Small increased boron levels predicted for interior and western Delta locations in response to a shift
 19 in the Delta source water percentages and tidal habitat restoration under this alternative would not
 20 be expected to cause exceedances of objectives, or substantial degradation of these water bodies.
 21 Alternative 2A maintenance also would not result in any substantial increases in boron
 22 concentrations in the affected environment. Boron concentrations would be reduced in water
 23 exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a potential
 24 improvement to boron loading in the lower San Joaquin River.

25 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 2A
 26 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 27 Existing Conditions, Alternative 2A would not result in substantially increased boron concentrations
 28 such that frequency of exceedances of municipal and agricultural water supply objectives would
 29 increase. The levels of boron degradation that may occur under Alternative 2A would not be of
 30 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
 31 agricultural beneficial uses within the affected environment. Long-term average boron
 32 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
 33 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
 34 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

37 **NEPA Effects:** Effects of CM2–CM21 on boron under Alternative 2A would be the same as those
 38 discussed for Alternative 1A and are determined to be not adverse.

39 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 40 under Alternative 1A. As such, effects on boron resulting from the implementation of CM2–CM21
 41 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 42 less than significant. No mitigation is required.

1 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 2A there would be no expected change to the sources of bromide in the
 5 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
 6 unchanged and resultant changes in flows from altered system-wide operations under Alternative
 7 2A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
 8 of these watersheds. Consequently, Alternative 2A would not be expected to adversely affect the
 9 MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or
 10 their associated reservoirs upstream of the Delta.

11 Under Alternative 2A, modeling indicates that long-term annual average flows on the San Joaquin
 12 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
 13 relative to the No Action Alternative (Appendix 5A, *Climate Change and the Effects of Reservoir*
 14 *Operations on Water Temperatures in the Study Area*). These decreases in flow would result in
 15 possible increases in long-term average bromide concentrations of about 3%, relative to Existing
 16 Conditions, and less than <1% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table
 17 24). The small increases in lower San Joaquin River bromide levels that could occur under
 18 Alternative 2A, relative to existing and the No Action Alternative conditions would not be expected
 19 to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin
 20 River.

21 ***Delta***

22 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 23 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 24 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 25 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 26 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 27 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 28 more information.

29 Under Alternative 2A, the geographic extent of effects pertaining to long-term average bromide
 30 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 31 although the magnitude of predicted long-term change and relative frequency of concentration
 32 threshold exceedances would be different. Using the mass-balance modeling approach for bromide
 33 (see Section 8.3.1.3, *Plan Area*), relative to Existing Conditions, modeled long-term average bromide
 34 concentrations would increase at Staten Island, Emmaton (during the drought period only), and
 35 Barker Slough, while modeled long-term average bromide concentrations would decrease at all
 36 other assessment locations (Appendix 8E, *Bromide*, Table 6). Overall effects would be greatest at
 37 Barker Slough, where predicted long-term average bromide concentrations would increase from 51
 38 µg/L to 63 µg/L (22% relative increase) for the modeled 16-year hydrologic period and would
 39 increase from 54 µg/L to 94 µg/L (75% relative increase) for the modeled drought period. At Barker
 40 Slough, the predicted 50 µg/L exceedance frequency would decrease from 49% under Existing
 41 Conditions to 38% under Alternative 2A, but would increase from 55% to 63% during the drought
 42 period. At Barker Slough, the predicted 100 µg/L exceedance frequency would increase from 0%
 43 under Existing Conditions to 17% under Alternative 2A, and would increase from 0% to 38% during
 44 the drought period. Relative increases in long-term average bromide concentrations at Staten Island

1 would be of similar magnitude to that described for Barker Slough, although modeled 100 µg/L
2 exceedance frequency increases would be much less considerable. At Staten Island, the predicted
3 100 µg/L exceedance frequency would increase from 1% under Existing Conditions to 4% under
4 Alternative 2A (0% to 2% during the drought period). Modeled long-term average concentration at
5 Staten Island would be about 62 µg/L (about 63 µg/L in drought years). Changes in exceedance
6 frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative change in long-
7 term average concentration, at other assessment locations would be less substantial. The
8 comparison to Existing Conditions reflects changes in bromide due to both Alternative 2A
9 operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other
10 components of Operational Scenario B) and climate change/sea level rise.

11 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
12 changes in long-term average bromide concentrations and changes in exceedance frequencies
13 relative to the No Action Alternative are generally of similar magnitude to those previously
14 described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 6). Modeled long-
15 term average bromide concentration increases would similarly be greatest at Barker Slough, where
16 long-term average concentrations are predicted to increase by about 26% (about 75% in drought
17 years) relative to the No Action Alternative. However, unlike the Existing Conditions comparison,
18 long-term average bromide concentrations at Buckley Cove under Alternative 2A would increase
19 relative to the No Action Alternative, although the increases would be relatively small ($\leq 4\%$). Unlike
20 the comparison to Existing Conditions, the comparison to the No Action Alternative reflects bromide
21 changes due only to operations.

22 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
23 conditions are very similar (Appendix 8E, *Bromide*, Table 6). Such similarity demonstrates that the
24 modeled Alternative 2A change in bromide is almost entirely due to Alternative 2A operations, and
25 not climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide
26 at Barker Slough, regardless whether Alternative 2A is compared to Existing Conditions, or
27 compared to the No Action Alternative.

28 Results of the modeling approach which used relationships between EC and chloride and between
29 chloride and bromide (see Section 8.3.1.3, *Plan Area*,) differed somewhat from what is presented
30 above for the mass-balance approach (see Appendix 8E, *Bromide*, Table 7). For most locations, the
31 frequency of exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between
32 the methods was predicted for Barker Slough. The increases in frequency of exceedance of the 100
33 µg/L threshold, relative to Existing Conditions and the No Action Alternative, were not as great
34 using this alternative EC to chloride and chloride to bromide relationship modeling approach as
35 compared to that presented above from the mass-balance modeling approach. However, there were
36 still substantial increases, resulting in 10% exceedance over the modeled period under Alternative
37 2A, as compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the
38 drought period, exceedance frequency increased from 0% under Existing Conditions and the No
39 Action Alternative, to 20% under Alternative 2A. Because the mass-balance approach predicts a
40 greater level of impact at Barker Slough, determination of impacts was based on the mass-balance
41 results.

42 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
43 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in
44 source water quality for existing drinking water treatment plants drawing water from the North Bay
45 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the

1 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
2 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
3 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
4 changes in the formation of disinfection byproducts such that considerable treatment plant
5 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
6 of the other modeled locations already frequently exceed the 100 µg/L threshold under Existing
7 Conditions and the No Action Alternative, these locations likely already require treatment plant
8 technologies to achieve equivalent levels of health protection, and thus no additional treatment
9 technologies would be triggered by the small increases in the frequency of exceeding the 100 µg/L
10 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
11 locations.

12 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
13 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
14 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
15 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
16 Slough and City of Antioch under Alternative 2A would experience a period average increase in
17 bromide during the months when these intakes would most likely be utilized. For those wet and
18 above normal water year types where mass balance modeling would predict water quality typically
19 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 165
20 µg/L (61% increase) at City of Antioch and would increase from 150 µg/L to 211 µg/L (41%
21 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
22 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
23 to chloride and chloride to bromide relationships show increases during these months, but the
24 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of
25 the differences in the data between the two modeling approaches, the decisions surrounding the use
26 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
27 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
28 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
29 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

30 Important to the results presented above is the assumed habitat restoration footprint on both the
31 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
32 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3, *Plan*
33 *Area*), not operations covered under CM1, are the driving factor in the modeled bromide increases.
34 The timing, location, and specific design of habitat restoration will have effects on Delta
35 hydrodynamics, and any deviations from modeled habitat restoration and implementation schedule
36 will lead to different outcomes. Although habitat restoration near Barker Slough is an important
37 factor contributing to modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat
38 restoration elsewhere in the Delta can also have large effects. Because of these uncertainties, and the
39 possibility of adaptive management changes to BDCP restoration activities, including location,
40 magnitude, and timing of restoration, the estimates are not predictive of the bromide levels that
41 would actually occur in Barker Slough or elsewhere in the Delta.

42 ***SWP/CVP Export Service Areas***

43 Under Alternative 2A, improvement in long-term average bromide concentrations would occur at
44 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
45 16-year hydrologic period at these locations would decrease by as much as 46% relative to Existing

1 Conditions and 39% relative to the No Action Alternative. Relative change in long-term average
2 bromide concentration would be less during drought conditions ($\leq 34\%$), but would still represent
3 considerable improvement (Appendix 8E, *Bromide*, Table 6). As a result, less frequent bromide
4 concentration exceedances of the 50 $\mu\text{g}/\text{L}$ and 100 $\mu\text{g}/\text{L}$ assessment thresholds would be predicted
5 and an overall improvement in Export Service Areas water quality would be experienced respective
6 to bromide. Commensurate with the decrease in exported bromide, an improvement in lower San
7 Joaquin River bromide would also be observed since bromide in the lower San Joaquin River is
8 principally related to irrigation water deliveries from the Delta. While the magnitude of this
9 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
10 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
11 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
12 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
13 much of the south Delta.

14 **NEPA Effects:** The discussion above is based on results of the mass-balance modeling approach.
15 Results of the modeling approach which used relationships between EC and chloride and between
16 chloride and bromide (see Section 8.3.1.3, *Plan Area*,) were consistent with the discussion above,
17 and assessment of bromide using these data results in the same conclusions as are presented above
18 for the mass-balance approach (see Appendix 8E, *Bromide*, Table 7).

19 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
20 facilities under Alternative 2A would not be expected to create new sources of bromide or
21 contribute towards a substantial change in existing sources of bromide in the affected environment.
22 Maintenance activities would not be expected to cause any substantial change in bromide such that
23 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
24 affected environment.

25 In summary, Alternative 2A operations and maintenance, relative to the No Action Alternative,
26 would result in small increases (i.e., $<1\%$) in long-term average bromide concentrations at Vernalis
27 related to relatively small declines in long-term average flow on the San Joaquin River. However,
28 Alternative 2A operation and maintenance activities would cause substantial degradation to water
29 quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct. Resultant
30 substantial change in long-term average bromide at Barker Slough could necessitate changes in
31 water treatment plant operations or require treatment plant upgrades in order to maintain DBP
32 compliance, and thus would constitute an adverse effect on water quality. Mitigation Measure WQ-5
33 is available to reduce these effects (implementation of this measure along with a separate, other
34 commitment as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*,
35 relating to the potential increased treatment costs associated with bromide-related changes would
36 reduce these effects).

37 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
38 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
39 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
40 constituent. For additional details on the effects assessment findings that support this CEQA impact
41 determination, see the effects assessment discussion that immediately precedes this conclusion.

42 Under Alternative 2A there would be no expected change to the sources of bromide in the
43 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
44 unchanged and resultant changes in flows from altered system-wide operations under Alternative

1 2A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
2 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
3 bromide, primarily due to the use of irrigation water imported from the southern Delta.
4 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
5 2A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
6 substantial predicted increases in long-term average bromide of about 3% relative to Existing
7 Conditions.

8 Relative to Existing Conditions, Alternative 2A would result in small decreases in long-term average
9 bromide concentration at most Delta assessment locations, with principal exceptions being the
10 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
11 effects would be greatest at Barker Slough, where substantial increases in long-term average
12 bromide concentrations would be predicted. The increase in long-term average bromide
13 concentrations predicted for Barker Slough would result in a substantial change in source water
14 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
15 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
16 formation of disinfection byproducts at drinking water treatment plants such that considerable
17 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
18 water health protection.

19 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
20 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 2A,
21 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
22 long-term average bromide concentrations are predicted to decrease by as much as 46% relative to
23 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
24 in the SWP/CVP Export Service Areas.

25 Based on the above, Alternative 2A operation and maintenance would not result in any substantial
26 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
27 Alternative 2A, water exported from the Delta to the SWP/CVP service area would be substantially
28 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
29 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
30 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 2A
31 operation and maintenance activities would not cause substantial long-term degradation to water
32 quality respective to bromide with the exception of water quality at Barker Slough, source of the
33 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
34 bromide would increase by 22%, and 75% during the modeled drought period. For the modeled 16-
35 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
36 would increase from 0% under Existing Conditions to 17% under Alternative 2A, while for the
37 modeled drought period, the frequency would increase from 0% to 38%. Substantial changes in
38 long-term average bromide could necessitate changes in treatment plant operation or require
39 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
40 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
41 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
42 impact is considered significant.

43 Implementation of Mitigation Measure WQ-5 along with a separate, other commitment relating to
44 the potential increased treatment costs associated with bromide-related changes would reduce
45 these effects. While mitigation measures to reduce these water quality effects in affected water

bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5 is recommended to attempt to reduce the effect that increased bromide concentrations may have on Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in feasible measures for reducing water quality effects is uncertain, this impact is considered to remain significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

In addition to and to supplement Mitigation Measure WQ-5, the project proponents have incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment costs that could result from bromide-related concentration effects on municipal water purveyor operations. Potential options for making use of this financial commitment include funding or providing other assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that could be taken pursuant to this commitment in order to reduce the water quality treatment costs associated with water quality effects relating to chloride, electrical conductivity, and bromide.

Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality Conditions

Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–CM21

NEPA Effects: CM2–CM21 proposed under Alternative 2A would be the same as those proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–CM21 would not present new or substantially changed sources of bromide to the study area. Some conservation measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution is not expected to substantially increase or present new sources of bromide. CM2–CM21 would not be expected to cause any substantial change in bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

In summary, implementation of CM2–CM21 under Alternative 2A, relative to the No Action Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide from implementing CM2–CM21 are determined to not be adverse.

CEQA Conclusion: CM2–CM21 proposed under Alternative 2A would be similar to those proposed under Alternative 1A. As such, effects on bromide resulting from the implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and Maintenance (CM1)

Upstream of the Delta

Under Alternative 2A there would be no expected change to the sources of chloride in the Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain

1 unchanged and resultant changes in flows from altered system-wide operations would have
 2 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
 3 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
 4 would decrease slightly compared to Existing Conditions and be similar compared to the No Action
 5 Alternative (as a result of climate change). The reduced flow would result in possible increases in
 6 long-term average chloride concentrations of up to about 3%, relative to the Existing Conditions and
 7 no change relative to No Action Alternative (Appendix 8G, Table Cl-62). The increased chloride
 8 concentrations would not increase the frequency of exceedances of any applicable objectives or
 9 criteria. Consequently, Alternative 2A would not be expected to cause exceedance of chloride
 10 objectives/criteria or substantially degrade water quality with respect to chloride, and thus would
 11 not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, associated
 12 reservoirs upstream of the Delta, or the San Joaquin River.

13 **Delta**

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 19 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 20 more information.

21 Relative to Existing Conditions, modeling predicts that Alternative 2A would result in similar or
 22 reduced long-term average chloride concentrations for the 16-year period modeled at most
 23 assessment locations, and, depending on modeling approach (see Section 8.3.1.3, *Plan Area*), and
 24 would result in increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., $\leq 23\%$)
 25 and SF Mokelumne at Staten Island (i.e., $\leq 18\%$) (Appendix 8G, *Chloride*, Tables Cl-13 and Cl-14).
 26 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
 27 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
 28 Bay source water as a result of increased salinity intrusion. More discussion of this phenomenon is
 29 included in Section 8.3.1.3, *Plan Area*. Consequently, while uncertain, the magnitude of chloride
 30 increases may be greater than indicated herein and would affect the western Delta assessment
 31 locations the most which are influenced to the greatest extent by the Bay source water. The
 32 comparison to Existing Conditions reflects changes in chloride due to both Alternative 2A operations
 33 (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other components of
 34 Operational Scenario B) and climate change/sea level rise.

35 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
 36 indicated that Alternative 2A would result in similar or reduced long-term average chloride
 37 concentrations for the 16-year period modeled at nine of the assessment locations and increased
 38 concentrations at the SF Mokelumne River at Staten Island (up to 26%), San Joaquin River at
 39 Buckley Cove (up to 3%), and the North Bay Aqueduct at Barker Slough (up to 21%) (Appendix 8G,
 40 Table Cl-13). The comparison to the No Action Alternative reflects chloride changes due only to
 41 operations.

42 The following outlines the modeled chloride changes relative to the applicable objectives and
 43 beneficial uses of Delta waters.

1 *Municipal Beneficial Uses—Relative to Existing Conditions*

2 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
3 (see Section 8.3.1.3, *Plan Area*) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for
4 municipal and industrial beneficial uses on a basis of the percentage of years the chloride objective
5 is exceeded for the modeled 16-year period. The objective is exceeded if chloride concentrations
6 exceed 150 mg/L for a specified number of days in a given water year at both the Antioch and
7 Contra Costa Pumping Plant #1 locations. For Alternative 2A, the modeled frequency of objective
8 exceedance would approximately double from 7% of years under Existing Conditions, to 13% of
9 years under Alternative 2A (Appendix 8G, Table Cl-64). The increase was due to a single year, 1990,
10 which was only one day short of the required number of days <150 mg/L. Given the uncertainty in
11 the chloride modeling approach, it is likely that real time operations of the SWP and CVP could
12 achieve compliance with this objective. (See Section 8.3.1.1, *Models Used and Their Linkages*, for a
13 discussion of chloride compliance modeling uncertainties and a description of real time operations
14 of the SWP and CVP.)

15 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
16 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
17 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
18 basis for the evaluation was the predicted number of days the objective was exceeded for the
19 modeled 16-year period. For Alternative 2A, the modeled frequency of objective exceedance would
20 decrease by approximately one half, from 6% of modeled days under Existing Conditions, to 3% of
21 modeled days under Alternative 2A (Appendix 8G, Table Cl-63).

22 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
23 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
24 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
25 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
26 approach to model monthly average chloride concentrations for the 16-year period, the predicted
27 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
28 Pumping Plant #1 (Appendix 8G, *Chloride*, Table Cl-15). The frequency of exceedances would
29 increase for the 16-year period modeled at the San Joaquin River at Antioch (i.e., from 66% under
30 Existing Conditions to 70%) and Sacramento River at Mallard Island (i.e., from 85% under Existing
31 Conditions to 88%) (Appendix 8G, Table Cl-15), and would cause further degradation at Antioch in
32 March and April (i.e., maximum reduction of 54% of available assimilative capacity for the 16-year
33 period modeled, and 100% reduction, or elimination of assimilative capacity, during the drought
34 period modeled) (Appendix 8G, Table Cl-17).

35 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
36 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
37 capacity would be similar to those discussed when utilizing the mass balance modeling approach
38 (Appendix 8G, *Chloride*, Tables Cl-16 and Cl-18). However, as with Alternative 1A the modeling
39 approach utilizing the chloride-EC relationships predicted changes of lesser magnitude, where
40 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
41 thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the
42 approach that yielded the more conservative predictions was used as the basis for determining
43 adverse impacts.

44 Based on the additional predicted seasonal and annual exceedances of the 250 mg/L Bay Delta
45 WQCP objective for chloride, and the magnitude of associated long-term average water quality

1 degradation in the western Delta, the potential exists for substantial adverse effects on the
2 municipal and industrial beneficial uses through reduced opportunity for diversion of water of
3 acceptable chloride levels.

4 *303(d) Listed Water Bodies—Relative to Existing Conditions*

5 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
6 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
7 nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would generally be similar
8 compared to Existing Conditions, and thus, would not be further degraded on a long-term basis
9 (Appendix 8G, Figure Cl-2). With respect to Suisun Marsh, the monthly average chloride
10 concentrations for the 16-year period modeled would generally increase compared to Existing
11 Conditions in some months during October through May at the Sacramento River at Collinsville
12 (Appendix 8G, Figure Cl-3) and Mallard Island (Appendix 8G, Figure Cl-1), and would increase
13 substantially at Montezuma Slough at Beldon's Landing (i.e., over a doubling of concentration in
14 December through February) (Appendix 8G, Figure Cl-4). Although modeling of Alternative 2A
15 assumed no operation of the Montezuma Slough Salinity Control Gates, the project description
16 assumes continued operation of the Salinity Control Gates, consistent with assumptions included in
17 the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative 4 with the
18 gates operational consistent with the No Action Alternative resulted in substantially lower EC levels
19 than indicated in the original Alternative 4 modeling results for Suisun Marsh, but EC levels were
20 still somewhat higher than EC levels under Existing Conditions for several locations and months.
21 Although chloride was not specifically modeled in this sensitivity analysis, it is expected that
22 chloride concentrations would be nearly proportional to EC levels in Suisun Marsh. Another
23 modeling run with the gates operational and restoration areas removed resulted in EC levels nearly
24 equivalent to Existing Conditions, indicating that design and siting of restoration areas has notable
25 bearing on EC levels at different locations within Suisun Marsh (see Appendix 8H, Attachment 1, for
26 more information on these sensitivity analyses). These analyses also indicate that increases in
27 salinity are related primarily to the hydrodynamic effects of CM4, not operational components of
28 CM1. Based on the sensitivity analyses, optimizing the design and siting of restoration areas may
29 limit the magnitude of long-term chloride increases in the Marsh. However, the chloride
30 concentration increases at certain locations could be substantial, depending on siting and design of
31 restoration areas. Thus, these increased chloride levels in Suisun Marsh are considered to contribute
32 to additional, measureable long-term degradation that potentially would adversely affect the
33 necessary actions to reduce chloride loading for any TMDL that is developed.

34 *Municipal Beneficial Uses—Relative to No Action Alternative*

35 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
36 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3, *Plan Area*) were
37 used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial
38 uses. For Alternative 2A, the modeled frequency of objective exceedance would increase from 0%
39 under the No Action Alternative to 13% of years under Alternative 2A (Appendix 8G, Table Cl-64).
40 The increase was due to two years, 1977 and 1990, which were only eight and one day(s) short of
41 the required number of days <150 mg/L, respectively. Given the uncertainty in the chloride
42 modeling approach, it is likely that real time operations of the SWP and CVP could achieve
43 compliance with this objective (see Section 8.3.1.1, *Models Used and Their Linkages*, for a discussion
44 of chloride compliance modeling uncertainties and a description of real time operations of the SWP
45 and CVP).

1 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
2 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
3 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. For
4 Alternative 2A, the modeled frequency of objective exceedance would decrease from 5% of modeled
5 days under the No Action Alternative to 3% of modeled days under Alternative 2A (Appendix 8G,
6 Table Cl-63).

7 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
8 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
9 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
10 model monthly average chloride concentrations for the 16-year period, the exceedance frequency
11 would be predicted to decrease slightly at the San Joaquin River at Antioch (i.e., from 73% for the No
12 Action Alternative to 70%), decrease slightly at the Contra Costa Canal at Pumping Plant #1 (i.e.,
13 from 14% to 12%), and increase slightly at the Sacramento River at Mallard Island (i.e., from 86% to
14 88%) (Appendix 8G, Table Cl-15). The available assimilative capacity would be reduced at the
15 Antioch location compared to the No Action Alternative (i.e., reduction of 25% in April, and 100% in
16 April [i.e., eliminated] during the drought period modeled) (Appendix 8G, Table Cl-17). Available
17 assimilative capacity also would be reduced at the Contra Costa Canal at Pumping Plant #1 by up to
18 17% and 12% in September and October of the 16-year modeled period, respectively, and up to
19 100% in the drought period) (Appendix 8G, Table Cl-17), reflecting substantial degradation at these
20 locations during months when average concentrations would be near, or exceed, the objective.

21 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
22 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
23 capacity would be similar to those discussed when utilizing the mass balance modeling approach
24 (Appendix 8G, Table Cl-16 and Table Cl 18). However, as with Alternative 1A the modeling approach
25 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
26 change utilizing the mass balance approach were generally of greater magnitude, and thus more
27 conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the approach
28 that yielded the more conservative predictions was used as the basis for determining adverse
29 impacts.

30 Based on the additional seasonal and annual exceedances of the 250 mg/L objective as well as the
31 magnitude of long-term average water quality degradation with respect to chloride at interior and
32 western Delta locations, the potential exists for substantial adverse effects to the municipal and
33 industrial beneficial uses through reduced opportunity for diversion of water with acceptable
34 chloride levels.

35 *303(d) Listed Water Bodies—Relative to No Action Alternative*

36 With respect to the 303(d) listing for chloride for Tom Paine Slough, Alternative 2A would generally
37 result in similar changes to those discussed for the comparison to Existing Conditions. Monthly
38 average chloride concentrations at the Old River at Tracy Road for the 16-year period modeled,
39 which represents the nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would
40 not be further degraded on a long-term basis (Appendix 8G, Figure Cl-2).

41 Monthly average chloride concentrations at source water channel locations for the Suisun Marsh
42 (Appendix 8G, Figures Cl-1, Cl-3, and Cl-4) would increase substantially in some months during
43 October through May compared to the No Action Alternative conditions. Sensitivity analyses
44 suggested that operation of the Salinity Control Gates and restoration area siting and design

1 considerations could reduce these increases. However, the chloride concentration increases at
 2 certain locations could be substantial, depending on siting and design of restoration areas. Thus,
 3 these increased chloride levels in Suisun Marsh are considered to contribute to additional,
 4 measureable long-term degradation in Suisun Marsh that potentially would adversely affect the
 5 necessary actions to reduce chloride loading for any TMDL that is developed.

6 ***SWP/CVP Export Service Areas***

7 Under Alternative 2A, long-term average chloride concentrations based on the mass balance
 8 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
 9 would decrease by as much as 33% relative to Existing Conditions and 29% compared to No Action
 10 Alternative (Appendix 8G, *Chloride*, Table Cl-13). The modeled frequency of exceedances of
 11 applicable water quality objectives/criteria would decrease relative to the Existing Conditions and
 12 No Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
 13 *Chloride*, Table Cl-15). Consequently, water exported into the SWP/CVP service area would
 14 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
 15 the No Action Alternative conditions.

16 Results of the modeling approach which used relationships between EC and chloride (see Section
 17 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment of chloride using
 18 these data results in the same conclusions as are presented above for the mass-balance approach
 19 (Appendix 8G, Table Cl-14 and Table Cl-16).

20 Commensurate with the reduced chloride concentrations in water exported to the service area,
 21 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
 22 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
 23 San Joaquin River flows (see discussion of Upstream of the Delta).

24 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
 25 contribute towards a substantial change in existing sources of chloride in the affected environment.
 26 Maintenance activities would not be expected to cause any substantial change in chloride such that
 27 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
 28 affected anywhere in the affected environment.

29 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 2A is not
 30 expected to result in substantially increased frequency of exceedance of the 150 mg/L municipal
 31 and industrial objective at Contra Costa Pumping Plant #1 and Antioch locations. The frequency of
 32 exceedances of the 250 mg/L municipal and industrial objective at interior and western Delta
 33 locations would generally decrease, however, further water quality degradation would occur.
 34 Measureable water quality degradation also could occur relative to the 303(d) impairment in Suisun
 35 Marsh. The predicted chloride increases constitute an adverse effect on water quality (see
 36 Mitigation Measure WQ-7; implementation of this measure along with a separate, other commitment
 37 relating to the potential increased chloride treatment costs would reduce these effects).
 38 Additionally, the predicted changes relative to the No Action Alternative conditions indicate that in
 39 addition to the effects of climate change/sea level rise, implementation of CM1 and CM4 under
 40 Alternative 2A would contribute substantially to the adverse water quality effects.

41 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 43 *Determination of Effects*) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
4 thus river flow rate and reservoir storage reductions that would occur under the Alternative 2A,
5 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
6 chloride levels. Additionally, relative to Existing Conditions, the Alternative 2A would not result in
7 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
8 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
9 watershed.

10 Relative to Existing Conditions, the Alternative 2A is not expected to result in substantially increased
11 frequency of exceedance of the 150 mg/L municipal and industrial objective at Contra Costa
12 Pumping Plant #1 and Antioch locations. Modeling results indicated that the frequency of
13 exceedance of the 250 mg/L Bay-Delta WQCP objective would increase at the San Joaquin River at
14 Antioch and at Mallard Slough (by 3% each), but these frequencies are expected to be within the
15 uncertainty present in the chloride modeling procedure. However, long-term degradation may occur
16 that may result in adverse effects on the municipal and industrial water supply beneficial use (see
17 Mitigation Measure WQ-7; implementation of this measure along with a separate, other commitment
18 relating to the potential increased chloride treatment costs would reduce these effects). Relative to
19 the Existing Conditions, the modeled increased chloride concentrations and degradation in the
20 western Delta could further contribute, at measurable levels, to the existing 303(d) listed
21 impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.

22 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
23 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
24 River.

25 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
26 2A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
27 Alternative 2A maintenance would not result in any substantial changes in chloride concentration
28 upstream of the Delta or in the SWP/CVP Export Service Areas. However, this impact is determined
29 to be significant due to increased chloride concentrations and degradation at western Delta
30 locations and its effects on municipal and industrial water supply and fish and wildlife beneficial
31 uses.

32 While mitigation measures to reduce these water quality effects in affected water bodies to less-
33 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
34 recommended to attempt to reduce the effect that increased chloride concentrations may have on
35 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
36 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
37 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
38 discussion of Alternative 1A.

39 In addition to and to supplement Mitigation Measure WQ-7, the project proponents have
40 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
41 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
42 costs that could result from chloride concentration effects on municipal, industrial and agricultural
43 water purveyor operations. Potential options for making use of this financial commitment include
44 funding or providing other assistance towards acquiring alternative water supplies or towards

1 modifying existing operations when chloride concentrations at a particular location reduce
 2 opportunities to operate existing water supply diversion facilities. Please refer to Appendix 3B for
 3 the full list of potential actions that could be taken pursuant to this commitment in order to reduce
 4 the water quality treatment costs associated with water quality effects relating to chloride, electrical
 5 conductivity, and bromide.

6 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 7 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

8 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

9 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-**
 10 **CM21**

11 **NEPA Effects:** Under Alternative 2A, the types and geographic extent of effects on chloride
 12 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 13 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
 14 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 15 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
 16 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
 17 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-
 18 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 19 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 20 considered an improvement compared to No Action Alternative conditions. In summary, based on
 21 the discussion above, the effects on chloride from implementing CM2–CM21 are considered to be
 22 not adverse.

23 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 2A would not present new or
 24 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 25 Delta, or in the SWP/CVP service area compared to Existing Conditions. Replacement of irrigated
 26 agricultural land uses in the Delta with habitat restoration conservation measures may result in
 27 some reduction in discharge of agricultural field drainage with elevated chloride concentrations,
 28 thus resulting in improved water quality conditions. Based on these findings, this impact is
 29 considered to be less than significant. No mitigation is required.

30 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 31 **Maintenance (CM1)**

32 **NEPA Effects:** Effects of CM1 on DO under Alternative 2A would be the same as those discussed for
 33 Alternative 1A and are considered to not be adverse.

34 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 2A would be similar to those discussed
 35 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 36 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
 37 determination for this constituent. For additional details on the effects assessment findings that
 38 support this CEQA impact determination, see the effects assessment discussion under Alternative
 39 1A.

40 Reservoir storage reductions that would occur under Alternative 2A, relative to Existing Conditions,
 41 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,

1 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
2 Similarly, river flow rate reductions that would occur would not be expected to result in a
3 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
4 flows would remain within the ranges historically seen under Existing Conditions and the affected
5 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
6 water temperature would not be expected to cause DO levels to be outside of the range seen
7 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
8 change sufficiently to affect DO levels.

9 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
10 Delta source water percentages under this alternative or substantial degradation of these water
11 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
12 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
13 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
14 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
15 the reaeration of Delta waters would not be expected to change substantially.

16 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
17 Export Service Areas waters under Alternative 2A, relative to Existing Conditions, because the
18 biochemical oxygen demand of the exported water would not be expected to substantially differ
19 from that under Existing Conditions (due to ever increasing water quality regulations), canal
20 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
21 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
22 downstream reservoirs.

23 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
24 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
25 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
26 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
27 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
28 because no substantial decreases in DO levels would be expected, greater degradation and DO-
29 related impairment of these areas would not be expected. This impact would be less than significant.
30 No mitigation is required.

31 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2-CM21**

32 **NEPA Effects:** Effects of CM2-CM21 on DO under Alternative 2A would be the same as those
33 discussed for Alternative 1A and are considered to not be adverse.

34 **CEQA Conclusion:** CM2-CM21 proposed under Alternative 2A would be similar to those proposed
35 under Alternative 1A. As such, effects on DO resulting from the implementation of CM2-CM21 would
36 be similar to those previously discussed for Alternative 1A. This impact is considered to be less than
37 significant. No mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 5 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 6 the San Joaquin River upstream of the Delta under Alternative 2A are not expected to be outside the
 7 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 8 minor changes in EC levels that could occur under Alternative 2A in water bodies upstream of the
 9 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 10 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 16 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 17 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 18 more information.

19 Relative to Existing Conditions, modeling indicates that Alternative 2A would result in an increase in
 20 the number of days the Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River
 21 at Emmaton, San Joaquin River at San Andreas Landing, Jersey Point (fish and wildlife objective),
 22 and Prisoners Point, and Old River near Middle River and at Tracy Bridge (Appendix 8H, *Electrical*
 23 *Conductivity*, Table EC-2).

24 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
 25 (1976–1991) would increase from 6% under Existing Conditions to 26% under Alternative 2A, and
 26 the percentage of days out of compliance would increase from 11% under Existing Conditions to
 27 40% under Alternative 2A.

28 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
 29 from 1% under Existing Conditions to 5% under Alternative 2A, and the percentage of days out of
 30 compliance with the EC objective would increase from 1% under Existing Conditions to 8% under
 31 Alternative 2A. Sensitivity analyses were performed for Alternative 4 Scenario H3, and indicated
 32 that many similar exceedances were modeling artifacts, and the small number of remaining
 33 exceedances were small in magnitude, lasted only a few days, and could be addressed with real time
 34 operations of the SWP and CVP (see Section 8.3.1.1, *Models Used and Their Linkages*, for a
 35 description of real time operations of the SWP and CVP). Due to similarities in the nature of the
 36 exceedances between alternatives, the findings from these analyses can be extended to this
 37 alternative as well.

38 The percentage of days the Prisoners Point EC objective would be exceeded for the entire period
 39 modeled would increase from 6% under Existing Conditions to 25% under Alternative 2A, and the
 40 percentage of days out of compliance with the EC objective would increase from 10% under Existing
 41 Conditions to 29% under Alternative 2A. At Jersey Point, relative to the fish and wildlife objective,
 42 the percentage of days the EC objective would be exceeded for the entire period modeled would

1 increase from 0% under Existing Conditions to 1% under Alternative 2A, and the percentage of days
2 out of compliance with the EC objective would increase from 0% under Existing Conditions to 2%
3 under Alternative 2A. Sensitivity analyses conducted for Alternative 4 Scenario H3 indicated that
4 removing all tidal restoration areas would reduce the number of exceedances, but there would still
5 be substantially more exceedances than under Existing Conditions or the No Action Alternative.
6 Results of the sensitivity analyses indicate that the exceedances are partially a function of the
7 operations of the alternative itself, perhaps due to Head of Old River Barrier assumptions and south
8 Delta export differences (see Appendix 8H, Attachment 1, for more discussion of these sensitivity
9 analyses). Due to similarities in the nature of the exceedances between alternatives, the findings
10 from these analyses can be extended to this alternative as well. Appendix 8H, Attachment 2, contains
11 a more detailed assessment of the likelihood of these exceedances impacting aquatic life beneficial
12 uses. Specifically, Appendix 8H, Attachment 2, discusses whether these exceedances might have
13 indirect effects on striped bass spawning in the Delta, and concludes that the high level of
14 uncertainty precludes making a definitive determination.

15 The increase in percentage of days exceeding the EC objectives and days out of compliance at the
16 Old River locations would be 2% at Tracy Bridge and less than 1% at Middle River. Sensitivity
17 analyses performed for Alternative 4 Scenario H3 indicated that many of these exceedances are
18 modeling artifacts, and modeling barrier installation assumptions consistent with historical dry year
19 practices of installing barriers earlier in the year could resolve these additional exceedances (see
20 Appendix 8H, Attachment 1, for a discussion of these sensitivity analyses). Due to similarities in the
21 nature of the exceedances between alternatives, the findings from these analyses can be extended to
22 this alternative as well. Furthermore, as noted in Section 8.1.3.7, *Salinity and Electrical Conductivity*,
23 SWP and CVP operations have relatively little influence on salinity levels at these locations, and the
24 elevated salinity in south Delta channels is affected substantially by local salt contributions
25 discharged into the San Joaquin River downstream of Vernalis. Thus, the modeling has limited
26 ability to estimate salinity accurately in this region.

27 Average EC levels at the western and southern Delta compliance locations would decrease from 0–
28 37% for the entire period modeled. During the drought period modeled (1987–1991), average EC
29 would decrease by 0–32%, at western and southern Delta locations, except Emmaton would have an
30 increase in average EC of 9% (Appendix 8H, Table EC-13). At the two interior Delta locations, there
31 would be increases in average EC: the S. Fork Mokelumne River at Terminous average EC would
32 increase 5% for the entire period modeled and 4% during the drought period modeled; and San
33 Joaquin River at San Andreas Landing average EC would increase 1% for the entire period modeled
34 and 10% during the drought period modeled. On average, EC would increase at San Andreas
35 Landing from February through September. Average EC in the S. Fork Mokelumne River at
36 Terminous would increase during all months. Average EC at Jersey Point during the months of
37 April–May, when the fish and wildlife objective applies in all but critical water year types, would
38 increase from 15–16% for the entire period modeled (Appendix 8H, Table EC-13). The comparison
39 to Existing Conditions reflects changes in EC due to both Alternative 2A operations (including north
40 Delta intake capacity of 15,000 cfs, Fall X2, and numerous other components of Operational Scenario
41 B) and climate change/sea level rise.

42 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
43 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
44 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
45 Tracy Bridge (Appendix 8H, *Electrical Conductivity*, Table EC-2). The increase in percentage of days
46 exceeding the EC objective would be 24% at Prisoners Point and 12% or less at the remaining

1 locations. The increase in percentage of days out of compliance would be 28% at Prisoners Point
2 and 15% or less at the remaining locations. For the entire period modeled, average EC levels would
3 increase at all Delta compliance locations relative to the No Action Alternative, except in the
4 Sacramento River at Emmaton, and the San Joaquin River at Jersey Point. The average EC increase
5 would be 6% or less (Appendix 8H, Table EC-13). Similarly, during the drought period modeled,
6 average EC would increase at all locations, except Emmaton and Jersey Point. The greatest average
7 EC increase during the drought period modeled would occur in the San Joaquin River at San Andreas
8 Landing (10%); the increase at the other locations would be 1–7% (Appendix 8H, Table EC-13). The
9 comparison to the No Action Alternative reflects changes in EC due only to Alternative 2A
10 operations (including north Delta intake capacity of 15,000 cfs, Fall X2, and numerous other
11 components of Operational Scenario B).

12 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
13 fish and wildlife apply. Average EC would increase for the entire period modeled under Alternative
14 2A, relative to Existing Conditions, during the months of March through May by 0.3–0.6 mS/cm in
15 the Sacramento River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would
16 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
17 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon’s Landing, with
18 long-term average EC levels increasing by 1.6–4.6 mS/cm, depending on the month, at least doubling
19 during some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table
20 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases
21 during all months of 0.5–2.4 mS/cm (Appendix 8H, Tables EC-24 and EC-25). Modeling of this
22 alternative assumed no operation of the Montezuma Slough Salinity Control Gates, but the project
23 description assumes continued operation of the Salinity Control Gates, consistent with assumptions
24 included in the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative
25 4 Scenario H3 with the gates operational consistent with the No Action Alternative resulted in
26 substantially lower EC levels than indicated in the original Alternative 4 modeling results, but EC
27 levels were still somewhat higher than EC levels under Existing Conditions and the No Action
28 Alternative for several locations and months. Another modeling run with the gates operational and
29 restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions and the No
30 Action Alternative, indicating that design and siting of restoration areas has notable bearing on EC
31 levels at different locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more
32 information on these sensitivity analyses). These analyses also indicate that increases are related
33 primarily to the hydrodynamic effects of CM4, not operational components of CM1. Based on the
34 sensitivity analyses, optimizing the design and siting of restoration areas may limit the magnitude of
35 long-term EC increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the
36 EC increases between alternatives, the findings from these analyses can be extended to this
37 alternative as well.

38 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
39 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
40 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
41 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
42 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
43 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
44 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
45 certain locations could be substantial, depending on siting and design of restoration areas, and it is
46 uncertain the degree to which current management plans for the Suisun Marsh would be able to

1 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
 2 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
 3 Long-term average EC increases in Suisun Marsh under Alternative 2A relative to the No Action
 4 Alternative would be similar to the increases relative to Existing Conditions.

5 Given that the western and southern Delta are Clean Water Act Section 303(d) listed as impaired
 6 due to elevated EC, the increase in the incidence of exceedance of EC objectives under Alternative
 7 2A, relative to Existing Conditions and the No Action Alternative, has the potential to contribute to
 8 additional impairment and potentially adversely affect beneficial uses. Suisun Marsh is CWA Section
 9 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
 10 concentrations could contribute to additional impairment.

11 ***SWP/CVP Export Service Areas***

12 At the Banks and Jones pumping plants, Alternative 2A would result in no exceedances of the Bay-
 13 Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, Table EC-
 14 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 15 Areas using water pumped at this location under the Alternative 2A.

16 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 2A
 17 would decrease 28% for the entire period modeled and 22% during the drought period modeled.
 18 Relative to the No Action Alternative, average EC levels would decrease by 22% for the entire period
 19 modeled and 17% during the drought period modeled. (Appendix 8H, Table EC-13)

20 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 2A
 21 would decrease 28% for the entire period modeled and 23% during the drought period modeled.
 22 Relative to the No Action Alternative, average EC levels would decrease by 24% for the entire period
 23 modeled and 20% during the drought period modeled. (Appendix 8H, Table EC-13)

24 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 25 pumping plants, Alternative 2A would not cause degradation of water quality with respect to EC in
 26 the SWP/CVP Export Service Areas; rather, Alternative 2A would improve long-term average EC
 27 conditions in the SWP/CVP Export Service Areas.

28 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 29 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
 30 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
 31 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
 32 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
 33 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
 34 impact discussion under the No Action Alternative).

35 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
 36 elevated EC. Alternative 2A would result in lower average EC levels relative to Existing Conditions
 37 and the No Action Alternative and, thus, would not contribute to additional beneficial use
 38 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

39 ***NEPA Effects:*** In summary, the increased frequency of exceedance of EC objectives and increased
 40 long-term and drought period average EC levels that would occur at western Delta compliance
 41 locations under Alternative 2A, relative to the No Action Alternative, would contribute to adverse
 42 effects on the agricultural beneficial uses. The increased long-term period average EC levels between

1 Jersey Point and Prisoners Point could contribute to adverse effects on fish and wildlife beneficial
2 uses (specifically, indirect adverse effects on striped bass spawning), though there is a high degree
3 of uncertainty associated with this impact. The western and southern Delta are CWA Section 303(d)
4 listed as impaired due to elevated EC, and the increase in incidence of exceedance of EC objectives
5 and increases in long-term average and drought period average EC in the western portion of the
6 Delta have the potential to contribute to additional beneficial use impairment. The increases in long-
7 term average EC levels that could occur in Suisun Marsh would further degrade existing EC levels
8 and could contribute to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is
9 Section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
10 average EC levels could contribute to additional beneficial use impairment. The effects on EC in the
11 western Delta, San Joaquin River at Prisoners Point, and in Suisun Marsh constitute an adverse effect
12 on water quality. Mitigation Measure WQ-11 would be available to reduce these effects
13 (implementation of this measure along with a separate, other commitment as set forth in EIR/EIS
14 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-related
15 changes would reduce these effects).

16 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
17 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
18 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
19 constituent. For additional details on the effects assessment findings that support this CEQA impact
20 determination, see the effects assessment discussion that immediately precedes this conclusion.

21 River flow rate and reservoir storage reductions that would occur under Alternative 2A, relative to
22 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
23 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
24 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
25 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
26 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
27 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
28 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
29 Delta.

30 Relative to Existing Conditions, Alternative 2A would not result in any substantial increases in long-
31 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
32 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
33 would decrease at both plants and, thus, this alternative would not contribute to additional
34 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
35 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
36 relative to Existing Conditions.

37 In the Plan Area, Alternative 2A would result in an increase in the frequency with which Bay-Delta
38 WQCP EC objectives are exceeded for the entire period modeled (1976–1991): in the Sacramento
39 River at Emmaton (agricultural objective; 20% increase), in the San Joaquin River at Prisoners Point
40 (fish and wildlife objective; 19% increase), in the interior Delta. Average EC levels at San Andreas
41 Landing would increase by 1% during for the entire period modeled and 10% during the drought
42 period modeled. The increases in long-term and drought period average EC levels and increased
43 frequency of exceedance of EC objectives that would occur in the Sacramento River at Emmaton
44 would potentially contribute to adverse effects on the agricultural beneficial uses in the western
45 Delta. The increased long-term period average EC levels between Jersey Point and Prisoners Point

1 could contribute to adverse effects on fish and wildlife beneficial uses (specifically, indirect adverse
 2 effects on striped bass spawning), though there is a high degree of uncertainty associated with this
 3 impact. Because EC is not bioaccumulative, the increases in long-term average EC levels would not
 4 directly cause bioaccumulative problems in aquatic life or humans. The western and southern Delta
 5 are Clean Water Act Section 303(d) listed for elevated EC and the increased frequency of exceedance
 6 of EC objectives that would occur in in the western Delta could make beneficial use impairment
 7 measurably worse. This impact is considered to be significant.

8 Further, relative to Existing Conditions, Alternative 2A could result in substantial increases in long-
 9 term average EC during the months of October through May in Suisun Marsh. The increases in long-
 10 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
 11 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
 12 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
 13 bioaccumulative problems in fish and wildlife. Suisun Marsh is Clean Water Act Section 303(d) listed
 14 for elevated EC and the increases in long-term average EC that would occur in the marsh could make
 15 beneficial use impairment measurably worse. This impact is considered to be significant.

16 Implementation of Mitigation Measure WQ-11 along with a separate, other commitment relating to
 17 the potential increased costs associated with EC-related changes would reduce these effects. While
 18 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
 19 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
 20 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
 21 However, because the effectiveness of this mitigation measure to result in feasible measures for
 22 reducing water quality effects is uncertain, this impact is considered to remain significant and
 23 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
 24 Alternative 1A.

25 In addition to and to supplement Mitigation Measure WQ-11, the project proponents have
 26 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 27 *AMMs*, and *CMs*, a separate, other commitment to address the potential increased water treatment
 28 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 29 purveyor operations. Potential options for making use of this financial commitment include funding
 30 or providing other assistance towards acquiring alternative water supplies or towards modifying
 31 existing operations when EC concentrations at a particular location reduce opportunities to operate
 32 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
 33 actions that could be taken pursuant to this commitment in order to reduce the water quality
 34 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
 35 bromide.

36 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 37 **Quality Conditions**

38 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

39 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 40 **CM21**

41 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 2A would be the same as those
 42 discussed for Alternative 1A and are considered not to be adverse.

1 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 2 under Alternative 1A. As such, effects on EC resulting from the implementation of CM2–CM21 would
 3 be similar to those previously discussed for Alternative 1A. This impact is considered to be less than
 4 significant. No mitigation is required.

5 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 2A, the magnitude and timing of reservoir releases and river flows upstream of
 9 the Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 10 Existing Conditions and the No Action Alternative.

11 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 12 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 13 relationships for mercury and methylmercury. No significant, predictive regression relationships
 14 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 15 (monthly or annual) (Appendix 8I, *Mercury*, Figures I-10 through I-13). Such a positive relationship
 16 between total mercury and flow is to be expected based on the association of mercury with
 17 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
 18 flow in the Sacramento River under Alternative 2A relative to Existing Conditions and the No Action
 19 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
 20 mercury is mobilized. Therefore mercury loading should not be substantially different due to
 21 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
 22 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
 23 that may occur in the water bodies of the affected environment located upstream of the Delta would
 24 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
 25 uses or substantially degrade the quality of these water bodies as related to mercury. Both
 26 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
 27 expected to remain above guidance levels at upstream of Delta locations, but will not change
 28 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
 29 under Alternative 2A.

30 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 31 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 32 Mercury Control Program. These projects will target specific sources of mercury and methylation
 33 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 34 The implementation of these projects could help to ensure that upstream of Delta environments will
 35 not be substantially degraded for water quality with respect to mercury or methylmercury.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 38 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 41 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 42 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 43 more information.

1 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
 2 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
 3 change in assimilative capacity of waterborne total mercury of Alternative 2A relative to the 25 ng/L
 4 ecological risk benchmark showed the greatest decrease to be 2.2% for Old River at Rock Slough as
 5 compared to Existing Conditions, and 2.1% for Old River at Rock Slough as compared to the No
 6 Action Alternative (Figures 8-53a and 8-54a). These changes are not expected to result in adverse
 7 effects to beneficial uses. Similarly, changes in methylmercury concentration are expected to be very
 8 small. The greatest annual average methylmercury concentration for drought conditions was 0.163
 9 ng/L for the San Joaquin River at Buckley Cove, which was slightly higher than Existing Conditions
 10 (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L)(Appendix 8I, Table I-6).
 11 All modeled input concentrations exceeded the methylmercury TMDL guidance objective of 0.06
 12 ng/L, therefore percentage change in assimilative capacity was not evaluated for methylmercury.

13 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
 14 annual average concentrations for mercury at the Delta locations. The greatest increase in
 15 exceedance quotients was 13% at Old River at Rock Slough relative to Existing Conditions, and 11 -
 16 12% at the Mokelumne River (South Fork) at Staten Island, Franks Tract, and Old River at Rock
 17 Slough relative to the No Action Alternative (Figure 8-55a and 8-55b; Appendix 8I, Table I-9b).
 18 Because these increases are relatively small, and it is not evident that substantive increases are
 19 expected at numerous locations throughout the Delta, these changes are expected to be within the
 20 uncertainty inherent in the modeling approach, and would likely not be measurable in the
 21 environment. See Appendix 8I for a discussion of the uncertainty associated with the fish tissue
 22 estimates.

23 ***SWP/CVP Export Service Areas***

24 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
 25 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
 26 methylmercury concentrations for Alternative 2A are projected to be lower than Existing Conditions
 27 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-2 and
 28 I-3). Therefore, mercury shows increased assimilative capacity at these locations (Figures 8-53a and
 29 8-54a).

30 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
 31 Alternative 2A, relative to Existing Conditions and the No Action Alternative at any location within
 32 the Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 14%
 33 improvement relative to Existing Conditions, 17% relative to the No Action Alternative) (Figure 8-
 34 55a and 8-55b; Appendix 8I, Table I-9b).

35 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
 36 comparison of Alternative 2A to the No Action Alternative (as waterborne and bioaccumulated
 37 forms) are not considered to be adverse.

38 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 40 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 41 constituent. For additional details on the effects assessment findings that support this CEQA impact
 42 determination, see the effects assessment discussion that immediately precedes this conclusion.

1 Under Alternative 2A, greater water demands and climate change would alter the magnitude and
2 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
3 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
4 methylmercury upstream of the Delta will not be substantially different relative to Existing
5 Conditions due to the lack of important relationships between mercury/methylmercury
6 concentrations and flow for the major rivers.

7 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
8 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
9 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
10 mercury concentrations show almost no differences would occur among sites for Alternative 2A as
11 compared to Existing Conditions for Delta sites.

12 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
13 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
14 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
15 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 2A as
16 compared to Existing Conditions.

17 As such, this alternative is not expected to cause additional exceedance of applicable water quality
18 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
19 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
20 not expected to increase substantially, no long-term water quality degradation is expected to occur
21 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
22 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
23 or fish tissue mercury concentrations would not make any existing mercury-related impairment
24 measurably worse. In comparison to Existing Conditions, Alternative 2A would not increase levels of
25 mercury by frequency, magnitude, and geographic extent such that the affected environment would
26 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
27 substantially increasing the health risks to wildlife (including fish) or humans consuming those
28 organisms. This impact is considered to be less than significant. No mitigation is required.

29 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-** 30 **CM21**

31 **NEPA Effects:** Some habitat restoration activities under Alternative 2A would occur on lands in the
32 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
33 Alternative 2A have the potential to increase water residence times and increase accumulation of
34 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
35 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
36 possible but uncertain depending on the specific restoration design implemented at a particular
37 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
38 not currently available. However, DSM2 modeling for Alternative 2A operations does incorporate
39 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
40 8.3.1.3, *Plan Area*) that result in changes to Delta hydrodynamics compared to the No Action
41 Alternative. These modeled restoration assumptions provide some insight into potential
42 hydrodynamic changes that could be expected related to implementing CM2 and CM4 and are
43 considered in the evaluation of the potential for increased mercury and methylmercury
44 concentrations under Alternative 2A.

1 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 2 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 3 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 4 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 5 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 6 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 7 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 8 better inform restoration design,
- 9 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 10 techniques,
- 11 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 12 organic material at a restoration site,
- 13 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 14 biologically unavailable, inorganic form of mercury,
- 15 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 16 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 17 at a site.

18 Because of the uncertainties associated with site-specific estimates of methylmercury
 19 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 20 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 21 need to be evaluated separately for each restoration effort, as part of design and implementation. In
 22 summary, because of this uncertainty and the known potential for methylmercury creation in the
 23 Delta this potential effect of implementing CM2–CM21 is considered adverse.

24 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 25 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 26 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 27 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 28 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 29 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 30 measurable increase in methylmercury concentrations would make existing mercury-related
 31 impairment measurably worse. Because mercury is bioaccumulative, increases in waterborne
 32 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 33 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 34 Design of restoration sites under Alternative 2A would be guided by CM12 which requires
 35 development of site specific mercury management plans as restoration actions are implemented.
 36 The effectiveness of minimization and mitigation actions implemented according to the mercury
 37 management plans is not known at this time although the potential to reduce methylmercury
 38 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 39 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 40 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 41 impact being considered significant. No mitigation measures would be available until specific
 42 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 43 unavoidable.

1 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
 5 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 6 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

7 Under Alternative 2A, modeling indicates that long-term annual average flows on the San Joaquin
 8 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 9 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
 10 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 11 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 12 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 13 affected, if at all, by changes in flow rates under Alternative 2A.

14 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 15 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 16 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 17 water bodies, with regards to nitrate.

18 ***Delta***

19 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 20 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 21 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 22 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 23 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 24 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 25 more information.

26 Results of the mixing calculations indicate that under Alternative 2A, relative to Existing Conditions
 27 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 28 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 10 and 11). Although
 29 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
 30 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
 31 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
 32 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
 33 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 34 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 35 concentration would be somewhat reduced under Alternative 2A, relative to Existing Conditions,
 36 and slightly increased relative to the No Action Alternative. No additional exceedances of the MCL
 37 are anticipated at any location (Appendix 8J, *Nitrate*, Table 10). On a monthly average basis and on a
 38 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
 39 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
 40 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for all locations
 41 and months, except San Joaquin River at Buckley Cove in August, which showed a 6.4% use of the
 42 assimilative capacity that was available under the No Action Alternative, for the drought period
 43 (1987–1991) (Appendix 8J, *Nitrate*, Table 12).

1 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 2 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 3 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 4 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 5 the modeling.

- 6 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 7 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 8 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 9 the increase becoming greater with increasing distance downstream. However, the increase in
 10 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 11 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 12 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Regional
 13 Water Quality Control Board 2010a:32).
- 14 • Under Alternative 2A, the planned upgrades to the SRWTP, which include nitrification/partial
 15 denitrification, would substantially decrease ammonia concentrations in the discharge, but
 16 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
 17 higher than under Existing Conditions.
- 18 • Overall, under Alternative 2A, the nitrogen load from the SRWTP discharge is expected to
 19 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 20 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
 21 of the facility are expected to be higher than modeling results indicate for both Existing
 22 Conditions and Alternative 2A, the increase is expected to be greater under Existing Conditions
 23 than for Alternative 2A due to the upgrades that are assumed under Alternative 2A.

24 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 25 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 26 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 27 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 28 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 29 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 30 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 31 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 32 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 33 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 34 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 35 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 36 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

37 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
 38 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 39 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

40 ***SWP/CVP Export Service Areas***

41 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 42 nitrate-N at the Banks and Jones pumping plants.

1 Results of the mixing calculations indicate that under Alternative 2A, relative to Existing Conditions
2 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
3 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Table 10 and 11).
4 During the late summer, particularly in the drought period assessed, concentrations are expected to
5 increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally, given the
6 many factors that contribute to potential algal blooms in the SWP and CVP canals within the Export
7 Service Area, and the lack of studies that have shown a direct relationship between nutrient
8 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
9 there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal increases in
10 nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
11 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, *Nitrate*,
12 Table 10). On a monthly average basis and on a long term annual average basis, for all modeled
13 years and for the drought period (1987–1991) only, use of assimilative capacity available under
14 Existing Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible
15 (<4%) for both Banks and Jones pumping plants (Appendix 8J, *Nitrate*, Table 12).

16 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
17 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
18 degrade the quality of exported water, with regards to nitrate.

19 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
20 CM1 are considered to be not adverse.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
23 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
24 constituent. For additional details on the effects assessment findings that support this CEQA impact
25 determination, see the effects assessment discussion that immediately precedes this conclusion.

26 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
27 substantial dilution available for point sources and the lack of substantial nonpoint sources of
28 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
29 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
30 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
31 Consequently, any modified reservoir operations and subsequent changes in river flows under
32 Alternative 2A, relative to Existing Conditions, are expected to have negligible, if any, effects on
33 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
34 watershed and upstream of the Delta in the San Joaquin River watershed.

35 In the Delta, results of the mixing calculations indicate that under Alternative 2A, relative to Existing
36 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
37 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
38 location, and use of assimilative capacity available under Existing Conditions, relative to the
39 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for virtually all locations and
40 months.

41 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
42 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
43 indicate that under Alternative 2A, relative to Existing Conditions, long-term average nitrate
44 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No

1 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
 2 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
 3 plants for all months.

4 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
 5 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 6 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
 7 alternative is not expected to cause additional exceedance of applicable water quality
 8 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 9 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
 10 expected to increase substantially, no long-term water quality degradation is expected to occur and,
 11 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
 12 affected environment and thus any increases that may occur in some areas and months would not
 13 make any existing nitrate-related impairment measurably worse because no such impairments
 14 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 15 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 16 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 17 significant. No mitigation is required.

18 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-
 19 CM21**

20 **NEPA Effects:** Effects of CM2–CM21 on nitrate under Alternative 2A would be the same as those
 21 discussed for Alternative 1A and are considered not to be adverse.

22 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 23 under Alternative 1A. As such, effects on nitrate resulting from the implementation of CM2–CM21
 24 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 25 less than significant. No mitigation is required.

26 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities
 27 Operations and Maintenance (CM1)**

28 ***Upstream of the Delta***

29 Under Alternative 2A, there would be no substantial change to the sources of DOC within the
 30 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 31 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 32 system operations and resulting reservoir storage levels and river flows would not be expected to
 33 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 34 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 35 2A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
 36 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 37 substantially degrade the quality of these water bodies, with regards to DOC.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are

1 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
2 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
3 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
4 more information.

5 Under Alternative 2A, the geographic extent of effects pertaining to long-term average DOC
6 concentrations in the Delta would be similar to that previously described for Alternative 1A,
7 although the magnitude of predicted long-term change and relative frequency of concentration
8 threshold exceedances would be slightly greater. Modeled effects would be greatest at Franks Tract,
9 Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the modeled
10 drought period, long-term average concentration increases ranging from 0.3–0.4 mg/L would be
11 predicted ($\leq 12\%$ net increase) (Appendix 8K, *Organic Carbon*, DOC Table 3). Increases in long-term
12 average concentrations would correspond to more frequent concentration threshold exceedances,
13 with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock
14 Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under
15 Existing Conditions to 74% under the Alternative 2A (an increase from 47% to 70% for the drought
16 period), and concentrations exceeding 4 mg/L would increase from 30% to 36% (32% to 38% for
17 the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3
18 mg/L would increase from 52% under Existing Conditions to 80% under Alternative 2A (45% to
19 80% for the drought period), and concentrations exceeding 4 mg/L would increase from 32% to
20 41% (35% to 42% for the drought period). Relative change in frequency of threshold exceedance for
21 other assessment locations would be similar or less. While Alternative 2A would generally lead to
22 slightly higher long-term average DOC concentrations (≤ 0.4 mg/L) at some municipal water intakes
23 and Delta interior locations, the predicted change would not be expected to adversely affect MUN
24 beneficial uses, or any other beneficial use. This comparison to Existing Conditions reflects changes
25 in DOC due to both Alternative 2A operations (including north Delta intake capacity of 15,000 cfs,
26 Fall X2, and numerous other components of Operational Scenario B) and climate change/sea level
27 rise.

28 In comparison, Alternative 2A relative to the No Action Alternative would generally result in a
29 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
30 increases of 0.2–0.3 mg/L DOC (i.e., $\leq 9\%$) would be predicted at Franks Tract, Rock Slough, and
31 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table 3).
32 Threshold concentration exceedance frequency trends would also be similar to those discussed for
33 the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance frequency
34 at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average
35 DOC concentrations exceeded 4 mg/L at Buckley Cove would increase slightly from 27% to 28%
36 (42% to 50% for the modeled drought period). While the Alternative 2A would generally lead to
37 slightly higher long-term average DOC concentrations at some Delta assessment locations when
38 compared to No Action Alternative conditions, the predicted change would not be expected to
39 adversely affect MUN beneficial uses, or any other beneficial use, particularly when considering the
40 relatively small change in long-term annual average concentration. Unlike the comparison to
41 Existing Conditions, this comparison to the No Action Alternative reflects changes in DOC due to
42 only Alternative 2A operations.

43 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
44 occur before significant changes in drinking water treatment plant design or operations are
45 triggered. The increases in long-term average DOC concentrations estimated to occur at various
46 Delta locations under Alternative 2A are of sufficiently small magnitude that they would not require

1 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
2 levels currently employed.

3 Relative to existing and No Action Alternative conditions, Alternative 2A would lead to predicted
4 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
5 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
6 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline conditions
7 comparison and modeling period.

8 ***SWP/CVP Export Service Areas***

9 Under Alternative 2A, modeled long-term average DOC concentrations would decrease at Banks and
10 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
11 period. Relative to Existing Conditions, long-term average DOC concentrations at Banks would be
12 predicted to decrease by 0.5 mg/L (0.2 mg/L during drought period) (Appendix 8K, *Organic Carbon*,
13 DOC Table 3). At Jones, long-term average DOC concentrations would be predicted to decrease by
14 0.4 mg/L (<0.1 mg/L during drought period). Predicted decreases under relative to the No Action
15 Alternative would be of similar magnitude. Such decreases in long-term average DOC would result in
16 generally lower exceedance frequencies for concentration thresholds, although the frequency of
17 exceedance during the modeled drought period (i.e., 1987–1991) would be predicted to increase.
18 For the Banks pumping plant during the drought period, exceedance of the 3 mg/L threshold would
19 increase from 57% under Existing Conditions to 84% under Alternative 2A, while at the Jones
20 pumping plant, exceedance frequency would increase from 72% to 88%. There would be
21 comparatively fewer increases in the frequency of exceeding the 4 mg/L threshold at Banks and
22 Jones. Comparisons to the No Action Alternative yield similar trends, but with slightly smaller
23 magnitude drought period changes. Overall, modeling results for the SWP/CVP Export Service Areas
24 predict an overall improvement in Export Service Areas water quality, although more frequent
25 exports of >3mg/L DOC water would likely occur for drought periods.

26 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
27 facilities under Alternative 2A would not be expected to create new sources of DOC or contribute
28 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
29 would not be expected to cause any substantial change in long-term average DOC concentrations
30 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

31 ***NEPA Effects:*** In summary, Alternative 2A, relative to the No Action Alternative, would not cause a
32 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
33 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
34 decrease by as much as 0.6 mg/L, while long-term average DOC concentrations for some Delta
35 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.3 mg/L.
36 The increase in long-term average DOC concentration that could occur within the Delta interior
37 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
38 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
39 DOC is determined not to be adverse.

40 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
41 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
42 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
43 constituent. For additional details on the effects assessment findings that support this CEQA impact
44 determination, see the effects assessment discussion that immediately precedes this conclusion.

1 While greater water demands under the Alternative 2A would alter the magnitude and timing of
 2 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
 3 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
 4 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
 5 flows would not be expected to cause a substantial long-term change in DOC concentrations
 6 upstream of the Delta.

7 Relative to Existing Conditions, Alternative 2A would result in relatively small increases (i.e., $\leq 12\%$)
 8 in long-term average DOC concentrations at some Delta interior locations, including Franks Tract,
 9 Rock Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase
 10 the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
 11 Alternative 2A would generally lead to slightly higher long-term average DOC concentrations (≤ 0.4
 12 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
 13 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

14 The assessment of Alternative 2A effects on DOC in the SWP/CVP Export Service Areas is based on
 15 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
 16 Existing Conditions, long-term average DOC concentrations would decrease by as much as 0.5 mg/L
 17 at Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
 18 predicted during periods of drought. Nevertheless, an overall improvement in DOC-related water
 19 quality would be predicted in the SWP/CVP Export Service Areas.

20 Based on the above, Alternative 2A operation and maintenance would not result in any substantial
 21 change in long-term average DOC concentration upstream of the Delta or result in substantial
 22 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
 23 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
 24 concentrations would increase by no more than 0.4 mg/L at any single Delta assessment location
 25 (i.e., $\leq 12\%$ relative increase), with long-term average concentrations estimated to remain at or
 26 below 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San
 27 Joaquin River during the drought period modeled. Nevertheless, long-term average concentrations
 28 at Buckley Cove are expected to decrease slightly during the drought period, relative to Existing
 29 Conditions. The increases in long-term average DOC concentration that could occur within the Delta
 30 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
 31 beneficial uses, of Delta waters or waters of the SWP/CVP Service Area. Because DOC is not
 32 bioaccumulative, the increases in long-term average DOC concentrations would not directly cause
 33 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use
 34 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
 35 the increases in long-term average DOC that could occur at various locations would not make any
 36 beneficial use impairment measurably worse. Because long-term average DOC concentrations are
 37 not expected to increase substantially, no long-term water quality degradation with respect to DOC
 38 is expected to occur and, thus, no adverse effects on beneficial uses would occur. This impact is
 39 considered to be less than significant. No mitigation is required.

40 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from** 41 **Implementation of CM2–CM21**

42 *NEPA Effects:* CM2–CM21 proposed under Alternative 2A would be the same as those proposed
 43 under Alternative 1A. As such, effects on DOC resulting from the implementation of CM2–CM21
 44 would be similar to those previously discussed for Alternative 1A. In summary, CM4–CM7 and CM10

1 could contribute substantial amounts of DOC to raw drinking water supplies, largely depending on
 2 final design and operational criteria for the related wetland and riparian habitat restoration
 3 activities. Substantially increased long-term average DOC in raw water supplies could lead to a need
 4 for treatment plant upgrades in order to appropriately manage DBP formation in treated drinking
 5 water. This potential for future DOC increases would lead to substantially greater associated risk of
 6 long-term adverse effects on the MUN beneficial use.

7 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 2A would
 8 present new localized sources of DOC to the study area, and in some circumstances would substitute
 9 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 10 proximity to municipal drinking water intakes, such restoration activities could contribute
 11 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 12 DOC could necessitate changes in water treatment plant operations or require treatment plant
 13 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 14 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

15 **CEQA Conclusion:** Effects of CM4–7 and CM10 on DOC under Alternative 2A would be similar to
 16 those discussed for Alternative 1A. This impact is considered to be significant and mitigation is
 17 required. It is uncertain whether implementation of Mitigation Measure WQ-18 would reduce
 18 identified impacts to a less-than-significant level. Hence, this impact remains significant and
 19 unavoidable.

20 In addition to and to supplement Mitigation Measure WQ-18, the project proponents have
 21 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 22 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
 23 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 24 operations. Potential options for making use of this financial commitment include funding or
 25 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 26 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 27 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 28 water quality effects relating to DOC.

29 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 30 **Effects on Municipal Intakes**

31 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

32 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 33 **(CM1)**

34 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 2A would be the same as those
 35 discussed for Alternative 1A and are considered to not be adverse.

36 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 2A would be the same as those
 37 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 38 significance (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA
 39 impact determination for this constituent. For additional details on the effects assessment findings
 40 that support this CEQA impact determination, see the effects assessment discussion under
 41 Alternative 1A.

1 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
2 (water facilities and operations) under Alternative 2A, relative to Existing Conditions, would not be
3 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
4 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
5 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
6 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
7 related regulations.

8 It is expected there would be no substantial change in Delta pathogen concentrations in response to
9 a shift in the Delta source water percentages under this alternative or substantial degradation of
10 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
11 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
12 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
13 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
14 and livestock-related uses, would continue under this alternative.

15 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
16 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
17 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
18 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
19 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
20 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
21 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

22 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
24 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
25 expected to increase substantially, no long-term water quality degradation for pathogens is
26 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
27 River in the Stockton Deep Water Ship Channel is Clean Water Act Section 303(d) listed for
28 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
29 are expected to occur on a long-term basis, further degradation and impairment of this area is not
30 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
31 considered to be less than significant. No mitigation is required.

32 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

33 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 2A would be the same as those
34 discussed for Alternative 1A and are considered to not be adverse.

35 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
36 under Alternative 1A. As such, effects on pathogens resulting from the implementation of CM2–
37 CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered
38 to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 2A no specific
 5 operations or maintenance activity of the SWP or CVP would substantially drive a change in
 6 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
 7 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
 8 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
 9 Joaquin Rivers.

10 Under Alternative 2A, winter (November–March) and summer (April–October) season average flow
 11 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito,
 12 and the San Joaquin River at Vernalis would change. Relative to Existing Conditions and the No
 13 Action Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3%
 14 during the summer and 4% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather
 15 River, average flow rates would decrease no more than 2% during the summer and winter, while on
 16 the American River average flow rates would decrease by as much as 15% in the summer but would
 17 increase by as much as 6% in the winter. Seasonal average flow rates on the San Joaquin River
 18 would decrease by as much as 12% in the summer, but increase by as much as 1% in the winter. For
 19 the same reasons stated for the No Action Alternative, decreased seasonal average flow of $\leq 15\%$ is
 20 not considered to be of sufficient magnitude to substantially increase pesticide concentrations or
 21 alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other
 22 beneficial uses of water bodies upstream of the Delta.

23 ***Delta***

24 Sources of diuron, OP, and pyrethroid insecticides to the Plan Area include direct input of surface
 25 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 26 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

27 Under Alternative 2A, the distribution and mixing of Delta source waters would change. Percentage
 28 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
 29 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 30 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 31 fractions. Relative to Existing Conditions, under Alternative 2A modeled San Joaquin River fractions
 32 would increase greater than 10% at Buckley Cove (drought period only), Franks Tract, Rock Slough,
 33 and Contra Costa PP No. 1 (Appendix 8D, *Source Water Fingerprinting Results*). At Buckley Cove, San
 34 Joaquin River source water fractions when modeled for the drought period would increase 15% in
 35 August. At Franks Tract, source water fractions when modeled for the 16-year hydrologic period
 36 would increase 13–17% during October through November and February through April. At Rock
 37 Slough, San Joaquin River source water fractions would increase 11–24% during September through
 38 March (11–15% during October and November of the modeled drought period). Similarly, San
 39 Joaquin River fractions at Contra Costa Pumping Plant No. 1 would increase 10–24% during October
 40 through April (11–13% during October and November of the modeled drought period). While the
 41 modeled 24% increases of San Joaquin River Fraction at Rock Slough and Contra Costa PP No. 1 in
 42 November are considerable, the resultant net fraction would be $\leq 30\%$. Relative to Existing
 43 Conditions, there would be no modeled increases in Sacramento River fractions greater than 13%
 44 (with exception to Banks and Jones, discussed below) and Delta agricultural fractions greater than

1 8%. These modeled changes in the source water fractions of Sacramento, San Joaquin and Delta
2 agriculture water are not of sufficient magnitude to substantially alter the long-term risk of
3 pesticide-related toxicity to aquatic life, nor adversely affect other beneficial uses of the Delta.

4 When compared to the No Action Alternative, changes in source water fractions would be similar in
5 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
6 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
7 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
8 River) for all months of the year but July and August. In July and August, the combined operational
9 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
10 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
11 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
12 year. Under the operational scenario of Alternative 2A, however, modeled July and August San
13 Joaquin River fractions at Buckley Cove would increase relative to the No Action Alternative, with
14 increases of 16% in July (33% for the modeled drought period) and 25% in August (48% for the
15 modeled drought period) (Appendix 8D, *Source Water Fingerprinting Results*). Despite these San
16 Joaquin River increases, the resulting net San Joaquin River source water fraction for July and
17 August would remain less than all other months. As a result, these modeled changes in the source
18 water fractions are not of sufficient magnitude to substantially alter the long-term risk of pesticide-
19 related toxicity to aquatic life, nor adversely affect other beneficial uses of the Delta.

20 ***SWP/CVP Export Service Areas***

21 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
22 the Banks and Jones pumping plants. Under Alternative 2A, Sacramento River source water fractions
23 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
24 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
25 pumping plant, Sacramento source water fractions would generally increase from 23–50% for the
26 period of January through June (22–25% for March through April of the modeled drought period)
27 and at Jones pumping plant Sacramento source water fractions would generally increase from 34–
28 59% for the period of January through June (16–51% for February through May of the modeled
29 drought period). These increases in Sacramento source water fraction would primarily balance
30 through equivalent decreases in San Joaquin River water. Based on the general observation that San
31 Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP insecticides in
32 terms of greater frequency of incidence and presence at concentrations exceeding water quality
33 benchmarks, modeled increases in Sacramento River fraction at Banks and Jones would generally
34 represent an improvement in export water quality respective to pesticides.

35 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
36 American, and San Joaquin Rivers, under Alternative 2A relative to the No Action Alternative, are of
37 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
38 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
39 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
40 substantially alter the long-term risk of pesticide-related water quality degradation and related
41 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
42 operations and maintenance (CM1) are determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
2 provided above are summarized here, and are then compared to the CEQA thresholds of significance
3 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
4 determination for this constituent. For additional details on the effects assessment findings that
5 support this CEQA impact determination, see the effects assessment discussion that immediately
6 precedes this conclusion.

7 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
8 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
9 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
10 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
11 substantially increase the long-term risk of pesticide-related water quality degradation and related
12 toxicity to aquatic life in these water bodies upstream of the Delta.

13 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
14 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
15 and maintenance activities would not affect these sources, changes in Delta source water fraction
16 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
17 Alternative 2A, however, modeled changes in source water fractions relative to Existing Conditions
18 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
19 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
20 any other beneficial uses of Delta waters.

21 The assessment of Alternative 2A effects on pesticides in the SWP/CVP Export Service Areas is
22 based on assessment of changes predicted at Banks and Jones pumping plants. As just discussed
23 regarding effects to pesticides in the Delta, modeled changes in source water fractions at the Banks
24 and Jones pumping plants are of insufficient magnitude to substantially alter the long-term risk of
25 pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies
26 of the SWP and CVP export service area.

27 Based on the above, Alternative 2A would not result in any substantial change in long-term average
28 pesticide concentration or result in substantial increase in the anticipated frequency with which
29 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
30 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
31 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
32 affected environment, and while some of these pesticides may be bioaccumulative, those present-
33 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
34 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
35 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
36 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
37 throughout the affected environment that name pesticides as the cause for beneficial use
38 impairment, the modeled changes in upstream river flows and Delta source water fractions would
39 not be expected to make any of these beneficial use impairments measurably worse. Because long-
40 term average pesticide concentrations are not expected to increase substantially, no long-term
41 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
42 effects on beneficial uses would occur. This impact is considered to be less than significant. No
43 mitigation is required.

1 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-**
 2 **CM21**

3 **NEPA Effects:** CM2–CM21 proposed under Alternative 2A would be the same as those proposed
 4 under Alternative 1A. As such, effects on pesticides resulting from the implementation of CM2–
 5 CM21 would be similar to those previously discussed for Alternative 1A. In summary, CM13
 6 proposes the use of herbicides to control invasive aquatic vegetation around habitat restoration
 7 sites. Herbicides directly applied to water could include adverse effects on non-target aquatic life,
 8 such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life toxicity objectives
 9 could be exceeded with sufficient frequency and magnitude such that beneficial uses would be
 10 impacted, thus constituting an adverse effect on water quality.

11 In summary, based on the discussion above, the effects on pesticides from implementing CM2–CM21
 12 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
 13 effect.

14 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 2A are similar to those
 15 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
 16 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
 17 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
 18 that would be less than significant.

19 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
 20 **Strategies**

21 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

22 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 23 **and Maintenance (CM1)**

24 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
 25 of the affected environment under Alternative 2A would be very similar (i.e., nearly the same) to
 26 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
 27 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
 28 2A, which are considered to be not adverse. Based on this finding, this impact is considered to be not
 29 adverse.

30 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
 31 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 32 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
 33 determination for this constituent. For additional details on the effects assessment findings that
 34 support this CEQA impact determination, see the effects assessment discussion that immediately
 35 precedes this conclusion.

36 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 37 because changes in flows do not necessarily result in changes in concentrations or loading of
 38 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
 39 Delta are not anticipated for Alternative 2A, relative to Existing Conditions.

40 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
 41 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a

1 long term-average basis under Alternative 2A, relative to Existing Conditions. Algal growth rates are
 2 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
 3 that may occur at some locations and times within the Delta would be expected to have little effect
 4 on primary productivity in the Delta.

5 The assessment of effects of phosphorus under Alternative 2A in the SWP and CVP Export Service
 6 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
 7 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
 8 anticipated to change substantially on a long term-average basis.

9 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
 10 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 11 CVP and SWP service areas under Alternative 2A relative to Existing Conditions. As such, this
 12 alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 14 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 15 are not expected to increase substantially, no long-term water quality degradation is expected to
 16 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 17 within the affected environment and thus any minor increases that may occur in some areas would
 18 not make any existing phosphorus-related impairment measurably worse because no such
 19 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 20 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 21 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 22 than significant. No mitigation is required.

23 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 24 **CM2–CM21**

25 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
 26 environment under Alternative 2A would be very similar (i.e., nearly the same) to those discussed
 27 for Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 28 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
 29 effects of these same actions under Alternative 2A, which are considered to be not adverse.

30 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 31 under Alternative 1A. As such, effects on phosphorus resulting from the implementation of CM2–
 32 CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered
 33 to be less than significant. No mitigation is required.

34 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 35 **Maintenance (CM1)**

36 ***Upstream of the Delta***

37 For the same reasons stated for the No Action Alternative, Alternative 2A would have negligible, if
 38 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 39 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 40 concentrations that could occur in the water bodies of the affected environment upstream of the
 41 Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any
 42 beneficial uses or substantially degrade the quality of these water bodies, with regard to selenium.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
7 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
8 more information.

9 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
10 locations under Alternative 2A, relative to Existing Conditions and the No Action Alternative, are
11 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-12 and M-22 for most biota
12 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
13 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
14 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
15 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
16 water at each modeled assessment location for all years. Appendix 8M, Figure M-21 provides more
17 detail in the form of monthly patterns of selenium concentrations in water during the modeling
18 period.

19 Alternative 2A would result in small changes in average selenium concentrations in water at all
20 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
21 (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some interior and
22 western Delta locations would increase by 0.01–0.04 µg/L for the entire period modeled (1976–
23 1991). These small increases in selenium concentrations in water would result in small reductions
24 (4% or less) in available assimilative capacity for selenium, relative to the 1.3 µg/L USEPA draft
25 water quality criterion (Figures 8-59a and 8-60a). The long-term average selenium concentrations
26 in water for Alternative 2A (range 0.09–0.40 µg/L) would be similar to those for Existing Conditions
27 (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and all would be
28 below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

29 Relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in very
30 small changes (less than 1%) in estimated selenium concentrations in most biota (whole-body fish,
31 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout the Delta, with little
32 difference among locations (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*, Table M-22).
33 Level of Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern
34 benchmarks) for selenium concentrations in those biota for all years and for drought years are less
35 than 1.0 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
36 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
37 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
38 predicted to increase by about 19% relative to Existing Conditions and to the No Action Alternative
39 in all years (from about 4.7 to 5.6 mg/kg dry weight), and those for sturgeon in the Sacramento
40 River at Mallard Island are predicted to increase by about 11% in all years (from about 4.4 to 4.9
41 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31). Selenium concentrations in sturgeon
42 during drought years are expected to increase by only 4% to 8% at those locations. Detection of
43 small changes in whole-body sturgeon such as those estimated for the western Delta would require
44 very large sample sizes because of the inherent variability in fish tissue selenium concentrations.
45 Low Toxicity Threshold Exceedance Quotients for selenium concentrations in sturgeon in the

1 western Delta would be 1.5 (indicating a higher probability for adverse effects) for drought years at
2 both locations (similar to Existing Conditions and the No Action Alternative and would increase
3 slightly, from 0.94 to 1.1, for all years in the San Joaquin River at Antioch (Appendix 8M, Table M-
4 32).

5 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
6 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
7 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
8 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
9 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
10 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
11 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
12 the two western Delta locations and used literature-derived uptake factors and trophic transfer
13 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
14 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
15 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
16 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
17 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
18 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
19 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
20 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
21 waterborne selenium concentration at the two locations in different time periods.

22 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
23 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
24 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
25 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
26 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
27 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
28 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
29 most areas of the Delta.

30 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
31 Alternative 2A would be greater in the East Delta and South Delta than in other sub-regions. Relative
32 to Existing Conditions, annual average residence times for Alternative 2A in the East Delta are
33 expected to increase by more than 16 days (Table 8-60a). Relative to the No Action Alternative,
34 annual average residence times for Alternative 2A in the East Delta are expected to increase by less
35 than 10 days. Increases in residence times for other sub-regions would be smaller, especially as
36 compared to Existing Conditions and the No Action Alternative (which are longer than those
37 modeled for the South Delta). As mentioned above, these results incorporate hydrodynamic effects
38 of both CM1 and of CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of
39 CM2 and CM4. However, it is expected that CM2 and CM4 would be substantial drivers of the
40 increased residence time.

41 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
42 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
43 concentrations in particulates, as the lowest level of the food chain, relative to the waterborne
44 concentration], and associated tissue concentrations [especially in clams and their consumers, such
45 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold

1 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
2 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
3 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
4 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

5 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
6 as related to residence time, but the effects of residence time are incorporated in the
7 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
8 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
9 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
10 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
11 concentrations are currently low and not approaching thresholds of concern (which, as discussed
12 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
13 residence time alone would not be expected to cause them to then approach or exceed thresholds of
14 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
15 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
16 sparse, the most likely area in which biota tissues would be at levels high enough that additional
17 bioaccumulation due to increased residence time from restoration areas would be a concern is the
18 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
19 increase in residence time estimated in the western Delta is 5 days relative to Existing Conditions,
20 and 3 days relative to the No Action Alternative. Given the available information, these increases are
21 small enough that they are not expected to substantially affect selenium bioaccumulation in the
22 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
23 residence times, further discussion is included in Impact WQ-26 below.

24 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 2A would
25 result in essentially no change in selenium concentrations throughout the Delta for most biota
26 (approximately 1% or less), although increases in selenium concentrations are predicted for
27 sturgeon in the western Delta. Concentrations of selenium in sturgeon would exceed only the lower
28 benchmark, indicating a low potential for effects. The modeling of bioaccumulation for sturgeon is
29 less calibrated to site-specific conditions than that for other biota, which was calibrated on a robust
30 dataset for modeling of bioaccumulation in largemouth bass as a representative species for the
31 Delta. Overall, Alternative 2A would not be expected to substantially increase the frequency with
32 which applicable benchmarks would be exceeded in the Delta (there being only a small increase for
33 sturgeon relative to the low benchmark and no exceedance of the high benchmark) or substantially
34 degrade the quality of water in the Delta, with regard to selenium.

35 ***SWP/CVP Export Service Areas***

36 Alternative 2A would result in small (0.06–0.09 $\mu\text{g/L}$) decreases in long-term average selenium
37 concentrations in water at the Banks and Jones pumping plants relative to Existing Conditions and
38 the No Action Alternative, for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a).
39 These decreases in long-term average selenium concentrations in water would result in increases in
40 available assimilative capacity for selenium at these pumping plants of 6–9%, relative to the 1.3
41 $\mu\text{g/L}$ USEPA draft water quality criterion (Figures 8-59a and 8-60a). Furthermore, the long-term
42 average selenium concentrations in water for Alternative 2A (range 0.15–0.19 $\mu\text{g/L}$) would be well
43 below the USEPA draft water quality criterion of 1.3 $\mu\text{g/L}$ (Appendix 8M, Table M-9a).

1 Relative to Existing Conditions and the No Action Alternative, Alternative 2A would result in very
2 small changes (less than 1%) in estimated selenium concentrations in biota (whole-body fish, bird
3 eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Figures 8-61a through 8-64b;
4 Appendix 8M, *Selenium*, Table M-22) at Banks and Jones pumping plants. Concentrations in biota
5 would not exceed any selenium benchmarks for Alternative 2A (Figures 8-61a through 8-64b).

6 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
7 bioaccumulated in biota) from Alternative 2A are not considered to be adverse.

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
10 purpose of making the CEQA impact determination for selenium. For additional details on the effects
11 assessment findings that support this CEQA impact determination, see the effects assessment
12 discussion that immediately precedes this conclusion.

13 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
14 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
15 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
16 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
17 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
18 Valley Water Board [2010d] and State Water Board [2010b, 2010c]) that are expected to result in
19 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
20 modified reservoir operations and subsequent changes in river flows under Alternative 2A, relative
21 to Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
22 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
23 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
24 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
25 water bodies as related to selenium.

26 Relative to Existing Conditions, modeling estimates indicate that Alternative 2A would result in
27 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
28 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
29 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
30 would increase slightly, from 0.94 for Existing Conditions to 1.1 for Alternative 2A. Concentrations
31 of selenium in sturgeon would exceed only the lower benchmark, indicating a low potential for
32 effects. Overall, Alternative 2A would not be expected to substantially increase the frequency with
33 which applicable benchmarks would be exceeded in the Delta (there being only a small exceedance
34 relative to the low benchmark for sturgeon and no exceedance of the high benchmark) or
35 substantially degrade the quality of water in the Delta, with regard to selenium.

36 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
37 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
38 Alternative 2A would cause no increase in the frequency with which applicable benchmarks would
39 be exceeded, and would slightly improve the quality of water in selenium concentrations at the
40 Banks and Jones pumping plants.

41 Based on the above, selenium concentrations that would occur in water under Alternative 2A would
42 not cause additional exceedances of applicable state or federal numeric or narrative water quality
43 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
44 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to

1 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions,
 2 water quality conditions under this alternative would not increase levels of selenium by frequency,
 3 magnitude, and geographic extent such that the affected environment would be expected to have
 4 measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing
 5 the health risks to wildlife (including fish) or humans consuming those organisms. Water quality
 6 conditions under this alternative with respect to selenium would not cause long-term degradation of
 7 water quality in the affected environment, and therefore would not result in use of available
 8 assimilative capacity such that exceedances of water quality objectives/criteria would be likely and
 9 would result in substantially increased risk for adverse effects to one or more beneficial uses. This
 10 alternative would not further degrade water quality by measurable levels, on a long-term basis, for
 11 selenium and, thus, cause the CWA Section 303(d)-listed impairment of beneficial use to be made
 12 discernibly worse. This alternative is considered to be less than significant. No mitigation is
 13 required.

14 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
 15 **CM21**

16 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 2A would be the same as those
 17 discussed for Alternative 1A and are considered not to be adverse.

18 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 19 under Alternative 1A. As such, effects on selenium resulting from the implementation of CM2–CM21
 20 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 21 less than significant. No mitigation is required.

22 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
 23 **and Maintenance (CM1)**

24 ***Upstream of the Delta***

25 For the same reasons stated for the No Action Alternative, Alternative 2A would result in negligible,
 26 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
 27 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 28 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 29 annual and long-term average basis. As such, Alternative 2A would not be expected to substantially
 30 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
 31 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
 32 degrade the quality of these water bodies, with regard to trace metals.

33 ***Delta***

34 For the same reasons stated for the No Action Alternative, Alternative 2A would not result in
 35 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
 36 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
 37 are expected to be negligible, on a long-term average basis. As such, Alternative 2A would not be
 38 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
 39 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
 40 regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 2A would not result in
3 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
4 from the Sacramento River through the proposed conveyance facilities. As such, there is not
5 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
6 area waters under Alternative 2A, relative to Existing Conditions and the No Action Alternative. As
7 such, Alternative 2A would not be expected to substantially increase the frequency with which
8 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
9 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to trace metals.

11 **NEPA Effects:** In summary, Alternative 2A, relative to the No Action Alternative, would not cause a
12 substantial increase in long-term average trace metals concentrations within the affected
13 environment, nor would it cause an increased frequency of water quality objective/criteria
14 exceedances within the affected environment. The effect on trace metals is determined not to be
15 adverse.

16 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 2A would be similar to those
17 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
18 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
19 this constituent. For additional details on the effects assessment findings that support this CEQA
20 impact determination, see the effects assessment discussion under Alternative 1A.

21 While greater water demands under the Alternative 2A would alter the magnitude and timing of
22 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
23 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
24 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
25 therefore, changes in river flows would not be expected to cause a substantial long-term change in
26 trace metal concentrations upstream of the Delta.

27 Average and 95th percentile trace metal concentrations are very similar across the primary source
28 waters to the Delta. Given this similarity, very large changes in source water fraction would be
29 necessary to effect a relatively small change in trace metal concentration at a particular Delta
30 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
31 waters are all below their respective water quality criteria, including those that are hardness-based
32 without a WER adjustment. No mixing of these three source waters could result in a metal
33 concentration greater than the highest source water concentration, and given that trace metals do
34 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
35 not be expected to occur under the Alternative 2A.

36 The assessment of the Alternative 2A effects on trace metals in the SWP/CVP Export Service Areas is
37 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
38 As just discussed regarding similarities in Delta source water trace metal concentrations, the
39 Alternative 2A is not expected to result in substantial changes in trace metal concentrations in Delta
40 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
41 in the SWP/CVP Export Service Area are expected to be negligible.

42 Based on the above, there would be no substantial long-term increase in trace metal concentrations
43 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export

1 service area waters under Alternative 2A relative to Existing Conditions. As such, this alternative is
2 not expected to cause additional exceedance of applicable water quality objectives by frequency,
3 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
4 in the affected environment. Because trace metal concentrations are not expected to increase
5 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
6 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
7 trace metal concentrations that may occur in water bodies of the affected environment would not be
8 expected to make any existing beneficial use impairments measurably worse. The trace metals
9 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
10 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
11 significant. No mitigation is required.

12 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
13 **CM2–CM21**

14 *NEPA Effects:* CM2–CM21 proposed under Alternative 2A would be the same as those proposed
15 under Alternative 1A. As such, effects on trace metals resulting from the implementation of CM2–
16 CM21 would be similar to those previously discussed for Alternative 1A. As they pertain to trace
17 metals, implementation of CM2–CM21 would not be expected to adversely affect beneficial uses of
18 the affected environment or substantially degrade water quality with respect to trace metals.

19 In summary, implementation of CM2–CM21 under Alternative 2A, relative to the No Action
20 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
21 metals from implementing CM2–CM21 is determined not to be adverse.

22 *CEQA Conclusion:* Implementation of CM2–CM21 under Alternative 2A would not cause substantial
23 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
24 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
25 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
26 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
27 environment. Because trace metal concentrations are not expected to increase substantially, no
28 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
29 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
30 concentrations that may occur throughout the affected environment would not be expected to make
31 any existing beneficial use impairments measurably worse. The trace metals discussed in this
32 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
33 problems in aquatic life or humans. This impact is considered to be less than significant. No
34 mitigation is required.

35 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
36 **Maintenance (CM1)**

37 *NEPA Effects:* Effects of CM1 on TSS and turbidity under Alternative 2A would be the same as those
38 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
39 to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 2A would be similar to
 2 those discussed for Alternative 1A, and are summarized here, then compared to the CEQA
 3 thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact
 4 determination for this constituent. For additional details on the effects assessment findings that
 5 support this CEQA impact determination, see the effects assessment discussion under Alternative
 6 1A.

7 Changes river flow rate and reservoir storage that would occur under Alternative 2A, relative to
 8 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
 9 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 10 suspended sediment concentrations are more affected by season than flow. Site-specific and
 11 temporal exceptions may occur due to localized temporary construction activities, dredging
 12 activities, development, or other land use changes would be site-specific and temporal, which would
 13 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 14 than substantial levels.

15 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 16 usually gradual, occurring over years, and high storm event inflows would not be substantially
 17 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 18 would not be substantially different from the levels under Existing Conditions. Consequently, this
 19 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 20 region, relative to Existing Conditions.

21 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 22 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 2A, relative to
 23 Existing Conditions, because this alternative is not expected to result in substantial changes in TSS
 24 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

25 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 26 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 27 concentrations and turbidity levels are not expected to be substantially different, long-term water
 28 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 29 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
 30 listed constituents. This impact is considered to be less than significant. No mitigation is required.

31 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

32 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 2A would be the same as
 33 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
 34 is determined to not be adverse.

35 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 2A would be similar to those proposed
 36 under Alternative 1A. As such, effects on TSS and turbidity resulting from the implementation of
 37 CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 38 considered to be less than significant. No mitigation is required.

39 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 40 **(CM1–CM21)**

41 The conveyance features for CM1 under Alternative 2A would be very similar to those discussed for
 42 Alternative 1A. The primary difference between Alternative 2A and Alternative 1A is that under

1 Alternative 2A, the locations of two intakes and two intermediate pumping plant locations would
 2 differ. As such, construction techniques and locations of major features of the conveyance system
 3 within the Delta would be similar. The remainder of the facilities constructed under Alternative 2A,
 4 including CM2–CM21, would be very similar to, or the same as, those to be constructed for
 5 Alternative 1A.

6 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
 7 associated with implementation of CM1 under Alternative 2A would be very similar to the effects
 8 discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would
 9 be essentially identical. Nevertheless, the construction of CM1, and any individual components
 10 necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in Appendix
 11 3B, *Environmental Commitments, AMMs, and CMs*. The specific environmental commitments that
 12 would be implemented under Alternative 2A would be similar to those described for Alternative 1A.
 13 Consequently, relative to the No Action Alternative, Alternative 2A would not be expected to cause
 14 exceedance of applicable water quality objectives/criteria or substantial water quality degradation
 15 with respect to constituents of concern, and thus would not adversely affect any beneficial uses
 16 upstream of the Delta, in the Delta, or in the SWP and CVP service area.

17 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 18 construction-related water quality effects are considered to be not adverse.

19 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 20 2A for construction-related activities along with agency-issued permits that also contain
 21 construction requirements to protect water quality, the construction-related effects, relative to
 22 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
 23 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
 24 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
 25 degrade water quality with respect to the constituents of concern on a long-term average basis, and
 26 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 27 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 28 would be temporary and intermittent in nature, the construction would involve negligible
 29 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 30 environment. As such, construction activities would not contribute measurably to bioaccumulation
 31 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 32 Based on these findings, this impact is determined to be less than significant. No mitigation is
 33 required.

34 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 35 **and Maintenance (CM1)**

36 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
 37 concentrations, in water bodies of the affected environment under Alternative 2A would be very
 38 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
 39 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
 40 Services Areas under Alternative 1A would similarly change under Alternative 2A, relative to
 41 Existing Conditions and the No Action Alternative. For the Delta in particular, there are differences
 42 in the direction and magnitude of water residence time changes during the *Microcystis* bloom period
 43 among the six Delta sub-regions under Alternative 2A compared to Alternative 1A, relative to
 44 Existing Conditions and No Action Alternative. However, under Alternative 2A, relative to Existing

1 Conditions and No Action Alternative, water residence times during the *Microcystis* bloom period in
2 various Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A,
3 lead to an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms
4 throughout the Delta.

5 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
6 would occur in the Delta under Alternative 2A, which could lead to earlier occurrences of *Microcystis*
7 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
8 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
9 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
10 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative
11 2A may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
12 because water temperatures will increase in the Export Service Areas due to the expected increase
13 in ambient air temperatures resulting from climate change.

14 NEPA Effects: Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
15 affected environment under Alternative 2A would be very similar to (i.e., nearly the same) to those
16 discussed for Alternative 1A. In summary, Alternative 2A operations and maintenance, relative to
17 the No Action Alternative, would result in long-term increases in hydraulic residence time of various
18 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
19 increased residence time could result in a concurrent increase in the frequency, magnitude, and
20 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
21 As a result, Alternative 2A operation and maintenance activities would cause further degradation to
22 water quality with respect to *Microcystis* in the Delta. Under Alternative 2A, relative to No Action
23 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
24 affected source water from the south Delta intakes and unaffected source water from the
25 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
26 and maintenance under Alternative 2A will result in increased or decreased levels of *Microcystis* and
27 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
28 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
29 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
30 *Microcystis* from implementing CM1 is determined to be adverse.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
33 purpose of making the CEQA impact determination for this constituent. For additional details on the
34 effects assessment findings that support this CEQA impact determination, see the effects assessment
35 discussion that immediately precedes this conclusion.

36 Under Alternative 2A, additional impacts from *Microcystis* in the reservoirs and watersheds
37 upstream of the Delta are not expected, relative to Existing Conditions. Operations and maintenance
38 occurring under Alternative 2A is not expected to change nutrient levels in upstream reservoirs or
39 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
40 conducive to *Microcystis* production.

41 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
42 expected to increase under Alternative 2A, resulting in an increase in the frequency, magnitude and
43 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
44 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven

1 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
 2 throughout the Delta during the summer and fall bloom period, due in small part to climate change
 3 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
 4 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
 5 production expected within any Delta sub-region is unknown because conditions will vary across
 6 the complex networks of intertwining channels, shallow back water areas, and submerged islands
 7 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
 8 to Alternative 2A. Consequently, it is possible that increases in the frequency, magnitude, and
 9 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
 10 maintenance of Alternative 2A and the hydrodynamic impacts of restoration (CM2 and CM4).

11 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
 12 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
 13 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
 14 Under Alternative 2A, relative to Existing Conditions, the potential for *Microcystis* to occur in the
 15 Export Service Area is expected to increase due to increasing water temperature, but this impact is
 16 driven entirely by climate change and not Alternative 2A. Water exported from the Delta to the
 17 Export Service Area is expected to be a mixture of *Microcystis*-affected source water from the south
 18 Delta intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
 19 determined whether operations and maintenance under Alternative 2A, relative to Existing
 20 Conditions, would result in increased or decreased levels of *Microcystis* and microcystins in the
 21 mixture of source waters exported from Banks and Jones pumping plants.

22 Based on the above, this alternative would not be expected to cause additional exceedance of
 23 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 24 would cause significant impacts on any beneficial uses of waters in the affected environment.
 25 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
 26 increases that could occur in some areas would not make any existing *Microcystis* impairment
 27 measurably worse because no such impairments currently exist. However, because it is possible that
 28 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
 29 occur due to the operations and maintenance of Alternative 2A and the hydrodynamic impacts of
 30 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
 31 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
 32 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
 33 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
 34 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 35 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
 36 the effects on *Microcystis* from implementing CM1 is determined to be significant.

37 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
 38 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
 39 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
 40 remain significant and unavoidable.

41 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 42 ***Microcystis* Blooms**

43 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

1 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 2 **Water Residence Time**

3 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

4 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 5 **Measures (CM2–CM21)**

6 The effects of CM2–CM21 on *Microcystis* under Alternative 2A would be the same as those discussed
 7 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
 8 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
 9 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters.
 10 Because the hydrodynamic effects associated with implementing CM2 and CM4 were incorporated
 11 into the modeling used to assess CM1, a detailed assessment of the effects of implementing CM2 and
 12 CM4 on *Microcystis* blooms in the Delta via their effects on Delta water residence time is provided
 13 under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation
 14 of Mitigation Measure WQ-32a. The effectiveness of the mitigation measure to result in feasible
 15 measures for reducing water quality effects is uncertain. Conservation Measures 3 (CM3) and CM5–
 16 CM21 would not result in an increase in the frequency, magnitude, and geographic extent of
 17 *Microcystis* blooms in the Delta.

18 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 2A would be the same as those
 19 discussed for Alternative 1A and are considered to be adverse.

20 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
 21 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 22 extent that would cause significant impacts on any beneficial uses of waters in the affected
 23 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 24 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 25 impairment measurably worse because no such impairments currently exist. Because restoration
 26 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
 27 create local areas of warmer water during the bloom season, it is possible that increases in the
 28 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
 29 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
 30 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 31 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 32 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 33 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
 34 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 35 determined to be significant.

36 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 37 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 38 measures for reducing water quality effects is uncertain, this impact is considered to remain
 39 significant and unavoidable.

40 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 41 ***Microcystis* Blooms**

42 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

1 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 2 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

3 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 4 that Alternative 2A would have a less than significant impact/no adverse effect on the following
 5 constituents in the Delta:

- 6 • Boron
- 7 • Dissolved Oxygen
- 8 • Pathogens
- 9 • Pesticides
- 10 • Trace Metals
- 11 • Turbidity and TSS

12 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 13 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 14 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 15 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 16 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 17 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 18 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 19 quality of the of San Francisco Bay.

20 The effects of Alternative 2A on bromide, chloride, and DOC, in the Delta were determined to be
 21 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 22 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 23 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 24 adversely affect any beneficial uses of San Francisco Bay.

25 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
 26 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
 27 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
 28 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
 29 which would be the primary driver of salinity changes, would be two to three orders of magnitude
 30 lower than (and thus minimal compared to) the Bay's tidal flow.

31 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
 32 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
 33 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
 34 Suisun Bay.

35 While effects of Alternative 2A on the nutrients ammonia, nitrate, and phosphorus were determined
 36 to be less than significant/not adverse, these constituents are addressed further below because the
 37 response of the seaward bays to changed nutrient concentrations/loading may differ from the
 38 response of the Delta. Selenium and mercury are discussed further, because they are
 39 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
 40 and exports are of concern.

Nutrients: Ammonia, Nitrate, and Phosphorus

Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 2A would be dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95% removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would decrease by 26%, relative to Existing Conditions, and increase by 9%, relative to the No Action Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to Suisun and San Pablo Bays under Alternative 2A would not adversely impact primary productivity in these embayments because light limitation and grazing currently limit algal production in these embayments. To the extent that algal growth increases in relation to a change in ammonia concentration, this would have net positive benefits, because current algal levels in these embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and cyanobacteria levels in the North Bay.

The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 2A is estimated to increase slightly (by 1%) relative to Existing Conditions and decrease by 4% relative to the No Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary productivity. However, there is uncertainty regarding the impact of nutrient ratios on phytoplankton community composition and abundance. Any effect on phytoplankton community composition would likely be small compared to the effects of grazing from introduced clams and zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that would result in adverse effects to beneficial uses.

Mercury

The estimated long-term average mercury and methylmercury loads in Delta exports are shown in Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay are estimated to change relatively little due to changes in source water fractions and net Delta outflow that would occur under Alternative 2A. Mercury load to the Bay, is estimated to be the same relative to Existing Conditions, and to decrease by 2 kg/year (1%) relative to the No Action Alternative. Methylmercury load is estimated to increase by 0.07 kg/year (2%), relative to Existing Conditions, and decrease by 0.02 kg/year (1%) relative to the No Action Alternative. The estimated total mercury load to the Bay is 261 kg/year, which would be less than the San Francisco Bay mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and methylmercury loads would be within the overall uncertainty associated with the estimates of long-term average net Delta outflow and the long-term average mercury and methylmercury concentrations in Delta source waters. The estimated changes in mercury load under the alternative would also be substantially less than the considerable differences among estimates in the current mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006; David et al. 2009).

Given that the estimated incremental increases of mercury and methylmercury loading to San Francisco Bay would fall within the uncertainty of current mercury and methylmercury load estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San Francisco Bay due to Alternative 2A are not expected to result in adverse effects to beneficial uses or

1 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
2 303(d) impairment measurably worse.

3 **Selenium**

4 Changes in source water fraction and net Delta outflow under Alternative 2A are projected to cause
5 the total selenium load to the North Bay to increase by 8%, relative to Existing Conditions, and 5%,
6 relative to the No Action Alternative (Appendix 80, Table O-3). Changes in long-term average
7 selenium concentrations of the North Bay are assumed to be proportional to changes in North Bay
8 selenium loads. Under Alternative 2A, the long-term average total selenium concentration of the
9 North Bay is estimated to be 0.14 µg/L and the dissolved selenium concentration is estimated to be
10 0.12 µg/L, which would be a 0.01 µg/L increase relative to Existing Conditions and the No Action
11 Alternative (Appendix 80, Table O-3). The dissolved selenium concentration would be below the
12 target of 0.202 µg/L developed by Presser and Luoma (2013) to coincide with a white sturgeon
13 whole-body fish tissue selenium concentration not greater than 8 mg/kg in the North Bay. The
14 incremental increase in dissolved selenium concentrations in the North Bay, relative to Existing
15 Conditions, would be negligible (0.01 µg/L) under this alternative. Thus, the estimated changes in
16 selenium loads in Delta exports to San Francisco Bay due to Alternative 2A are not expected to result
17 in adverse effects to beneficial uses or substantially degrade the water quality with regard to
18 selenium, or make the existing CWA Section 303(d) impairment measurably worse.

19 **NEPA Effects:** Based on the discussion above, Alternative 2A, relative to the No Action Alternative,
20 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
21 DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia, nitrate, phosphorus), trace
22 metals, or turbidity and TSS in the San Francisco Bay. Further, changes in these constituent
23 concentrations in Delta outflow would not be expected to cause changes in Bay concentrations of
24 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses. In
25 summary, based on the discussion above, effects on the San Francisco Bay from implementation of
26 CM1–CM21 are considered to be not adverse.

27 **CEQA Conclusion:** Based on the above, Alternative 2A would not be expected to cause long-term
28 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
29 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
30 would result in substantially increased risk for adverse effects to one or more beneficial uses.
31 Further, based on the above, this alternative would not be expected to cause additional exceedance
32 of applicable water quality objectives/criteria in the San Francisco Bay by frequency, magnitude,
33 and geographic extent that would cause significant impacts on any beneficial uses of waters in the
34 affected environment. Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay
35 would not adversely affect beneficial uses, because the uses most affected by changes in these
36 parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial changes in DO,
37 pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta, relative to
38 Existing Conditions; therefore, no substantial changes these constituents levels in the Bay are
39 anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay salinity, as
40 the change in Delta outflow would two to three orders of magnitude lower than (and thus minimal
41 compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in the Delta
42 would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant of the
43 Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 26%
44 decrease in total nitrogen load and 1% increase in phosphorus load, relative to Existing Conditions,
45 are expected to have minimal effect on water quality degradation, primary productivity, or

1 phytoplankton community composition. The estimated no change in mercury load (0 kg/year; 0%)
 2 and increase in methylmercury load (0.07 kg/year; 2%), relative to Existing Conditions, is within the
 3 level of uncertainty in the mass load estimate and not expected to contribute to water quality
 4 degradation, make the CWA section 303(d) mercury impairment measurably worse or cause
 5 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
 6 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
 7 load would be 8%, but estimated total and dissolved selenium concentrations under this alternative
 8 would be nearly the same as Existing Conditions, and less than the target associated with white
 9 sturgeon whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium load is
 10 not expected to contribute to water quality degradation, or make the CWA section 303(d) selenium
 11 impairment measurably worse or cause selenium to bioaccumulate to greater levels in aquatic
 12 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 13 is considered to be less than significant.

14 **8.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five** 15 **Intakes (15,000 cfs; Operational Scenario B)**

16 Alternative 2B would include the same physical/structural water conveyance components and
 17 eastern alignment as Alternative 1B, but, like Alternative 2A, could entail two different intake and
 18 intake pumping plant locations downstream of Steamboat and Sutter Slough (i.e., Intakes 6 and 7).
 19 Alternative 2B would also include an operable barrier at the head of Old River. Intakes would be
 20 located on the west bank of the Sacramento River and diverted water would be carried by canal to a
 21 new 600-acre forebay at Byron Tract. An intermediate pumping plant would be constructed, but
 22 there would be no intermediate forebay. Water supply and conveyance operations would follow the
 23 guidelines described as Scenario B, which includes Fall X2. CM2–CM21 would be implemented under
 24 this alternative, and these conservation measures would be the same as those under Alternative 1A.
 25 See Chapter 3, *Description of Alternatives*, Section 3.5.6, for additional details on Alternative 2B.

26 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

27 Alternative 2B has the same diversion and conveyance operations and conservation measures as
 28 Alternative 2A. The primary difference between the two alternatives is that conveyance under
 29 Alternative 2B would be in a lined or unlined canal, instead of pipeline. Because there would be no
 30 difference in conveyance capacity or operations, there would be no differences between these two
 31 alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow, source
 32 fractions to various Delta locations, and hydrodynamics in the Delta. Conveyance of water in an open
 33 channel instead of a pipeline may result in differing physical properties (e.g., DO, pH, temperature)
 34 of the water upon reaching the south Delta export pumps than if the water was conveyed in a
 35 pipeline. However, the physical properties of water arriving at the south Delta export pumps would
 36 continue to change and would equilibrate to similar levels as Alternative 2A as it is conveyed
 37 throughout the SWP/CVP Export Service Areas. Because no substantial differences in water quality
 38 effects are anticipated anywhere in the affected environment under Alternative 2B compared to
 39 those described in detail for Alternative 2A, the water quality effects described for Alternative 2A
 40 also appropriately characterize effects under Alternative 2B.

41 **Water Quality Effects Resulting from Implementation of CM2–CM21**

42 Alternative 2B has the same conservation measures as Alternative 2A. Because no substantial
 43 differences in water quality effects are anticipated anywhere in the affected environment under

1 Alternative 2B compared to those described in detail for Alternative 2A, the water quality effects
2 described for Alternative 2A also appropriately characterize effects under Alternative 2B.

3 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 4 **(CM1–CM21)**

5 The primary difference between Alternative 2B and Alternative 1A is that under Alternative 2B, a
6 canal would be constructed for CM1 along the eastern side of the Delta to convey the Sacramento
7 River water south, rather than the tunnel/pipeline features. As such, construction techniques and
8 locations of major features of the conveyance system within the Delta would be different (see
9 Chapter 3, *Description of Alternatives*, Section 3.5.6). The remainder of the facilities constructed
10 under Alternative 2B, including CM2–CM21, would be very similar to, or the same as, those to be
11 constructed for Alternative 1A.

12 **NEPA Effects:** The types of potential construction-related water quality effects associated with
13 implementation of CM1 under Alternative 2B would be very similar to the effects discussed for
14 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
15 identical. However, given the substantial differences in the conveyance features under CM1 with
16 construction of a canal, there could be differences in the location, magnitude, duration, and
17 frequency of construction activities and related water quality effects. In particular, relative to the No
18 Action Alternative conditions, construction of the major canal features for CM1 under Alternative 2B
19 would involve extensive general construction activities, material handling/storage/placement
20 activities, surface soil grading/excavation/disposal and associated exposure of disturbed sites to
21 erosion and runoff, and construction site dewatering operations. Nevertheless, the construction of
22 CM1, and any individual components necessitated by CM2, and CM4–CM10, with the
23 implementation of the BMPs specified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*,
24 and other agency permitted construction requirements would result in the potential water quality
25 effects being largely avoided and minimized. The specific environmental commitments that would
26 be implemented under Alternative 2B would be similar to those described for Alternative 1A with
27 the exception that Category “B” BMPs for tunnel muck dewatering basin construction and
28 operations, if necessary at all, would be much reduced. Consequently, relative to the No Action
29 Alternative, Alternative 2B would not be expected to cause exceedance of applicable water quality
30 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
31 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
32 SWP and CVP service area.

33 In summary, with implementation of environmental commitments in Appendix 3B, the potential
34 construction-related water quality effects are considered to be not adverse.

35 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
36 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
37 listed constituents to water bodies of the affected environment. As such, construction activities
38 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
39 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
40 implemented under Alternative 2B for construction-related activities along with agency-issued
41 permits that also contain construction related mitigation requirements to protect water quality, the
42 construction-related effects, relative to Existing Conditions, would not be expected to cause or
43 contribute to substantial alteration of existing drainage patterns which would result in substantial
44 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality

objectives/criteria, or substantially degrade water quality with respect to the constituents of concern on a long-term average basis, and thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on these findings, this impact is determined to be less than significant. No mitigation is required.

8.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario B)

Alternative 2C would include the same physical/structural water conveyance components and western alignment as Alternative 1C, but would also include an operable barrier at the head of Old River. Intake 1 through 5 would be located on the west bank of the Sacramento River and diverted water would be carried by canals and tunnels to a new 600-acre forebay at Byron Tract. An intermediate pumping plant would be constructed, but there would be no intermediate forebay. Water supply and conveyance operations would follow the guidelines described as Scenario B, which includes Fall X2. CM2–CM21 would be implemented under this alternative, and these conservation measures would be the same as those under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.7, for additional details on Alternative 2C.

Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)

Alternative 2C has the same diversion and conveyance operations and conservation measures as Alternative 2A. The primary differences between the two alternatives is that conveyance under Alternative 2C would be in a lined or unlined canal, instead of pipeline, and the alignment of the canal would be along the western side of the Delta, rather than the eastern side. Because there would be no difference in conveyance capacity or operations, there would be no differences between these two alternatives in upstream of the Delta river flows or reservoir operations, Delta inflow, source fractions to various Delta locations, and hydrodynamics in the Delta. Conveyance of water in an open channel instead of a pipeline may result in differing physical properties (e.g., DO, pH, temperature) of the water upon reaching the south Delta export pumps than if the water was conveyed in a pipeline. However, the physical properties of water arriving at the south Delta export pumps would continue to change and would equilibrate to similar levels as Alternative 2A as it is conveyed throughout the SWP/CVP Export Service Areas. Because no substantial differences in water quality effects are anticipated anywhere in the affected environment under Alternative 2C compared to those described in detail for Alternative 2A, the water quality effects described for Alternative 2A also appropriately characterize effects under Alternative 2C.

Water Quality Effects Resulting from Implementation of CM2–CM21

Alternative 2C has the same conservation measures as Alternative 2A. Because no substantial differences in water quality effects are anticipated anywhere in the affected environment under Alternative 2C compared to those described in detail for Alternative 2A, the water quality effects described for Alternative 2A also appropriately characterize effects under Alternative 2C.

Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1–CM21)

The primary difference between Alternative 2C and Alternative 1A is that under Alternative 2C, a canal would be constructed for CM1 along the western side of the Delta to convey the Sacramento River water south, in addition to the tunnel/pipeline features. As such, construction techniques and

1 locations of major features of the conveyance system within the Delta would be different (see
2 Chapter 3, *Description of Alternatives*, Section 3.5.7). The remainder of the facilities constructed
3 under Alternative 2C, including CM2–CM21, would be very similar to, or the same as, those to be
4 constructed for Alternative 1A.

5 **NEPA Effects:** The types of potential construction-related water quality effects associated with
6 implementation of CM1 under Alternative 2C would be very similar to the effects discussed for
7 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
8 identical. Given the substantial differences in the conveyance features under CM1 with construction
9 of a canal in addition to the tunnel/pipeline features, there could be differences in the location,
10 magnitude, duration, and frequency of construction activities and related water quality effects. In
11 particular, relative to the No Action Alternative conditions, construction of the major canal features
12 for CM1 under Alternative 2C would involve extensive general construction activities, material
13 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
14 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
15 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
16 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
17 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements would result
18 in the potential water quality effects being largely avoided and minimized. The specific
19 environmental commitments that would be implemented under Alternative 2C would be similar to
20 those described for Alternative 1A. However, this alternative would involve environmental
21 commitments associated with both tunnel/pipeline and canal construction activities. Consequently,
22 relative to the No Action Alternative, Alternative 2C would not be expected to cause exceedance of
23 applicable water quality objectives/criteria or substantial water quality degradation with respect to
24 constituents of concern, and thus would not adversely affect any beneficial uses upstream of the
25 Delta, in the Delta, or in the SWP and CVP service area.

26 In summary, with implementation of environmental commitments in Appendix 3B, the potential
27 construction-related water quality effects are considered to be not adverse.

28 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
29 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
30 listed constituents to water bodies of the affected environment. As such, construction activities
31 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
32 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
33 implemented under Alternative 2C for construction-related activities along with agency-issued
34 permits that also contain construction related mitigation requirements to protect water quality, the
35 construction-related effects, relative to Existing Conditions, would not be expected to cause or
36 contribute to substantial alteration of existing drainage patterns which would result in substantial
37 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
38 objectives/criteria, or substantially degrade water quality with respect to the constituents of
39 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in
40 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
41 these findings, this impact is determined to be less than significant. No mitigation is required.

8.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and Intakes 1 and 2 (6,000 cfs; Operational Scenario A)

Alternative 3 would comprise physical/structural components similar to those under Alternative 1A with the principal exception that Alternative 3 would convey up to 6,000 cfs of water from the north Delta to the south Delta. Diverted water would be conveyed through pipelines/tunnels from two screened intakes (i.e., Intakes 1 and 2) located on the east bank of the Sacramento River between Clarksburg and Walnut Grove. Alternative 3 would include a 750-acre intermediate forebay and pumping plant. A new 600-acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to the south Delta pumping plants. Water supply and conveyance operations would follow the guidelines described as Scenario A, which does not include Fall X2. CM2–CM21 would be implemented under this alternative, and would be the same as those under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.8, for additional details on Alternative 3.

Effects of the Alternative on Delta Hydrodynamics

Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can substantially affect water quality within the Delta:

- Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-sourced water and a concurrent increase in San Joaquin River-sourced water can increase the concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity, nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by decreased exports of San Joaquin River water (due to increased Sacramento River water exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows also can affect water residence time and many related physical, chemical, and biological variables.
- Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta outflow can increase the concentration of salts (bromide, chloride) and levels of electrical conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet and above normal water years) will decrease levels of these constituents, particularly in the west Delta.

Since the only difference between Alternative 3 and Alternative 1A is that the north Delta diversion capacity under Alternative 3 is 6,000 cfs instead of 15,000 cfs under Alternative 1A, effects on Delta hydrodynamics under Alternative 3 are very similar to Alternative 1A, but are generally of a lesser extent.

Under Alternative 3, over the long term, average annual delta exports are anticipated to increase by 227 TAF relative to Existing Conditions, and decrease by 930 TAF relative to the No Action Alternative. Since, over the long-term, approximately 35% of the exported water will be from the new north Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more information). The result of this is increased San Joaquin River water influence throughout the south, west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This can be seen, for example, in Appendix 8D, ALT 3–Old River at Rock Slough for ALL years (1976–1991), which shows increased SJR percentage and decreased SAC percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

1 Under Alternative 3, long-term average annual Delta outflow is anticipated to decrease 227 TAF
 2 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 3 capacity of 6,000 cfs and numerous other components of Operational Scenario A) and climate
 4 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 5 increased sea water intrusion in the west Delta. The increase of sea water intrusion in the west Delta
 6 under Alternative 1A is greater relative to the No Action alternative because the No Action
 7 alternative includes operations to meet Fall X2, whereas Existing Conditions and Alternative 3 do
 8 not. Long-term average annual Delta outflow is anticipated to decrease under Alternative 3 by 977
 9 TAF relative to the No Action Alternative, due only to changes in operations. The increases in sea
 10 water intrusion (represented by an increase in BAY percentage) can be seen, for example, in
 11 Appendix 8D, ALT 3–Sacramento River at Mallard Island for ALL years (1976–1991).

12 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 *Upstream of the Delta*

15 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
 16 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 17 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 18 concentrations that could occur in the water bodies of the affected environment located upstream of
 19 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 20 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 21 ammonia.

22 *Delta*

23 Assessment of effects of ammonia under Alternative 3 is the same as discussed under Alternative
 24 1A, except that because flows in the Sacramento River at Freeport are different between the two
 25 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 26 concentrations in the Sacramento River downstream of Freeport are different.

27 As Table 8-66 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 28 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 3 and the No
 29 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
 30 occur during February, August, September, and November, and remaining months would be
 31 unchanged or have a minor decrease. A minor increase in the annual average concentration would
 32 occur under Alternative 3, compared to the No Action Alternative. Moreover, the estimated
 33 concentrations downstream of Freeport under Alternative 3 would be similar to existing source
 34 water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in
 35 source water fraction anticipated under Alternative 3, relative to the No Action Alternative, are not
 36 expected to substantially increase ammonia concentrations at any Delta locations.

37 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 38 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 39 beneficial uses or substantially degrade the water quality at these locations, with regards to
 40 ammonia.

1 **Table 8-66. Estimated Ammonia-N (mg/L as N) Concentrations in the Sacramento River Downstream**
 2 **of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and**
 3 **Alternative 3**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 3	0.068	0.089	0.068	0.060	0.058	0.060	0.058	0.062	0.064	0.064	0.073	0.076	0.067

4
5 ***SWP/CVP Export Service Areas***

6 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 7 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 8 Alternative 1A, under Alternative 3 for areas of the Delta that are influenced by Sacramento River
 9 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
 10 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 11 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 12 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
 13 quality of exported water, with regards to ammonia.

14 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
 15 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
 16 under Alternative 3, relative to No Action Alternative. Any negligible increases in ammonia-N
 17 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
 18 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 19 degrade the water quality at these locations, with regards to ammonia.

20 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
 21 of CM1 are considered to be not adverse.

22 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 23 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 24 purpose of making the CEQA impact determination for this constituent. For additional details on the
 25 effects assessment findings that support this CEQA impact determination, see the effects assessment
 26 discussion that immediately precedes this conclusion.

27 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 28 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 29 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 30 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 31 any modified reservoir operations and subsequent changes in river flows under Alternative 3,
 32 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 33 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 34 of the Delta in the San Joaquin River watershed.

35 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 36 substantially lower under Alternative 3, relative to Existing Conditions, due to upgrades to the
 37 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta

1 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 2 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 3 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 4 either of these concentrations.

5 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 6 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 7 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 8 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 3,
 9 relative to Existing Conditions.

10 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 11 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 12 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
 13 alternative is not expected to cause additional exceedance of applicable water quality
 14 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 15 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
 16 not expected to increase substantially, no long-term water quality degradation is expected to occur
 17 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 18 affected environment and thus any minor increases that could occur in some areas would not make
 19 any existing ammonia-related impairment measurably worse because no such impairments
 20 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 21 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 22 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 23 significant. No mitigation is required.

24 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 25 CM21**

26 **NEPA Effects:** Effects of CM2–CM21 on ammonia under Alternative 3 would be the same as those
 27 discussed for Alternative 1A and are considered to be not adverse.

28 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 29 under Alternative 1A. As such, effects on ammonia resulting from the implementation of CM2–CM21
 30 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 31 less than significant. No mitigation is required.

32 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and 33 Maintenance (CM1)**

34 ***Upstream of the Delta***

35 Effects of CM1 on boron under Alternative 3 in areas upstream of the Delta would be very similar to
 36 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 37 in the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 38 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 39 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
 40 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
 41 project operations, climate change, and increased water demands) and would be similar compared
 42 to the No Action Alternative considering only changes due to Alternative 3 operations. The reduced

1 flow would result in possible increases in long-term average boron concentrations of up to about
2 3% relative to the Existing Conditions (Appendix 8F, Table Bo-32). The increased boron
3 concentrations would not increase the frequency of exceedances of any applicable objectives or
4 criteria and would not be expected to cause further degradation at measurable levels in the lower
5 San Joaquin River, and thus would not cause the existing impairment there to be discernibly worse.
6 Consequently, Alternative 3 would not be expected to cause exceedance of boron objectives/criteria
7 or substantially degrade water quality with respect to boron, and thus would not adversely affect
8 any beneficial uses of the Sacramento River, the eastside tributaries, associated reservoirs upstream
9 of the Delta, or the San Joaquin River.

10 **Delta**

11 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
12 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
13 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
14 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
15 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
16 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
17 information.

18 Effects of CM1 on boron under Alternative 3 in the Delta would be similar to the effects discussed for
19 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 3 would
20 result in unchanged or reduced long-term average boron concentrations for the 16-year period
21 modeled at northern and eastern Delta locations, and would increase at interior and western Delta
22 locations (by as much as 8% at the SF Mokelumne River at Staten Island, 9% at Franks Tract, 6% at
23 Old River at Rock Slough, and 4% at the Sacramento River at Emmaton) (Appendix 8F, Table Bo-10).
24 This comparison to Existing Conditions reflects changes due to both Alternative 3 operations
25 (including north Delta intake capacity of 6,000 cfs and numerous other components of Operational
26 Scenario A) and climate change/sea level rise. This comparison to the No Action Alternative reflects
27 changes due only to operations.

28 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
29 concentrations at western Delta assessment locations (more discussion of this phenomenon is
30 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
31 diversions which occur primarily at interior Delta locations. The long-term annual average and
32 monthly average boron concentrations, for either the 16-year period or drought period modeled,
33 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
34 agricultural objective at any of the eleven Delta assessment locations, which represents no change
35 from the Existing Conditions and No Action Alternative conditions (Appendix 8F, Table Bo-3A).
36 Reductions in long-term average assimilative capacity of up to 4% at interior Delta locations (i.e.,
37 Franks Tract and Old River at Rock Slough) would be small with respect to the 500 µg/L agricultural
38 objective (Appendix 8F, Table Bo-11). However, because the absolute boron concentrations would
39 still be well below the lowest 500 µg/L objective for the protection of the agricultural beneficial use
40 under Alternative 3, the levels of boron degradation would not be of sufficient magnitude to
41 substantially increase the risk of exceeding objectives or cause adverse effects to municipal and
42 agricultural water supply beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F,
43 Figure Bo-2).

1 **SWP/CVP Export Service Areas**

2 Effects of CM1 on boron under Alternative 3 in the Delta would be very similar to the effects
3 discussed for Alternative 1A. Under Alternative 3, long-term average boron concentrations would
4 decrease by as much as 15% at the Banks Pumping Plant and by as much as 14% at Jones Pumping
5 Plant relative to Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-10) as a
6 result of export of a greater proportion of low-boron Sacramento River water. Commensurate with
7 the decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
8 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
9 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
10 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
11 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
12 Joaquin River and associated TMDL actions for reducing boron loading.

13 Maintenance of SWP and CVP facilities under Alternative 3 would not be expected to create new
14 sources of boron or contribute towards a substantial change in existing sources of boron in the
15 affected environment. Maintenance activities would not be expected to cause any substantial
16 increases in boron concentrations or degradation with respect to boron such that objectives would
17 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 3 would
20 result in relatively small increases in long-term average boron concentrations in the Delta and not
21 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
22 would not be expected to cause exceedances of applicable objectives or further measurable water
23 quality degradation, and thus would not constitute an adverse effect on water quality.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
26 purpose of making the CEQA impact determination for this constituent. For additional details on the
27 effects assessment findings that support this CEQA impact determination, see the effects assessment
28 discussion that immediately precedes this conclusion.

29 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
30 river flow rate and reservoir storage reductions that would occur under the Alternative 3, relative to
31 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
32 Additionally, relative to Existing Conditions, Alternative 3 would not result in reductions in river
33 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
34 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

35 Small increased boron levels predicted for interior and western Delta locations (i.e., up to 9%
36 increase) in response to a shift in the Delta source water percentages and tidal habitat restoration
37 under this alternative would not be expected to cause exceedances of objectives, or substantial
38 degradation of these water bodies. Alternative 3 maintenance also would not result in any
39 substantial increases in boron concentrations in the affected environment. Boron concentrations
40 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
41 reflecting a potential improvement to boron loading in the lower San Joaquin River.

42 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 3
43 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to

Existing Conditions, Alternative 3 would not result in substantially increased boron concentrations such that frequency of exceedances of municipal and agricultural water supply objectives would increase. The levels of boron degradation that may occur under Alternative 3 would not be of sufficient magnitude to cause substantially increased risk for adverse effects to municipal or agricultural beneficial uses within the affected environment. Long-term average boron concentrations would decrease in Delta water exports to the SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower San Joaquin River. Based on these findings, this impact is determined to be less than significant. No mitigation is required.

Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21

NEPA Effects: Effects of CM2–CM21 on boron under Alternative 3 would be the same as those discussed for Alternative 1A and are determined to be not adverse.

CEQA Conclusion: CM2–CM21 proposed under Alternative 3 would be similar to those proposed under Alternative 1A. As such, effects on boron resulting from the implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and Maintenance (CM1)

Upstream of the Delta

Under Alternative 3 there would be no expected change to the sources of bromide in the Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged and resultant changes in flows from altered system-wide operations under Alternative 3 would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these watersheds. Consequently, Alternative 3 would not be expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their associated reservoirs upstream of the Delta.

Under Alternative 3, modeling indicates that long-term annual average flows on the San Joaquin River would decrease by 6%, relative to Existing Conditions and would remain virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). These decreases in flow would result in possible increases in long-term average bromide concentrations of about 3% relative to Existing Conditions and less than <1% relative to No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower San Joaquin River bromide levels that could occur under Alternative 3, relative to existing and No Action Alternative conditions would not be expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

Delta

Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing of source waters, these effects are included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
2 information.

3 Under Alternative 3, the geographic extent of effects pertaining to long-term average bromide
4 concentrations in the Delta would be similar to that previously described for Alternative 1A,
5 although the magnitude of predicted long-term change and relative frequency of concentration
6 threshold exceedances would be different. Using the mass-balance modeling approach for bromide
7 (see Section 8.3.1.3), relative to Existing Conditions, modeled long-term average bromide
8 concentrations would increase at Staten Island, Emmaton, and Barker Slough, while modeled long-
9 term average bromide concentrations would generally decrease at other assessment locations
10 (Appendix 8E, *Bromide*, Table 8). Overall effects would be greatest at Barker Slough, where
11 predicted long-term average bromide concentrations would increase from 51 µg/L to 69 µg/L (34%
12 relative increase) for the modeled 16-year hydrologic period and would increase from 54 µg/L to 99
13 µg/L (85% relative increase) for the modeled drought period. At Barker Slough, the predicted 50
14 µg/L exceedance frequency would decrease slightly from 49% under Existing Conditions to 48%
15 under Alternative 3, but would increase from 55% to 77% during the drought period. At Barker
16 Slough, the predicted 100 µg/L exceedance frequency would increase from 0% under Existing
17 Conditions to 22% under Alternative 3, and would increase from 0% to 47% during the drought
18 period. In contrast, increases in bromide at Staten Island would result in a 50 µg/L bromide
19 threshold exceedance increase from 47% under Existing Conditions to 71% under Alternative 3
20 (52% to 73% during the modeled drought period). However, unlike Barker Slough, modeling shows
21 that long-term average bromide concentration at Staten Island would exceed the 100 µg/L
22 assessment threshold concentration 1% under Existing Conditions and 3% under Alternative 3 (0%
23 to 2% during the modeled drought period). The long-term average bromide concentrations would
24 be 60 µg/L (62 µg/L for the modeled drought period) at Staten Island under Alternative 3. Changes
25 in exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
26 change in long-term average concentration, at other assessment locations would be less substantial.
27 This comparison to Existing Conditions reflects changes in bromide due to both Alternative 3
28 operations (including north Delta intake capacity of 6,000 cfs and numerous other components of
29 Operational Scenario A) and climate change/sea level rise.

30 In comparison, Alternative 3 relative to the No Action Alternative would result in predicted
31 increases in long-term average bromide concentrations at all locations with the exception of the
32 Banks and Jones pumping plants (Appendix 8E, *Bromide*, Table 8). These increases would continue
33 to be greatest at Barker Slough, where long-term average concentrations are predicted to increase
34 by about 38% (about 85% in drought years) relative to the No Action Alternative. Increases in long-
35 term average bromide concentrations would be less than 29% at the remaining assessment
36 locations. Due to the relatively small differences between modeled Existing Conditions and No
37 Action baselines, changes in the frequency with which concentration thresholds of 50 µg/L and 100
38 µg/L are exceeded are of similar magnitude to the previously described existing condition
39 comparison. Unlike the comparison to Existing Conditions, this comparison to the No Action
40 Alternative reflects changes in bromide due only to Alternative 3 operations.

41 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
42 conditions are very similar (Appendix 8E, *Bromide*, Table 8). Such similarity demonstrates that the
43 modeled Alternative 3 change in bromide is almost entirely due to Alternative 3 operations, and not
44 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
45 Barker Slough, regardless whether Alternative 3 is compared to Existing Conditions, or compared to
46 the No Action Alternative.

1 Results of the modeling approach which used relationships between EC and chloride and between
2 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
3 mass-balance approach (see Appendix 8E, Table 9). For most locations, the frequency of exceedance
4 of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods was
5 predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L threshold,
6 relative to Existing Conditions and the No Action Alternative, were not as great using this alternative
7 EC to chloride and chloride to bromide relationship modeling approach as compared to that
8 presented above from the mass-balance modeling approach. However, there were still substantial
9 increases, resulting in 9% exceedance over the modeled period under Alternative 3, as compared to
10 1% under Existing Conditions and 2% under the No Action Alternative. For the drought period,
11 exceedance frequency increased from 0% under Existing Conditions and the No Action Alternative,
12 to 18% under Alternative 3. Because the mass-balance approach predicts a greater level of impact at
13 Barker Slough, determination of impacts was based on the mass-balance results.

14 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
15 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in
16 source water quality for existing drinking water treatment plants drawing water from the North Bay
17 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
18 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
19 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
20 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
21 changes in the formation of disinfection byproducts such that considerable treatment plant
22 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
23 of the other modeled locations already frequently exceed the 100 µg/L threshold under Existing
24 Conditions and the No Action Alternative, these locations likely already require treatment plant
25 technologies to achieve equivalent levels of health protection, and thus no additional treatment
26 technologies would be triggered by the small increases in the frequency of exceeding the 100 µg/L
27 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
28 locations.

29 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
30 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
31 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
32 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
33 Slough and City of Antioch under Alternative 3 would experience a period average increase in
34 bromide during the months when these intakes would most likely be utilized. For those wet and
35 above normal water year types where mass balance modeling would predict water quality typically
36 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 149
37 µg/L (45% increase) at City of Antioch and would increase from 150 µg/L to 201 µg/L (34%
38 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
39 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
40 to chloride and chloride to bromide relationships show increases during these months, but the
41 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of
42 the differences in the data between the two modeling approaches, the decisions surrounding the use
43 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
44 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
45 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
46 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

1 Important to the results presented above is the assumed habitat restoration footprint on both the
2 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
3 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
4 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
5 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
6 deviations from modeled habitat restoration and implementation schedule will lead to different
7 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
8 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
9 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
10 management changes to BDCP restoration activities, including location, magnitude, and timing of
11 restoration, the estimates are not predictive of the bromide levels that would actually occur in
12 Barker Slough or elsewhere in the Delta.

13 ***SWP/CVP Export Service Areas***

14 Under Alternative 3, improvement in long-term average bromide concentrations would occur at the
15 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
16 year hydrologic period at these locations would decrease by as much as 31% relative to Existing
17 Conditions and 21% relative to the No Action Alternative. Relative change in long-term average
18 bromide concentration would generally be less for the drought period ($\leq 31\%$), but would still
19 represent considerable improvement (Appendix 8E, *Bromide*, Table 8). As a result, less frequent
20 bromide concentration exceedances of the 50 $\mu\text{g}/\text{L}$ and 100 $\mu\text{g}/\text{L}$ assessment thresholds would be
21 predicted and an overall improvement in Export Service Areas water quality would be experienced
22 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in
23 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
24 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
25 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
26 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
27 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
28 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
29 much of the south Delta.

30 ***NEPA Effects:*** The discussion above is based on results of the mass-balance modeling approach.
31 Results of the modeling approach which used relationships between EC and chloride and between
32 chloride and bromide (see Section 8.3.1.3) were consistent with the discussion above, and
33 assessment of bromide using these data results in the same conclusions as are presented above for
34 the mass-balance approach (see Appendix 8E, *Bromide*, Table 9).

35 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
36 facilities under Alternative 3 would not be expected to create new sources of bromide or contribute
37 towards a substantial change in existing sources of bromide in the affected environment.
38 Maintenance activities would not be expected to cause any substantial change in bromide such that
39 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
40 affected environment.

41 In summary, Alternative 3 operations and maintenance, relative to the No Action Alternative, would
42 result in small increases (i.e., $<1\%$) in long-term average bromide concentrations at Vernalis related
43 to relatively small declines in long-term average flow on the San Joaquin River. However, Alternative
44 3 operation and maintenance activities would cause substantial degradation to water quality with

1 respect to bromide at Barker Slough, source of the North Bay Aqueduct. Resultant substantial
2 change in long-term average bromide at Barker Slough could necessitate changes in water treatment
3 plant operations or require treatment plant upgrades in order to maintain DBP compliance, and thus
4 would constitute an adverse effect on water quality. Mitigation Measure WQ-5 is available to reduce
5 these effects (implementation of this measure along with a separate, other commitment as set forth
6 in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential
7 increased treatment costs associated with bromide-related changes would reduce these effects).

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
10 purpose of making the CEQA impact determination for this constituent. For additional details on the
11 effects assessment findings that support this CEQA impact determination, see the effects assessment
12 discussion that immediately precedes this conclusion.

13 Under Alternative 3 there would be no expected change to the sources of bromide in the Sacramento
14 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
15 and resultant changes in flows from altered system-wide operations under Alternative 3 would have
16 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
17 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
18 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
19 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 3, long-term
20 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
21 increases in long-term average bromide of about 3% relative to Existing Conditions.

22 Relative to Existing Conditions, Alternative 3 would result in small decreases in long-term average
23 bromide concentration at most Delta assessment locations, with principal exceptions being the
24 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
25 effects would be greatest at Barker Slough, where substantial increases in long-term average
26 bromide concentrations would be predicted. The increase in long-term average bromide
27 concentrations predicted for Barker Slough would result in a substantial change in source water
28 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
29 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
30 formation of disinfection byproducts at drinking water treatment plants such that considerable
31 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
32 water health protection.

33 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
34 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 3,
35 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
36 long-term average bromide concentrations are predicted to decrease by as much as 31% relative to
37 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
38 in the SWP/CVP Export Service Areas.

39 Based on the above, Alternative 3 operation and maintenance would not result in any substantial
40 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
41 Alternative 3, water exported from the Delta to the SWP/CVP service area would be substantially
42 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
43 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
44 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 3

1 operation and maintenance activities would not cause substantial long-term degradation to water
 2 quality respective to bromide with the exception of water quality at Barker Slough, source of the
 3 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
 4 bromide would increase by 34%, and 85% during the modeled drought period. For the modeled 16-
 5 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
 6 would increase from 0% under Existing Conditions to 22% under Alternative 3, while for the
 7 modeled drought period, the frequency would increase from 0% to 47%. Substantial changes in
 8 long-term average bromide could necessitate changes in treatment plant operation or require
 9 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
 10 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
 11 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
 12 impact is considered significant.

13 Implementation of Mitigation Measure WQ-5 along with a separate, other commitment relating to
 14 the potential increased treatment costs associated with bromide-related changes would reduce
 15 these effects. While mitigation measures to reduce these water quality effects in affected water
 16 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
 17 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
 18 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 19 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 20 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
 21 discussion of Alternative 1A.

22 In addition to and to supplement Mitigation Measure WQ-5, the project proponents have
 23 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 24 *AMMs, and CMs,* a separate, other commitment to address the potential increased water treatment
 25 costs that could result from bromide-related concentration effects on municipal water purveyor
 26 operations. Potential options for making use of this financial commitment include funding or
 27 providing other assistance towards implementation of the North Bay Aqueduct AIP, acquiring
 28 alternative water supplies, or other actions to indirectly reduce the effects of elevated bromide and
 29 DOC in existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
 30 potential actions that could be taken pursuant to this commitment in order to reduce the water
 31 quality treatment costs associated with water quality effects relating to chloride, electrical
 32 conductivity, and bromide.

33 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 34 **Conditions**

35 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

36 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 37 **CM21**

38 **NEPA Effects:** CM2–CM21 proposed under Alternative 3 would be the same as those proposed
 39 under Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–CM21 would not
 40 present new or substantially changed sources of bromide to the study area. Some conservation
 41 measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement
 42 or substitution is not expected to substantially increase or present new sources of bromide. CM2–

1 CM21 would not be expected to cause any substantial change in bromide such that MUN beneficial
2 uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

3 In summary, implementation of CM2–CM21 under Alternative 3, relative to the No Action
4 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
5 from implementing CM2–CM21 are determined to not be adverse.

6 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
7 under Alternative 1A. As such, effects on bromide resulting from the implementation of CM2–CM21
8 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
9 less than significant. No mitigation is required.

10 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 Under Alternative 3 there would be no expected change to the sources of chloride in the Sacramento
14 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
15 and resultant changes in flows from altered system-wide operations would have negligible, if any,
16 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
17 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
18 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
19 result of climate change). The reduced flow would result in possible increases in long-term average
20 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
21 Action Alternative (Appendix 8G, Table CI-62). Consequently, Alternative 3 would not be expected to
22 cause exceedance of chloride objectives/criteria or substantially degrade water quality with respect
23 to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River, the
24 eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

25 ***Delta***

26 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
27 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
28 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
29 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
30 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
31 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
32 information.

33 Relative to Existing Conditions, modeling predicts that Alternative 3 would result in similar or
34 reduced long-term average chloride concentrations for the 16-year period modeled at most of the
35 assessment locations, and, depending on modeling approach (see Section 8.3.1.3), would result in
36 increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., $\leq 28\%$), SF Mokelumne at
37 Staten Island (i.e., $\leq 19\%$), Sacramento River at Emmaton (i.e., $\leq 16\%$), and Sacramento River at
38 Mallard Island (i.e., $\leq 5\%$) (Appendix 8G, *Chloride*, Table CI-19 and Table CI-20). Additionally,
39 implementation of tidal habitat restoration under CM4 would increase the tidal exchange volume in
40 the Delta, and thus may contribute to increased chloride concentrations in the Bay source water as a
41 result of increased salinity intrusion. More discussion of this phenomenon is included in Section
42 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may be greater than

1 indicated herein and would affect the western Delta assessment locations the most which are
2 influenced to the greatest extent by the Bay source water. This comparison to Existing Conditions
3 reflects changes in chloride due to both Alternative 3 operations (including north Delta intake
4 capacity of 6,000 cfs and numerous other components of Operational Scenario A) and climate
5 change/sea level rise.

6 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
7 indicated that Alternative 3A would result in increased long-term average chloride concentrations
8 for the 16-year period modeled at nine of the assessment locations (Appendix 8G, Table CI-19). The
9 increases in long-term average chloride concentrations would generally be largest compared to the
10 No Action Alternative condition, ranging from 2% at the San Joaquin River at Buckley Cove to 32%
11 at the North Bay Aqueduct at Barker Slough. Long-term average chloride concentrations would
12 decrease at the Banks pumping plant and Jones pumping plant locations. The comparison to the No
13 Action Alternative reflects chloride changes due only to operations.

14 The following outlines the modeled chloride changes relative to the applicable objectives and
15 beneficial uses of Delta waters.

16 *Municipal Beneficial Uses—Relative to Existing Conditions*

17 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
18 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
19 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
20 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
21 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
22 Pumping Plant #1 locations. For Alternative 3, the modeled frequency of objective exceedance
23 would be unchanged at 7% of years under Existing Conditions and Alternative 3 (Appendix 8G,
24 Table CI-64).

25 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
26 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
27 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
28 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
29 year period. For Alternative 3, the modeled frequency of objective exceedance would decrease
30 slightly, from 6% of modeled days under Existing Conditions, to 4% of modeled days under
31 Alternative 3 (Appendix 8G, Table CI-63).

32 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
33 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
34 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
35 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
36 approach to model monthly average chloride concentrations for the 16-year period, the predicted
37 frequency of exceeding the 250 mg/L objective would occur for the 16-year period modeled at the
38 San Joaquin River at Antioch (i.e., from 66% under Existing Conditions to 74%) and Sacramento
39 River at Mallard Island (i.e., from 85% under Existing Conditions to 87%) (Appendix 8G, Table CI-
40 21), and would cause further degradation at Antioch in March and April (Appendix 8G, Table CI-23).
41 The frequency of exceedances at the Contra Costa Canal at Pumping Plant #1 would not increase
42 (Appendix 8G, Table CI-21); however, available assimilative capacity would be reduced by up to
43 100% (i.e., eliminated) in October and November compared to Existing Conditions (Appendix 8G,

1 Table CI-23), reflecting substantial degradation during these months when average concentrations
2 would be near, or exceed, the objective.

3 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
4 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
5 capacity would be similar to those discussed when utilizing the mass balance modeling approach
6 (Appendix 8G, Table CI-22 and Table CI-24). However, as with Alternative 1A the modeling approach
7 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
8 change utilizing the mass balance approach were generally of greater magnitude, and thus more
9 conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that
10 yielded the more conservative predictions was used as the basis for determining adverse impacts.

11 Based on the additional predicted annual and seasonal exceedances of the 250 mg/L Bay Delta
12 WQCP objectives for chloride, and the magnitude of associated long-term average water quality
13 degradation at interior and western Delta locations, the potential exists for substantial adverse
14 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
15 water with acceptable chloride levels.

16 *303(d) Listed Water Bodies—Relative to Existing Conditions*

17 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
18 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
19 nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would generally be similar
20 compared to Existing Conditions, and thus, would not be further degraded on a long-term basis
21 (Appendix 8G, Figure CI-2). With respect to Suisun Marsh, the monthly average chloride
22 concentrations for the 16-year period modeled would increase compared to Existing Conditions in
23 some months during October through May at the Sacramento River at Collinsville (Appendix 8G,
24 Figure CI-3), Mallard Island (Appendix 8G, Figure CI-1), and increase substantially at Montezuma
25 Slough at Beldon's Landing (i.e., up to a tripling of concentration in December through February)
26 (Appendix 8G, Figure CI-4). Although modeling of Alternative 3 assumed no operation of the
27 Montezuma Slough Salinity Control Gates, the project description assumes continued operation of
28 the Salinity Control Gates, consistent with assumptions included in the No Action Alternative. A
29 sensitivity analysis modeling run conducted for Alternative 4 with the gates operational consistent
30 with the No Action Alternative resulted in substantially lower EC levels than indicated in the original
31 Alternative 4 modeling results for Suisun Marsh, but EC levels were still somewhat higher than EC
32 levels under Existing Conditions for several locations and months. Although chloride was not
33 specifically modeled in this sensitivity analysis, it is expected that chloride concentrations would be
34 nearly proportional to EC levels in Suisun Marsh. Another modeling run with the gates operational
35 and restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions,
36 indicating that design and siting of restoration areas has notable bearing on EC levels at different
37 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
38 sensitivity analyses). These analyses also indicate that increases in salinity are related primarily to
39 the hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity
40 analyses, optimizing the design and siting of restoration areas may limit the magnitude of long-term
41 chloride increases in the Marsh. However, the chloride concentration increases at certain locations
42 could be substantial, depending on siting and design of restoration areas. Thus, these increased
43 chloride levels in Suisun Marsh are considered to contribute to additional, measureable long-term
44 degradation that potentially would adversely affect the necessary actions to reduce chloride loading
45 for any TMDL that is developed.

Municipal Beneficial Uses—Relative to No Action Alternative

Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For Alternative 3, the modeled frequency of objective exceedance would increase from 0% under the No Action Alternative to 7% of years under Alternative 3 (Appendix 8G, Table CI-64).

Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. For Alternative 3, the modeled frequency of objective exceedance would decrease slightly from 5% of modeled days under the No Action Alternative to 4% of modeled days under Alternative 3 (Appendix 8G, Table CI-63).

Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to model monthly average chloride concentrations for the 16-year period, a small increase in exceedance frequency would be predicted relative to the No Action Alternative at the Contra Costa Canal at Pumping Plant #1 (i.e., from 14% for the No Action Alternative to 20%), San Joaquin River at Antioch (i.e., from 73% to 74%), and Sacramento River at Mallard Island (i.e., from 86% to 87%) (Appendix 8G, Table CI-21). Additionally, the available assimilative capacity would be reduced at the Contra Costa Canal at Pumping Plant #1 in September through November (i.e., ranging from 29% to 100% [i.e., elimination]) and at the Antioch location in April (i.e., up to 46%) (Appendix 8G, Table CI-23), reflecting substantial degradation during these months when average concentrations would be near, or exceed, the objective.

In comparison, when utilizing the chloride-EC relationship to model monthly average chloride concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative capacity would be similar to those discussed when utilizing the mass balance modeling approach (Appendix 8G, Table CI-22 and Table CI-24). However, as with Alternative 1A the modeling approach utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of change utilizing the mass balance approach were generally of greater magnitude, and thus more conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach that yielded the more conservative predictions was used as the basis for determining adverse impacts.

Based on the additional predicted annual and seasonal exceedances of one or both Bay Delta WQCP objectives for chloride, and the magnitude of associated long-term average water quality degradation at interior and western Delta locations, the potential exists for substantial adverse effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of water with acceptable chloride levels.

303(d) Listed Water Bodies—Relative to No Action Alternative

With respect to the 303(d) listing for chloride for Tom Paine Slough, Alternative 3 would generally result in similar changes to those discussed for the comparison to Existing Conditions. Monthly average chloride concentrations at the Old River at Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would not be further degraded on a long-term basis (Appendix 8G, Figure CI-2).

1 Monthly average chloride concentrations at source water channel locations for the Suisun Marsh
2 (Appendix 8G, Figures Cl-1, Cl-3, and Cl-4) would increase substantially in some months during
3 October through May compared to the No Action Alternative conditions but sensitivity analyses
4 suggest that operation of the Salinity Control Gates and restoration area siting and design
5 considerations could reduce these increases. However, the chloride concentration increases at
6 certain locations could be substantial, depending on siting and design of restoration areas. Thus,
7 these increased chloride levels in Suisun Marsh are considered to contribute to, additional,
8 measureable long-term degradation would occur in Suisun Marsh that potentially would adversely
9 affect the necessary actions to reduce chloride loading for any TMDL that is developed.

10 ***SWP/CVP Export Service Areas***

11 Under Alternative 3, long-term average chloride concentrations based on the mass balance analysis
12 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
13 decrease by as much as 30% relative to Existing Conditions and 21% compared to No Action
14 Alternative (Appendix 8G, *Chloride*, Table Cl-19). The modeled frequency of exceedances of
15 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
16 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
17 *Chloride*, Table Cl-21). Consequently, water exported into the SWP/CVP service area would
18 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
19 the No Action Alternative conditions.

20 Results of the modeling approach which used relationships between EC and chloride (see Section
21 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
22 results in the same conclusions as are presented above for the mass-balance approach (Appendix
23 8G, Table Cl-20 and Table Cl-22).

24 Commensurate with the reduced chloride concentrations in water exported to the service area,
25 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
26 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
27 San Joaquin River flows (see discussion of Upstream of the Delta).

28 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
29 contribute towards a substantial change in existing sources of chloride in the affected environment.
30 Maintenance activities would not be expected to cause any substantial change in chloride such that
31 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
32 affected anywhere in the affected environment.

33 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 3 would
34 result in increased water quality degradation and frequency of exceedance of the 150 mg/L
35 objective at Contra Costa Pumping Plant #1 and Antioch, the 250 mg/L municipal and industrial
36 objective at interior and western Delta locations on a monthly average chloride basis, and could
37 contribute to measureable water quality degradation relative to the 303(d) impairment in Suisun
38 Marsh. The predicted chloride increases constitute an adverse effect on water quality (see
39 Mitigation Measure WQ-7; implementation of this measure along with a separate, other commitment
40 relating to the potential increased chloride treatment costs would reduce these effects).
41 Additionally, the predicted changes relative to the No Action Alternative conditions indicate that in
42 addition to the effects of climate change/sea level rise, implementation of CM1 and CM4 under
43 Alternative 3 would contribute substantially to the adverse water quality effects.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
7 thus river flow rate and reservoir storage reductions that would occur under the Alternative 3,
8 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
9 chloride levels. Additionally, relative to Existing Conditions, the Alternative 3 would not result in
10 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
11 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
12 watershed.

13 Relative to Existing Conditions, the Alternative 3 would result in substantially increased chloride
14 concentrations in the Delta such that the frequency of exceedance of the 250 mg/L Bay-Delta WQCP
15 objective would increase at the San Joaquin River at Antioch (by 8%) and at Mallard Slough (by 2%),
16 and long-term degradation may occur at Antioch, Mallard Slough, and Contra Costa Canal at
17 Pumping Plant #1, that may result in adverse effects on the municipal and industrial water supply
18 beneficial use (see Mitigation Measure WQ-7; implementation of this measure along with a separate,
19 other commitment relating to the potential increased chloride treatment costs would reduce these
20 effects). Relative to the Existing Conditions, the modeled increased chloride concentrations and
21 degradation in the western Delta could further contribute, at measurable levels to the existing
22 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.

23 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
24 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
25 River.

26 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
27 3 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
28 Alternative 3 maintenance would not result in any substantial changes in chloride concentration
29 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
30 this impact is determined to be significant due to increased chloride concentrations and degradation
31 at western Delta locations and its effects on municipal and industrial water supply, and fish and
32 wildlife beneficial uses.

33 While mitigation measures to reduce these water quality effects in affected water bodies to less-
34 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
35 recommended to attempt to reduce the effect that increased chloride concentrations may have on
36 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
37 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
38 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
39 discussion of Alternative 1A.

40 In addition to and to supplement Mitigation Measure WQ-7, the project proponents have
41 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
42 *AMMs*, and *CMs*, a separate, other commitment to address the potential increased water treatment
43 costs that could result from chloride concentration effects on municipal, industrial and agricultural
44 water purveyor operations. Potential options for making use of this financial commitment include

1 funding or providing other assistance towards acquiring alternative water supplies or towards
 2 modifying existing operations when chloride concentrations at a particular location reduce
 3 opportunities to operate existing water supply diversion facilities. Please refer to Appendix 3B for
 4 the full list of potential actions that could be taken pursuant to this commitment in order to reduce
 5 the water quality treatment costs associated with water quality effects relating to chloride, electrical
 6 conductivity, and bromide.

7 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-**
 8 **CM21**

9 **NEPA Effects:** Under Alternative 3, the types and geographic extent of effects on chloride
 10 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 11 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
 12 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 13 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
 14 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
 15 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-
 16 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 17 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 18 considered an improvement compared to No Action Alternative conditions.

19 In summary, based on the discussion above, the effects on chloride from implementing CM2–CM21
 20 are considered to be not adverse.

21 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 3 would not present new or
 22 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 23 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 24 with habitat restoration conservation measures may result in some reduction in discharge of
 25 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 26 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 27 mitigation is required.

28 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 29 **Maintenance (CM1)**

30 **NEPA Effects:** Effects of CM1 on DO under Alternative 3 would be the same as those discussed for
 31 Alternative 1A and are considered to not be adverse.

32 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 3 would be similar to those discussed for
 33 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 34 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 35 constituent. For additional details on the effects assessment findings that support this CEQA impact
 36 determination, see the effects assessment discussion under Alternative 1A.

37 Reservoir storage reductions that would occur under Alternative 3, relative to Existing Conditions,
 38 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
 39 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
 40 Similarly, river flow rate reductions that would occur would not be expected to result in a
 41 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
 42 flows would remain within the ranges historically seen under Existing Conditions and the affected

1 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
 2 water temperature would not be expected to cause DO levels to be outside of the range seen
 3 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
 4 change sufficiently to affect DO levels.

5 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 6 Delta source water percentages under this alternative or substantial degradation of these water
 7 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 8 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 9 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 10 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 11 the reaeration of Delta waters would not be expected to change substantially.

12 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 13 Export Service Areas waters under Alternative 3, relative to Existing Conditions, because the
 14 biochemical oxygen demand of the exported water would not be expected to substantially differ
 15 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 16 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 17 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 18 downstream reservoirs.

19 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 20 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 21 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 22 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 23 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 24 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 25 related impairment of these areas would not be expected. This impact would be less than significant.
 26 No mitigation is required.

27 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

28 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 3 would be the same as those
 29 discussed for Alternative 1A and are considered to not be adverse.

30 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 31 under Alternative 1A. As such, effects on DO resulting from the implementation of CM2–CM21 would
 32 be similar to those previously discussed for Alternative 1A. This impact is considered to be less than
 33 significant. No mitigation is required.

34 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 35 **Operations and Maintenance (CM1)**

36 ***Upstream of the Delta***

37 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 38 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 39 the San Joaquin River upstream of the Delta under Alternative 3 are not expected to be outside the
 40 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 41 minor changes in EC levels that could occur under Alternative 3 in water bodies upstream of the

1 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
2 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
9 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
10 information.

11 Relative to Existing Conditions, modeling indicates that Alternative 3 would result in an increase in
12 the number of days when Bay-Delta WQCP compliance locations would exceed EC objectives or be
13 out of compliance with the EC objectives at the Sacramento River at Emmaton and San Joaquin River
14 at Jersey Point (fish and wildlife objective) in the western Delta and San Joaquin River at San
15 Andreas Landing in the interior Delta (Appendix 8H, Table EC-3).

16 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
17 (1976–1991) would increase from 6% under Existing Conditions to 30% under Alternative 3, and
18 the days out of compliance with the EC objective would increase from 11% under Existing
19 Conditions to 44% under Alternative 3.

20 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
21 from 1% under Existing Conditions to 4% under Alternative 3. Further, the percentage of days out of
22 compliance with the EC objective would increase from 1% under Existing Conditions to 6% under
23 Alternative 3. Sensitivity analyses were performed for Alternative 4 Scenario H3, and indicated that
24 many similar exceedances were modeling artifacts, and the small number of remaining exceedances
25 were small in magnitude, lasted only a few days, and could be addressed with real time operations
26 of the SWP and CVP (see Section 8.3.1.1, *Models Used and Their Linkages*, for a description of real
27 time operations of the SWP and CVP). Due to similarities in the nature of the exceedances between
28 alternatives, the findings from these analyses can be extended to this alternative as well.

29 At Jersey Point, relative to the fish and wildlife objective, the percentage of days of EC objective
30 exceedance and days out of compliance would increase from 0% under Existing Conditions to 3%
31 under Alternative 3, which represents a very small increase for this objective. Further discussion of
32 EC increases relative to this objective can be found in Appendix 8H, Attachment 2.

33 Average EC levels at the western and southern Delta compliance locations, except at Emmaton in the
34 western Delta, would decrease from 1–28% for the entire period modeled and 2–30% during the
35 drought period modeled (1987–1991) (Appendix 8H, Table EC-14). At Emmaton, average EC would
36 increase by 14% for the entire period modeled and 12% for the drought period modeled. At the two
37 interior Delta locations, there would be increases in average EC: the S. Fork Mokelumne River at
38 Terminous average EC would increase 4% for the entire period modeled and 3% during the drought
39 period modeled; and San Joaquin River at San Andreas Landing average EC would increase 12% for
40 the entire period modeled and 13% during the drought period modeled. On average, EC would
41 increase at Emmaton during December and March through September. Average EC would increase
42 at San Andreas Landing during all months except November. Average EC in the S. Fork Mokelumne
43 River at Terminous would increase during all months. Average EC at Jersey Point during the months

1 of April–May, when the fish and wildlife objective applies in all but critical water year types, would
 2 increase from 14–17% for the entire period modeled (Appendix 8H, Table EC-14; further discussion
 3 of EC increases relative to this objective can be found in Appendix 8H Attachment 2). Of the Clean
 4 Water Act section 303(d) listed sections of the Delta—western, northwestern, and southern—the
 5 western portion of the Delta at Emmaton would have an increased frequency of exceedance of EC
 6 objectives (Appendix 8H, Table EC-3) and increased average EC. Thus, Alternative 3 could contribute
 7 to additional impairment and adversely affect beneficial uses for section 303(d) listed Delta
 8 waterways, relative to Existing Conditions. These EC changes are similar to that described for
 9 Alternative 1A. The comparison to Existing Conditions reflects changes in EC due to both Alternative
 10 3 operations (including north Delta intake capacity of 6,000 cfs and numerous other components of
 11 Operational Scenario A) and climate change/sea level rise.

12 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
 13 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
 14 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River; and Old
 15 River at Tracy Bridge (Appendix 8H, Table EC-3). The increase in percentage of days exceeding the
 16 EC objective would be 3% or less and the increase in percentage of days out of compliance would be
 17 5% or less, with the exception of Emmaton, which would have a 16% increase in days exceeding the
 18 EC objective and a 19% increase in days out of compliance. Regarding exceedances at Old River at
 19 Middle River and at Tracy Bridge, as noted in Section 8.1.3.7, SWP and CVP operations have
 20 relatively little influence on salinity levels at these locations, and the elevated salinity in south Delta
 21 channels is affected substantially by local salt contributions discharged into the San Joaquin River
 22 downstream of Vernalis. Thus, the modeling has limited ability to estimate salinity accurately in this
 23 region. Average EC would increase at some compliance locations for the entire period modeled:
 24 Sacramento River at Emmaton (13%), San Joaquin River at Jersey Point (2%), S. Fork Mokelumne
 25 River at Terminous (4%), San Joaquin River at San Andreas Landing (18%), and San Joaquin River at
 26 Prisoners Point (9%) (Appendix 8H, Table EC-14). For the drought period modeled, the locations
 27 with an average EC increase, relative to the No Action Alternative, would be: Sacramento River at
 28 Emmaton (1%), S. Fork Mokelumne River at Terminous (4%), San Joaquin River at San Andreas
 29 Landing (13%), San Joaquin River at Brandt Bridge (1%), Old River at Tracy Bridge (1%), and San
 30 Joaquin River at Prisoners Point (5%) (Appendix 8H, Table EC-14). The western and southern Delta
 31 are CWA section 303(d) listed for elevated EC and the increased incidence of exceedance of EC
 32 objectives and EC degradation that could occur in the western Delta could make beneficial use
 33 impairment measurably worse. Since there would be very little change in EC levels in the southern
 34 Delta and there is not expected to be an increase in frequency of exceedances of objectives, this
 35 alternative is not expected to make beneficial use impairment measurably worse in the southern
 36 Delta. These EC changes are similar to that described for Alternative 1A. The comparison to the No
 37 Action Alternative reflects changes in EC due only to Alternative 3 operations (including north Delta
 38 intake capacity of 6,000 cfs and numerous other components of Operational Scenario A).

39 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
 40 fish and wildlife apply. Long-term average EC would increase under Alternative 3, relative to
 41 Existing Conditions, during the months of March through May by 0.3–0.9 mS/cm in the Sacramento
 42 River at Collinsville (Appendix 8H, Table EC-21). Long-term average EC would decrease relative to
 43 Existing Conditions in Montezuma Slough at National Steel during October–May (Appendix 8H,
 44 Table EC-22). The most substantial increase would occur near Beldon’s Landing, with long-term
 45 average EC levels increasing by 1.8–6.1 mS/cm, depending on the month, which would be a doubling
 46 or tripling of long-term average EC relative to Existing Conditions (Appendix 8H, Table EC-23).

1 Sunrise Duck Club and Volanti Slough also would have long-term average EC increases during all
 2 months of 1.7–4.0 mS/cm (Appendix 8H, Tables EC-24 and EC-25). Modeling of this alternative
 3 assumed no operation of the Montezuma Slough Salinity Control Gates, but the project description
 4 assumes continued operation of the Salinity Control Gates, consistent with assumptions included in
 5 the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative 4 Scenario
 6 H3 with the gates operational consistent with the No Action Alternative resulted in substantially
 7 lower EC levels than indicated in the original Alternative 4 modeling results, but EC levels were still
 8 somewhat higher than EC levels under Existing Conditions and the No Action Alternative for several
 9 locations and months. Another modeling run with the gates operational and restoration areas
 10 removed resulted in EC levels nearly equivalent to Existing Conditions and the No Action
 11 Alternative, indicating that design and siting of restoration areas has notable bearing on EC levels at
 12 different locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on
 13 these sensitivity analyses). These analyses also indicate that increases are related primarily to the
 14 hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity analyses,
 15 optimizing the design and siting of restoration areas may limit the magnitude of long-term EC
 16 increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the EC increases
 17 between alternatives, the findings from these analyses can be extended to this alternative as well.

18 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
 19 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
 20 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
 21 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
 22 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
 23 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
 24 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
 25 certain locations could be substantial, depending on siting and design of restoration areas, and it is
 26 uncertain the degree to which current management plans for the Suisun Marsh would be able to
 27 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
 28 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
 29 Long-term average EC increases in Suisun Marsh under Alternative 3 relative to the No Action
 30 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh is section
 31 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
 32 concentrations could contribute to additional impairment. These EC changes are similar to that
 33 described for Alternative 1A.

34 ***SWP/CVP Export Service Areas***

35 At the Banks and Jones pumping plants, Alternative 3 would result in no exceedances of the Bay-
 36 Delta WQCP’s 1,000 μ mhos/cm EC objective for the entire period modeled (Appendix 8H, Table EC-
 37 10). Thus, there would be no adverse effect on the beneficial uses in the SWP/CVP Export Service
 38 Areas using water pumped at this location under Alternative 3.

39 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 3
 40 would decrease 18% for the entire period modeled and 18% during the drought period modeled.
 41 Relative to the No Action Alternative, average EC levels would decrease by 12% for the entire period
 42 modeled and drought period modeled. (Appendix 8H, Table EC-14)

43 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 3
 44 would decrease 17% for the entire period modeled and 20% during the drought period modeled.

1 Relative to the No Action Alternative, average EC levels would decrease by 13% for the entire period
2 modeled and 16% during the drought period modeled. (Appendix 8H, Table EC-14)

3 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
4 pumping plants, Alternative 3 would not cause degradation of water quality with respect to EC in
5 the SWP/CVP Export Service Areas; rather, Alternative 3 would improve long-term average EC
6 conditions in the SWP/CVP Export Service Areas.

7 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
8 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
9 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
10 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
11 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
12 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
13 impact discussion under the No Action Alternative).

14 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
15 elevated EC. Alternative 3 would result in lower average EC levels relative to Existing Conditions and
16 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
17 related to elevated EC in the SWP/CVP Export Service Areas waters.

18 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives and increased
19 long-term and drought period average EC levels that would occur at western Delta compliance
20 locations under Alternative 3, relative to the No Action Alternative, would contribute to adverse
21 effects on the agricultural beneficial uses. The increased long-term period average EC levels between
22 Jersey Point and Prisoners Point could contribute to adverse effects on fish and wildlife beneficial
23 uses (specifically, indirect adverse effects on striped bass spawning), though there is a high degree
24 of uncertainty associated with this impact. The western and southern Delta are CWA section 303(d)
25 listed as impaired due to elevated EC, and the increase in incidence of exceedance of EC objectives
26 and increases in long-term average and drought period average EC in the western portion of the
27 Delta have the potential to contribute to additional beneficial use impairment. The increases in long-
28 term average EC levels that could occur in Suisun Marsh would further degrade existing EC levels
29 and could contribute to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is
30 section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
31 average EC levels could contribute to additional beneficial use impairment. The effects on EC in the
32 western Delta, San Joaquin River at Prisoners Point, and in Suisun Marsh constitute an adverse effect
33 on water quality. Mitigation Measure WQ-11 would be available to reduce these effects
34 (implementation of this measure along with a separate, other commitment as set forth in EIR/EIS
35 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-related
36 changes would reduce these effects).

37 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
38 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
39 purpose of making the CEQA impact determination for this constituent. For additional details on the
40 effects assessment findings that support this CEQA impact determination, see the effects assessment
41 discussion that immediately precedes this conclusion.

42 River flow rate and reservoir storage reductions that would occur under Alternative 3, relative to
43 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
44 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed

1 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
2 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
3 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
4 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
5 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
6 Delta.

7 Relative to Existing Conditions, Alternative 3 would not result in any substantial increases in long-
8 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
9 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
10 would decrease at both plants and, thus, this alternative would not contribute to additional
11 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
12 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
13 relative to Existing Conditions.

14 In the Plan Area, Alternative 3 would result in an increase in the frequency with which Bay-Delta
15 WQCP EC objectives for agricultural beneficial use protection are exceeded in the Sacramento River
16 at Emmaton (24%; western Delta) for the entire period modeled (1976–1991). Further, average EC
17 levels at Emmaton would increase by 14% for the entire period modeled and 12% during the
18 drought period modeled. Average EC levels at San Andreas Landing would increase by 12% for the
19 entire period modeled and 13% during the drought period modeled. In addition, there would be an
20 increase in the average EC of 14–17% at Jersey Point (for the entire period modeled) during the
21 months of April–May, when the fish and wildlife objective applies. Because EC is not
22 bioaccumulative, the increases in long-term average EC levels would not directly cause
23 bioaccumulative problems in aquatic life or humans. The interior Delta is not Clean Water Act
24 section 303(d) listed for elevated EC; however, the western Delta is. The increases in long-term and
25 drought period average EC levels and increased frequency of exceedance of EC objectives that would
26 occur in the Sacramento River at Emmaton would potentially contribute to adverse effects on the
27 agricultural beneficial uses in the western Delta. The increased long-term period average EC levels
28 between Jersey Point and Prisoners Point could contribute to adverse effects on fish and wildlife
29 beneficial uses (specifically, indirect adverse effects on striped bass spawning), though there is a
30 high degree of uncertainty associated with this impact. This impact is considered to be significant.

31 Further, relative to Existing Conditions, Alternative 3 could result in substantial increases in long-
32 term average EC during the months of October through May in Suisun Marsh. The increases in long-
33 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
34 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
35 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
36 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
37 elevated EC and the increases in long-term average EC that would occur in the marsh could make
38 beneficial use impairment measurably worse. This impact is considered to be significant.

39 Implementation of Mitigation Measure WQ-11 along with a separate, other commitment relating to
40 the potential increased costs associated with EC-related changes would reduce these effects. While
41 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
42 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
43 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
44 However, because the effectiveness of this mitigation measure to result in feasible measures for
45 reducing water quality effects is uncertain, this impact is considered to remain significant and

1 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
2 Alternative 1A.

3 In addition to and to supplement Mitigation Measure WQ-11, the project proponents have
4 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
5 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
6 costs that could result from EC concentration effects on municipal, industrial and agricultural water
7 purveyor operations. Potential options for making use of this financial commitment include funding
8 or providing other assistance towards acquiring alternative water supplies or towards modifying
9 existing operations when EC concentrations at a particular location reduce opportunities to operate
10 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
11 actions that could be taken pursuant to this commitment in order to reduce the water quality
12 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
13 bromide.

14 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
15 **Quality Conditions**

16 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

17 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2-**
18 **CM21**

19 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 3 would be the same as those discussed
20 for Alternative 1A and are considered not to be adverse.

21 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
22 under Alternative 1A. As such, effects on EC resulting from the implementation of CM2–CM21 would
23 be similar to those previously discussed for Alternative 1A. This impact is considered to be less than
24 significant. No mitigation is required.

25 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
26 **Maintenance (CM1)**

27 ***Upstream of the Delta***

28 Under Alternative 3, the magnitude and timing of reservoir releases and river flows upstream of the
29 Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
30 Existing Conditions and the No Action Alternative.

31 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
32 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
33 relationships for mercury and methylmercury. No significant, predictive regression relationships
34 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
35 (monthly or annual)(Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
36 total mercury and flow is to be expected based on the association of mercury with suspended
37 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
38 Sacramento River under Alternative 3 relative to Existing Conditions and the No Action Alternative
39 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
40 mobilized. Therefore, mercury loading should not be substantially different due to changes in flow.
41 In addition, even though it may be flow-affected, total mercury concentrations remain well below

1 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
2 the water bodies of the affected environment located upstream of the Delta would not be of
3 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
4 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
5 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
6 remain above guidance levels at upstream of Delta locations, but will not change substantially
7 relative to Existing Conditions or the No Action Alternative due to changes in flows under
8 Alternative 3.

9 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
10 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
11 Mercury Control Program. These projects will target specific sources of mercury and methylation
12 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
13 The implementation of these projects could help to ensure that upstream of Delta environments will
14 not be substantially degraded for water quality with respect to mercury or methylmercury.

15 ***Delta***

16 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
17 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
18 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
19 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
20 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
21 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
22 information.

23 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
24 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
25 change in assimilative capacity of waterborne total mercury of Alternative 3 relative to the 25 ng/L
26 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
27 0.7% for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant, and 0.8% for the
28 Mokelumne River (South Fork) at Staten Island and Franks Tract relative to the No Action
29 Alternative (Figures 8-53a and 8-54a). These changes are not expected to result in adverse effects to
30 beneficial uses. Similarly, changes in methylmercury concentration are expected to be very small.
31 The greatest annual average methylmercury concentration for drought conditions was 0.167 ng/L
32 for the San Joaquin River at Buckley Cove which was slightly higher than Existing Conditions (0.161
33 ng/L), and the same as the No Action Alternative (Appendix 8I, Table I-6 and Figure I-3). All
34 modeled input concentrations exceeded the methylmercury TMDL guidance objective of 0.06 ng/L,
35 therefore percentage change in assimilative capacity was not evaluated for methylmercury.

36 Fish tissue showed small increases in exceedance quotients based on long-term annual average
37 concentrations for mercury at the Delta locations. There was a 6% increase at the Mokelumne River
38 (South Fork) at Staten Island, the San Joaquin River at Buckley Cove, Franks Tract, and Old River at
39 Rock Slough relative to Existing Conditions, and a 8% increase at the Mokelumne River (South Fork)
40 at Staten Island relative to the No Action Alternative (Figures 8-55a, and 8-55b; Appendix 8I, Table
41 I-10b). All water export locations except Contra Costa Pumping Plant #1 showed improved bass
42 tissue mercury estimates (Figures 8-55a and 8-55b; Appendix 8I, Tables I-10a, I-10b). Because these
43 increases are relatively small, and it is not evident that substantive increases are expected at
44 numerous locations throughout the Delta, these changes are expected to be within the uncertainty

1 inherent in the modeling approach, and would likely not be measurable in the environment. See
2 Appendix 8I for a discussion of the uncertainty associated with the fish tissue estimates.

3 **SWP/CVP Export Service Areas**

4 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
5 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
6 methylmercury concentrations for Alternative 3 are projected to be lower than Existing Conditions,
7 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-2 and
8 I-3). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53a
9 and 8-54a). Bass tissue mercury concentrations are also improved under Alternative 3, relative to
10 Existing Conditions and the No Action Alternative (Figures 8-55a and 8-55b; Appendix 8I, Tables I-
11 10a, I-10b).

12 **NEPA Effects:** In summary, based on the above discussion, the effects of mercury and
13 methylmercury in comparison of Alternative 3 to the No Action Alternative (as waterborne and
14 bioaccumulated forms) are not considered to be adverse.

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
17 purpose of making the CEQA impact determination for this constituent. For additional details on the
18 effects assessment findings that support this CEQA impact determination, see the effects assessment
19 discussion that immediately precedes this conclusion.

20 Under Alternative 3, greater water demands and climate change would alter the magnitude and
21 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
22 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
23 methylmercury upstream of the Delta will not be substantially different relative to Existing
24 Conditions due to the lack of important relationships between mercury/methylmercury
25 concentrations and flow for the major rivers.

26 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
27 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
28 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
29 mercury concentrations show almost no differences would occur among sites for Alternative 3 as
30 compared to Existing Conditions for Delta sites.

31 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
32 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
33 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
34 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 3 as
35 compared to Existing Conditions.

36 As such, this alternative is not expected to cause additional exceedance of applicable water quality
37 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
38 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
39 not expected to increase substantially, no long-term water quality degradation is expected to occur
40 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
41 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
42 or fish tissue mercury concentrations would not make any existing mercury-related impairment
43 measurably worse. In comparison to Existing Conditions, Alternative 3 would not increase levels of

mercury by frequency, magnitude, and geographic extent such that the affected environment would be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans consuming those organisms. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2–CM21

NEPA Effects: Some habitat restoration activities under Alternative 3 would occur on lands in the Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under Alternative 3 have the potential to increase water residence times and increase accumulation of organic sediments that are known to enhance methylmercury bioaccumulation in biota in the restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is possible but uncertain depending on the specific restoration design implemented at a particular Delta location. Models to estimate the potential for methylmercury formation in restored areas are not currently available. However, DSM2 modeling for Alternative 3 operations does incorporate assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These modeled restoration assumptions provide some insight into potential hydrodynamic changes that could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the potential for increased mercury and methylmercury concentrations under Alternative 3.

CM12 addresses the potential for methylmercury bioaccumulation associated with restoration activities and acknowledges the uncertainties associated with mitigating or minimizing this potential effect. CM12 proposes project-specific mercury management plans for restoration actions that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate for potential increases in methylmercury bioaccumulation at future restoration sites include:

- Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to better inform restoration design,
- Sequestering methylmercury at restoration sites using low intensity chemical dosing techniques,
- Minimizing microbial methylation associated with anoxic conditions by reducing the amount of organic material at a restoration site,
- Designing restoration sites to enhance photo degeneration that converts methylmercury into a biologically unavailable, inorganic form of mercury,
- Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- Considering capping mercury laden sediments, where possible to reduce methylation potential at a site.

Because of the uncertainties associated with site-specific estimates of methylmercury concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of methylmercury management proposed under CM12 to reduce methylmercury concentrations would need to be evaluated separately for each restoration effort, as part of design and implementation.

In summary, because of this uncertainty and the known potential for methylmercury creation in the Delta this potential effect of implementing CM2–CM21 is considered adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 2 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 3 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 4 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 5 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 6 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 7 measurable increase in methylmercury concentrations would make existing mercury-related
 8 impairment measurably worse. Because mercury is bioaccumulative, increases in waterborne
 9 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 10 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 11 Design of restoration sites under Alternative 3 would be guided by CM12 which requires
 12 development of site specific mercury management plans as restoration actions are implemented.
 13 The effectiveness of minimization and mitigation actions implemented according to the mercury
 14 management plans is not known at this time although the potential to reduce methylmercury
 15 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 16 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 17 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 18 impact being considered significant. No mitigation measures would be available until specific
 19 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 20 unavoidable.

21 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
 22 **Maintenance (CM1)**

23 ***Upstream of the Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
 25 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 26 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

27 Under Alternative 3, modeling indicates that long-term annual average flows on the San Joaquin
 28 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 29 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
 30 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 31 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 32 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 33 affected, if at all, by changes in flow rates under Alternative 3.

34 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 35 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 36 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 37 water bodies, with regards to nitrate.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 42 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 43 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
2 information.

3 Results of the mixing calculations indicate that under Alternative 3, relative to Existing Conditions,
4 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
5 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 13 and 14). Although
6 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
7 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
8 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
9 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
10 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
11 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
12 concentration would be somewhat reduced under Alternative 3, relative to Existing Conditions and
13 would be nearly the same (i.e., any increase would be negligible) as that under the No Action
14 Alternative. No additional exceedances of the MCL are anticipated at any location (Appendix 8J,
15 *Nitrate*, Table 13). On a monthly average basis and on a long term annual average basis, for all
16 modeled years and for the drought period (1987–1991) only, use of assimilative capacity available
17 under Existing Conditions and the No Action Alternative, relative to the drinking water MCL of 10
18 mg/L-N, was low or negligible (i.e., <5%) for all locations and months, except for Jones PP in
19 November, where use of assimilative capacity available under Existing Conditions was 6.5% in the
20 drought period (1987–1991) (Appendix 8J, *Nitrate*, Table 15).

21 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
22 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
23 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
24 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
25 the modeling.

- 26 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
27 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
28 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
29 the increase becoming greater with increasing distance downstream. However, the increase in
30 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
31 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
32 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Regional
33 Water Quality Control Board 2010a:32).
- 34 • Under Alternative 3, the planned upgrades to the SRWTP, which include nitrification/partial
35 denitrification, would substantially decrease ammonia concentrations in the discharge, but
36 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
37 higher than under Existing Conditions.
- 38 • Overall, under Alternative 3, the nitrogen load from the SRWTP discharge is expected to
39 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
40 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
41 of the facility are expected to be higher than modeling results indicate for both Existing
42 Conditions and Alternative 3, the increase is expected to be greater under Existing Conditions
43 than for Alternative 3 due to the upgrades that are assumed under Alternative 3.

1 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
2 immediately downstream of other wastewater treatment plants that practice nitrification, but not
3 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
4 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
5 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
6 State has determined that no beneficial uses are adversely affected by the discharge, and that the
7 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
8 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
9 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
10 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
11 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
12 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
13 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

14 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
15 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
16 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

17 ***SWP/CVP Export Service Areas***

18 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
19 nitrate-N at the Banks and Jones pumping plants.

20 Results of the mixing calculations indicate that under Alternative 3i, relative to Existing Conditions
21 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
22 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Tables 13 and
23 14). During the late summer, particularly in the drought period assessed, concentrations are
24 expected to increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally,
25 given the many factors that contribute to potential algal blooms in the SWP and CVP canals within
26 the Export Service Area, and the lack of studies that have shown a direct relationship between
27 nutrient concentrations in the canals and reservoirs and problematic algal blooms in these water
28 bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal increases
29 in nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
30 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, *Nitrate*,
31 Table 13). On a monthly average basis and on a long term annual average basis, for all modeled
32 years and for the drought period (1987–1991) only, use of assimilative capacity available under
33 Existing Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible
34 (<4%) for both Banks and Jones pumping plants (Appendix 8J, *Nitrate*, Table 15).

35 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
36 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
37 degrade the quality of exported water, with regards to nitrate.

38 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
39 CM1 are considered to be not adverse.

40 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
41 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
42 purpose of making the CEQA impact determination for this constituent. For additional details on the

1 effects assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
4 substantial dilution available for point sources and the lack of substantial nonpoint sources of
5 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
6 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
7 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
8 Consequently, any modified reservoir operations and subsequent changes in river flows under
9 Alternative 3, relative to Existing Conditions, are expected to have negligible, if any, effects on
10 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
11 watershed and upstream of the Delta in the San Joaquin River watershed.

12 In the Delta, results of the mixing calculations indicate that under Alternative 3, relative to Existing
13 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
14 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
15 location, and use of assimilative capacity available under Existing Conditions, relative to the
16 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <5%) for virtually all locations and
17 months.

18 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
19 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
20 indicate that under Alternative 3, relative to Existing Conditions, long-term average nitrate
21 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
22 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
23 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
24 plants for all months.

25 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
26 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
27 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
28 alternative is not expected to cause additional exceedance of applicable water quality
29 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
30 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
31 expected to increase substantially, no long-term water quality degradation is expected to occur and,
32 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
33 affected environment and thus any increases that may occur in some areas and months would not
34 make any existing nitrate-related impairment measurably worse because no such impairments
35 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
36 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
37 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
38 significant. No mitigation is required.

39 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 40 CM21**

41 **NEPA Effects:** Effects of CM2–CM21 on nitrate under Alternative 3 would be the same as those
42 discussed for Alternative 1A and are considered not to be adverse.

1 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 2 under Alternative 1A. As such, effects on nitrate resulting from the implementation of CM2–CM21
 3 would be similar to those previously discussed for Alternative 1A. This impact is considered to be
 4 less than significant. No mitigation is required.

5 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 6 **Operations and Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 3, there would be no substantial change to the sources of DOC within the
 9 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 10 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 11 system operations and resulting reservoir storage levels and river flows would not be expected to
 12 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 13 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 14 3, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 15 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 16 degrade the quality of these water bodies, with regards to DOC.

17 ***Delta***

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 22 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 23 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 24 information.

25 Under Alternative 3, the geographic extent of effects pertaining to long-term average DOC
 26 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 27 although the magnitude of predicted long-term change and relative frequency of concentration
 28 threshold exceedances would be less. Modeled effects would be greatest at Franks Tract, Rock
 29 Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the modeled
 30 drought period, long-term average concentration increases ranging from 0.2–0.3 mg/L would be
 31 predicted ($\leq 8\%$ net increase) (Appendix 8K, *Organic Carbon*, DOC Table 4). Increases in long-term
 32 average concentrations would correspond to more frequent concentration threshold exceedances,
 33 with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock
 34 Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under
 35 Existing Conditions to 65% under the Alternative 3 (an increase from 47% to 63% for the drought
 36 period), and concentrations exceeding 4 mg/L would increase from 30% to 33% (32% to 38% for
 37 the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3
 38 mg/L would increase from 52% under Existing Conditions to 65% under Alternative 3 45% to 67%
 39 for the drought period), and concentrations exceeding 4 mg/L would increase from 32% to 37%
 40 (35% to 42% for the drought period). Relative change in frequency of threshold exceedance for
 41 other assessment locations would be similar or less. While Alternative 3 would generally lead to
 42 slightly higher long-term average DOC concentrations (≤ 0.3 mg/L) at some municipal water intakes
 43 and Delta interior locations, the predicted change would not be expected to adversely affect MUN

1 beneficial uses, or any other beneficial use. This comparison to Existing Conditions reflects changes
 2 in DOC due to both Alternative 3 operations (including north Delta intake capacity of 6,000 cfs and
 3 numerous other components of Operational Scenario A) and climate change/sea level rise.

4 In comparison, Alternative 3 relative to the No Action Alternative would generally result in a
 5 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
 6 increases of 0.1–0.2 mg/L DOC (i.e., ≤7%) would be predicted at Franks Tract, Rock Slough, and
 7 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table 4).
 8 Threshold concentration exceedance frequency trends would also be similar to those discussed for
 9 the existing condition comparison, with exception to the predicted 4 mg/L exceedance frequency at
 10 Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average
 11 DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 33% (42% to
 12 63% for the modeled drought period). While the Alternative 3 would generally lead to slightly
 13 higher long-term average DOC concentrations at some Delta assessment locations when compared
 14 to No Action Alternative conditions, the predicted change would not be expected to adversely affect
 15 MUN beneficial uses, or any other beneficial use, particularly when considering the relatively small
 16 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
 17 this comparison to the No Action Alternative reflects changes in DOC due to only Alternative 3
 18 operations.

19 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
 20 occur before significant changes in drinking water treatment plant design or operations are
 21 triggered. The increases in long-term average DOC concentrations estimated to occur at various
 22 Delta locations under Alternative 3 are of sufficiently small magnitude that they would not require
 23 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
 24 levels currently employed.

25 Relative to existing and No Action Alternative conditions, Alternative 3 would lead to predicted
 26 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 27 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
 28 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on baseline conditions
 29 comparison and modeling period.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 3, modeled long-term average DOC concentrations would decrease at Banks and
 32 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 33 period, relative to Existing Conditions and the No Action Alternative. Relative to Existing Conditions,
 34 long-term average DOC concentrations at Banks would be predicted to decrease by 0.3 mg/L (0.1
 35 mg/L during drought period) (Appendix 8K, *Organic Carbon*, DOC Table 4). At Jones, long-term
 36 average DOC concentrations would be predicted to decrease by 0.2 mg/L (<0.1 mg/L during drought
 37 period). Such decreases in long-term average DOC, however, would not necessarily translate into
 38 lower exceedance frequencies for concentration thresholds. To the contrary, long-term average DOC
 39 concentrations at Banks exceeding 3 mg/L would increase from 64% under Existing Conditions to
 40 69% under Alternative 3 (57% to 92% for the drought period), and at Jones would increase from
 41 71% to 77% (72% to 88% for the drought period). In contrast, however, the frequency of
 42 concentrations exceeding 4 mg/L at Banks and Jones would decrease or remain relatively
 43 unchanged. Comparisons to the No Action Alternative yield similar trends, but with slightly smaller
 44 16-year hydrologic period and drought period changes. Overall, modeling results for the SWP/CVP

1 Export Service Areas predict an overall long-term improvement in Export Service Areas water
2 quality, primarily through a reduction in exports of water exceeding 4 mg/L.

3 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
4 facilities under Alternative 3 would not be expected to create new sources of DOC or contribute
5 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
6 would not be expected to cause any substantial change in long-term average DOC concentrations
7 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

8 **NEPA Effects:** In summary, Alternative 3, relative to the No Action Alternative, would not cause a
9 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
10 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
11 decrease by as much as 0.4 mg/L, while long-term average DOC concentrations for some Delta
12 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.2 mg/L.
13 The increase in long-term average DOC concentration that could occur within the Delta interior
14 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
15 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
16 DOC is determined not to be adverse.

17 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
18 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
19 purpose of making the CEQA impact determination for this constituent. For additional details on the
20 effects assessment findings that support this CEQA impact determination, see the effects assessment
21 discussion that immediately precedes this conclusion.

22 While greater water demands under the Alternative 3 would alter the magnitude and timing of
23 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
24 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
25 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
26 flows would not be expected to cause a substantial long-term change in DOC concentrations
27 upstream of the Delta.

28 Relative to Existing Conditions, Alternative 3 would result in relatively small increases (i.e., $\leq 8\%$) in
29 long-term average DOC concentrations at some Delta interior locations, including Franks Tract, Rock
30 Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase the
31 frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
32 Alternative 3 would generally lead to slightly higher long-term average DOC concentrations (≤ 0.3
33 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
34 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

35 The assessment of Alternative 3 effects on DOC in the SWP/CVP Export Service Areas is based on
36 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to the
37 existing condition, long-term average DOC concentrations would decrease by as much as 0.3 mg/L at
38 Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
39 predicted. Nevertheless, an overall improvement in DOC-related water quality would be predicted in
40 the SWP/CVP Export Service Areas.

41 Based on the above, Alternative 3 operation and maintenance would not result in any substantial
42 change in long-term average DOC concentration upstream of the Delta or result in substantial
43 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L

1 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
 2 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
 3 (i.e., $\leq 8\%$ relative increase), with long-term average concentrations estimated to remain at or below
 4 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
 5 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
 6 Cove are predicted to remain the same during the drought period, relative to Existing Conditions.
 7 The increases in long-term average DOC concentration that could occur within the Delta would not
 8 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
 9 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
 10 increases in long-term average DOC concentrations would not directly cause bioaccumulative
 11 problems in aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus
 12 is not 303(d) listed for any water body within the affected environment. Thus, the increases in long-
 13 term average DOC that could occur at various locations would not make any beneficial use
 14 impairment measurably worse. Because long-term average DOC concentrations are not expected to
 15 increase substantially, no long-term water quality degradation with respect to DOC is expected to
 16 occur and, thus, no adverse effects on beneficial uses would occur. This impact is considered to be
 17 less than significant. No mitigation is required.

18 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 19 **Implementation of CM2–CM21**

20 **NEPA Effects:** CM2–CM21 proposed under Alternative 3 would be the same as those proposed
 21 under Alternative 1A. As such, effects on DOC resulting from the implementation of CM2–CM21
 22 would be similar to those previously discussed for Alternative 1A. In summary, CM4–CM7 and CM10
 23 could contribute substantial amounts of DOC to raw drinking water supplies, largely depending on
 24 final design and operational criteria for the related wetland and riparian habitat restoration
 25 activities. Substantially increased long-term average DOC in raw water supplies could lead to a need
 26 for treatment plant upgrades in order to appropriately manage DBP formation in treated drinking
 27 water. This potential for future DOC increases would lead to substantially greater associated risk of
 28 long-term adverse effects on the MUN beneficial use.

29 In addition to and to supplement Mitigation Measure WQ-18, the project proponents have
 30 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 31 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
 32 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 33 operations. Potential options for making use of this financial commitment include funding or
 34 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 35 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 36 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 37 water quality effects relating to DOC.

38 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 3 would
 39 present new localized sources of DOC to the study area, and in some circumstances would substitute
 40 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 41 proximity to municipal drinking water intakes, such restoration activities could contribute
 42 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 43 DOC could necessitate changes in water treatment plant operations or require treatment plant
 44 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 45 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

1 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 3 would be similar to
 2 those discussed for Alternative 1A. Similar to the discussion for Alternative 1A, this impact is
 3 considered to be significant and mitigation is required. It is uncertain whether implementation of
 4 Mitigation Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence,
 5 this impact remains significant and unavoidable.

6 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 7 **Effects on Municipal Intakes**

8 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

9 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 10 **(CM1)**

11 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 3 would be the same as those
 12 discussed for Alternative 1A and are considered to not be adverse.

13 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 3 would be the same as those
 14 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 15 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 16 this constituent. For additional details on the effects assessment findings that support this CEQA
 17 impact determination, see the effects assessment discussion under Alternative 1A.

18 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 19 (water facilities and operations) under Alternative 3, relative to Existing Conditions, would not be
 20 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 21 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
 22 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 23 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 24 related regulations.

25 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 26 a shift in the Delta source water percentages under this alternative or substantial degradation of
 27 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
 28 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 29 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 30 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 31 and livestock-related uses, would continue under this alternative.

32 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
 33 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
 34 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
 35 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
 36 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
 37 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
 38 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

39 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 40 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 41 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 42 expected to increase substantially, no long-term water quality degradation for pathogens is

1 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 2 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
 3 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 4 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 5 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 6 considered to be less than significant. No mitigation is required.

7 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

8 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 3 would be the same as those
 9 discussed for Alternative 1A and are considered to not be adverse.

10 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 11 under Alternative 1A. As such, effects on pathogens resulting from the implementation of CM2–
 12 CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered
 13 to be less than significant. No mitigation is required.

14 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 15 **Maintenance (CM1)**

16 ***Upstream of the Delta***

17 For the same reasons stated for the No Action Alternative, under Alternative 3, no specific
 18 operations or maintenance activity of the SWP or CVP would substantially drive a change in
 19 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
 20 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on
 21 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
 22 Joaquin Rivers.

23 Under Alternative 3, winter (November–March) and summer (April–October) season average flow
 24 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
 25 and the San Joaquin River at Vernalis would change. Relative to existing condition and No Action
 26 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 7% during
 27 the summer and 2% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River,
 28 average flow rates would decrease no more than 14% during the summer, but would increase by as
 29 much as 18% in the winter. Similarly, American River average flow rates would decrease by as much
 30 as 16% in the summer but would increase by as much as 6% in the winter. Seasonal average flow
 31 rates on the San Joaquin River would decrease by as much as 12% in the summer, but increase by as
 32 much as 1% in the winter. For the same reasons stated for the No Action Alternative, decreased
 33 seasonal average flow of $\leq 16\%$ is not considered to be of sufficient magnitude to substantially
 34 increase pesticide concentrations or alter the long-term risk of pesticide-related toxicity to aquatic
 35 life, nor adversely affect other beneficial uses of water bodies upstream of the Delta.

36 ***Delta***

37 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 38 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 39 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

40 Under Alternative 3, the distribution and mixing of Delta source waters would change. Percentage
 41 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–

1 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 2 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 3 fractions. Relative to Existing Conditions, under Alternative 3 modeled San Joaquin River fractions
 4 would increase greater than 10% at (not including Banks and Jones, discussed below) Rock Slough
 5 and Contra Costa PP No. 1 (Appendix 8D, *Source Water Fingerprinting Results*). At Rock Slough, San
 6 Joaquin River source water fractions when modeled for the 16-year hydrologic period would
 7 increase 11% during March, while at Contra Costa PP No. 1 San Joaquin River source water fractions
 8 when modeled for the 16-year hydrologic period would increase 14% during March. Corresponding
 9 increases for the modeled drought period would not be greater than 7% at Rock Slough or Contra
 10 Costa PP No. 1. Relative to Existing Conditions, there would be no modeled increases in Sacramento
 11 River fractions greater than 10% (with exception to Banks and Jones which are discussed below)
 12 and Delta agricultural fractions greater than 7%. These modeled changes in the source water
 13 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
 14 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
 15 other beneficial uses of the Delta.

16 When compared to the No Action Alternative, changes in source water fractions would be similar in
 17 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
 18 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
 19 Joaquin River fractions would increase 13% in July and 24% in August when compared to No Action
 20 Alternative (Appendix 8D, *Source Water Fingerprinting Results*). These increases would primarily
 21 balance through decreases in Sacramento River water and eastside tributary waters. Nevertheless,
 22 the San Joaquin River would only account for 37% of the total source water volume at Buckley Cove
 23 in July and August during the modeled drought period. As such, these modeled changes in the source
 24 water fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient
 25 magnitude to substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor
 26 adversely affect other beneficial uses of the Delta.

27 ***SWP/CVP Export Service Areas***

28 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 29 the Banks and Jones pumping plants. Under Alternative 3, Sacramento River source water fractions
 30 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
 31 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
 32 pumping plant, Sacramento source water fractions would generally increase from 12–34% for the
 33 period of January through June (12–22% for March through May of the modeled drought period)
 34 and at Jones pumping plant Sacramento source water fractions would generally increase from 18–
 35 39% for the period of January through June (12–36% for February through June of the modeled
 36 drought period). These increases in Sacramento source water fraction would primarily balance
 37 through equivalent decreases in San Joaquin River water. Based on the general observation that San
 38 Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP insecticides in
 39 terms of greater frequency of incidence and presence at concentrations exceeding water quality
 40 benchmarks, modeled increases in Sacramento River fraction at Banks and Jones would generally
 41 represent an improvement in export water quality respective to pesticides.

42 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
 43 American, and San Joaquin Rivers, under Alternative 3 relative to the No Action Alternative, are of
 44 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
 45 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.

1 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
2 substantially alter the long-term risk of pesticide-related water quality degradation and related
3 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
4 operations and maintenance (CM1) are determined not to be adverse.

5 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
6 provided above are summarized here, and are then compared to the CEQA thresholds of significance
7 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
8 constituent. For additional details on the effects assessment findings that support this CEQA impact
9 determination, see the effects assessment discussion that immediately precedes this conclusion.

10 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
11 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
12 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
13 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
14 substantially increase the long-term risk of pesticide-related water quality degradation and related
15 toxicity to aquatic life in these water bodies upstream of the Delta.

16 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
17 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
18 and maintenance activities would not affect these sources, changes in Delta source water fraction
19 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
20 Alternative 3, however, modeled changes in source water fractions relative to Existing Conditions
21 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
22 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
23 any other beneficial uses of Delta waters.

24 The assessment of Alternative 3 effects on pesticides in the SWP/CVP Export Service Areas is based
25 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
26 effects to pesticides in the Delta, modeled changes in source water fractions at the Banks and Jones
27 pumping plants are of insufficient magnitude to substantially alter the long-term risk of pesticide-
28 related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies of the
29 SWP and CVP export service area.

30 Based on the above, Alternative 3 would not result in any substantial change in long-term average
31 pesticide concentration or result in substantial increase in the anticipated frequency with which
32 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
33 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
34 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
35 affected environment, and while some of these pesticides may be bioaccumulative, those present-
36 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
37 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
38 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
39 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
40 throughout the affected environment that name pesticides as the cause for beneficial use
41 impairment, the modeled changes in upstream river flows and Delta source water fractions would
42 not be expected to make any of these beneficial use impairments measurably worse. Because long-
43 term average pesticide concentrations are not expected to increase substantially, no long-term
44 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse

1 effects on beneficial uses would occur. This impact is considered to be less than significant. No
2 mitigation is required.

3 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 4 **CM21**

5 **NEPA Effects:** CM2–CM21 proposed under Alternative 3 would be the same as those proposed
6 under Alternative 1A. As such, effects on pesticides resulting from the implementation of CM2–
7 CM21 would be similar to those previously discussed for Alternative 1A. In summary, CM13
8 proposes the use of herbicides to control invasive aquatic vegetation around habitat restoration
9 sites. Herbicides directly applied to water could include adverse effects on non-target aquatic life,
10 such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life toxicity objectives
11 could be exceeded with sufficient frequency and magnitude such that beneficial uses would be
12 impacted, thus constituting an adverse effect on water quality.

13 In summary, based on the discussion above, the effects on pesticides from implementing CM2–CM21
14 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
15 effect.

16 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 3 are similar to those
17 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
18 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
19 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
20 that would be less than significant.

21 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management** 22 **Strategies**

23 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

24 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 25 **and Maintenance (CM1)**

26 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
27 of the affected environment under Alternative 3 would be very similar (i.e., nearly the same) to
28 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
29 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
30 3, which are considered to be not adverse.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
32 provided above are summarized here, and are then compared to the CEQA thresholds of significance
33 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
34 constituent. For additional details on the effects assessment findings that support this CEQA impact
35 determination, see the effects assessment discussion that immediately precedes this conclusion.

36 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
37 because changes in flows do not necessarily result in changes in concentrations or loading of
38 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
39 Delta are not anticipated for Alternative 3, relative to Existing Conditions.

1 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
 2 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
 3 long term-average basis under Alternative 3, relative to Existing Conditions. Algal growth rates are
 4 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
 5 that may occur at some locations and times within the Delta would be expected to have little effect
 6 on primary productivity in the Delta.

7 The assessment of effects of phosphorus under Alternative 3 in the SWP and CVP Export Service
 8 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
 9 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
 10 anticipated to change substantially on a long term-average basis.

11 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
 12 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 13 CVP and SWP service areas under Alternative 3 relative to Existing Conditions. As such, this
 14 alternative is not expected to cause additional exceedance of applicable water quality
 15 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 16 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 17 are not expected to increase substantially, no long-term water quality degradation is expected to
 18 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 19 within the affected environment and thus any minor increases that may occur in some areas would
 20 not make any existing phosphorus-related impairment measurably worse because no such
 21 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 22 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 23 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 24 than significant. No mitigation is required.

25 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
 26 **CM2–CM21**

27 *NEPA Effects:* Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
 28 environment under Alternative 3 would be very similar (i.e., nearly the same) to those discussed for
 29 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 30 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
 31 effects of these same actions under Alternative 3, which are considered to be not adverse.

32 *CEQA Conclusion:* CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 33 under Alternative 1A. As such, effects on phosphorus resulting from the implementation of CM2–
 34 CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered
 35 to be less than significant. No mitigation is required.

36 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 37 **Maintenance (CM1)**

38 ***Upstream of the Delta***

39 For the same reasons stated for the No Action Alternative, Alternative 3 would have negligible, if
 40 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 41 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 42 concentrations that could occur in the water bodies of the affected environment upstream of the

1 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
2 beneficial uses or substantially degrade the quality of these water bodies, with regard to selenium.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
10 information.

11 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
12 locations under Alternative 3, relative to Existing Conditions and the No Action Alternative, are
13 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-13 and M-23 for most biota
14 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
15 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
16 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
17 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
18 water at each modeled assessment location for all years. Appendix 8M, Figure M-21 provides more
19 detail in the form of monthly patterns of selenium concentrations in water during the modeling
20 period.

21 Alternative 3 would result in small changes in average selenium concentrations in water at all
22 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
23 (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some interior and
24 western Delta locations would increase by 0.01 µg/L for the entire period modeled (1976–1991).
25 These small increases in selenium concentrations in water would result in small reductions (1% or
26 less) in available assimilative capacity for selenium, relative to the 1.3 µg/L USEPA draft water
27 quality criterion (Figures 8-59a and 8-60a). The long-term average selenium concentrations in
28 water for Alternative 3 (range 0.09–0.38 µg/L) would be similar to those for Existing Conditions
29 (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and all would be
30 below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

31 Relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in very
32 small changes (less than 1%) in estimated selenium concentrations in most biota (whole-body fish,
33 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout the Delta, with little
34 difference among locations (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*, Table M-23).
35 Level of Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern
36 benchmarks) for selenium concentrations in those biota for all years and for drought years are less
37 than 1.0 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
38 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
39 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
40 predicted to increase by about 7% relative to Existing Conditions and to the No Action Alternative in
41 all years (from about 4.7 to 5.0 mg/kg dry weight), and those for sturgeon in the Sacramento River
42 at Mallard Island are predicted to increase by about 4% in all years (from about 4.4 to 4.6 mg/kg dry
43 weight) (Appendix 8M, Tables M-30 and M-31). Selenium concentrations in sturgeon during drought
44 years are expected to increase by only 2% or 3% at those locations (Appendix 8M, Tables M-30 and

1 M-31). Detection of small changes in whole-body sturgeon such as those estimated for the western
2 Delta would require very large sample sizes because of the inherent variability in fish tissue
3 selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium concentrations
4 in sturgeon in the western Delta would exceed 1.0 (indicating a higher probability for adverse
5 effects) for drought years at both locations (as they do for Existing Conditions and the No Action
6 Alternative); however, for the entire period modeled, the quotient would not be exceeded at either
7 location (Appendix 8M, Table M-32).

8 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
9 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
10 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
11 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
12 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
13 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
14 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
15 the two western Delta locations and used literature-derived uptake factors and trophic transfer
16 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
17 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
18 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
19 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
20 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
21 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
22 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
23 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
24 waterborne selenium concentration at the two locations in different time periods.

25 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
26 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
27 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
28 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
29 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
30 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
31 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
32 most areas of the Delta.

33 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
34 Alternative 3 would be greater in the East Delta than in other sub-regions. Relative to Existing
35 Conditions, annual average residence times for Alternative 3 in the East Delta are expected to
36 increase by more than 15 days (Table 8-60a). Relative to the No Action Alternative, annual average
37 residence times for Alternative 3 in the East Delta are expected to increase by less than 9 days.
38 Increases in residence times for other sub-regions would be smaller, especially as compared to
39 Existing Conditions and the No Action Alternative (which are longer than those modeled for the
40 South Delta). As mentioned above, these results incorporate hydrodynamic effects of both CM1 and
41 CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of CM2 and CM4.
42 However, it is expected that CM2 and CM4 are substantial drivers of the increased residence time.

43 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
44 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
45 concentrations in particulates, as the lowest level of the food chain, relative to the waterborne

1 concentration], and associated tissue concentrations [especially in clams and their consumers, such
2 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
3 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
4 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
5 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
6 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

7 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
8 as related to residence time, but the effects of residence time are incorporated in the
9 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
10 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
11 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
12 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
13 concentrations are currently low and not approaching thresholds of concern (which, as discussed
14 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
15 residence time alone would not be expected to cause them to then approach or exceed thresholds of
16 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
17 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
18 sparse, the most likely area in which biota tissues would be at levels high enough that additional
19 bioaccumulation due to increased residence time from restoration areas would be a concern is the
20 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
21 increase in residence time estimated in the western Delta is 6 days relative to Existing Conditions,
22 and 4 days relative to the No Action Alternative. Given the available information, these increases are
23 small enough that they are not expected to substantially affect selenium bioaccumulation in the
24 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
25 residence times, further discussion is included in Impact WQ-26 below.

26 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 3 would
27 result in essentially no change in selenium concentrations throughout the Delta for most biota (less
28 than 1%), although increases in selenium concentrations are predicted for sturgeon in the western
29 Delta. Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a
30 low potential for effects. The modeling of bioaccumulation for sturgeon is less calibrated to site-
31 specific conditions than that for other biota, which was calibrated on a robust dataset for modeling
32 of bioaccumulation in largemouth bass as a representative species for the Delta. Overall, Alternative
33 3 would not be expected to substantially increase the frequency with which applicable benchmarks
34 would be exceeded in the Delta (there being only a small increase for sturgeon relative to the low
35 benchmark and no exceedance of the high benchmark) or substantially degrade the quality of water
36 in the Delta, with regard to selenium.

37 ***SWP/CVP Export Service Areas***

38 Alternative 3 would result in small (0.04 µg/L) decreases in long-term average selenium
39 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
40 the No Action Alternative, for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a).
41 These decreases in long-term average selenium concentrations in water would result in increases in
42 available assimilative capacity for selenium at these pumping plants of 4%, relative to the 1.3 µg/L
43 USEPA draft water quality criterion (Figures 8-59a and 8-60a). Furthermore, the modeled selenium
44 concentrations in water for Alternative 3 (range 0.17–0.24 µg/L) would be below the USEPA draft
45 water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

1 Relative to Existing Conditions and the No Action Alternative, Alternative 3 would result in very
2 small changes (less than 1%) in estimated selenium concentrations in biota (whole-body fish, bird
3 eggs [invertebrate diet], and fish fillets) (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*,
4 Table M-23) at Banks and Jones pumping plants. Concentrations in biota would not exceed any
5 selenium benchmarks for Alternative 3 (Figures 8-61a through 8-64b).

6 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
7 bioaccumulated in biota) from Alternative 3 are not considered to be adverse.

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
10 Determination of Effects) for the purpose of making the CEQA impact determination for selenium.
11 For additional details on the effects assessment findings that support this CEQA impact
12 determination, see the effects assessment discussion that immediately precedes this conclusion.

13 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
14 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
15 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
16 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
17 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
18 Valley Water Board [2010d] and State Water Board [2010b, 2010c]) that are expected to result in
19 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
20 modified reservoir operations and subsequent changes in river flows under Alternative 3, relative to
21 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
22 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
23 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
24 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
25 water bodies as related to selenium.

26 Relative to Existing Conditions, modeling estimates indicate that Alternative 3 would result in
27 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
28 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
29 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
30 would increase slightly, from 0.94 for Existing Conditions to 1.0 for Alternative 3. Concentrations of
31 selenium in sturgeon would exceed only the lower benchmark during the drought period modeled,
32 indicating a low potential for effects. Overall, Alternative 3 would not be expected to substantially
33 increase the frequency with which applicable benchmarks would be exceeded in the Delta (there
34 being only a small exceedance for sturgeon relative to the low benchmark for sturgeon during the
35 drought period and no exceedance of the high benchmark) or substantially degrade the quality of
36 water in the Delta, with regard to selenium.

37 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
38 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
39 Alternative 3 would cause no increase in the frequency with which applicable benchmarks would be
40 exceeded and would slightly improve the quality of water in selenium concentrations at the Banks
41 and Jones pumping plants.

42 Based on the above, selenium concentrations that would occur in water under Alternative 3 would
43 not cause additional exceedances of applicable state or federal numeric or narrative water quality
44 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment

(Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to one or more beneficial uses within affected water bodies. In comparison to Existing Conditions, water quality conditions under this alternative would not increase levels of selenium by frequency, magnitude, and geographic extent such that the affected environment would be expected to have measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans consuming those organisms. Water quality conditions under this alternative with respect to selenium would not cause long-term degradation of water quality in the affected environment, and therefore would not result in use of available assimilative capacity such that exceedances of water quality objectives/criteria would be likely and would result in substantially increased risk for adverse effects to one or more beneficial uses. This alternative would not further degrade water quality by measurable levels, on a long-term basis, for selenium and, thus, cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly worse. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–CM21

NEPA Effects: Effects of CM2–CM21 on selenium under Alternative 3 would be the same as those discussed for Alternative 1A and are considered not to be adverse.

CEQA Conclusion: CM2–CM21 proposed under Alternative 3 would be similar to those proposed under Alternative 1A. As such, effects on selenium resulting from the implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations and Maintenance (CM1)

Upstream of the Delta

For the same reasons stated for the No Action Alternative, Alternative 3 would result in negligible, and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an annual and long-term average basis. As such, Alternative 3 would not be expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in water bodies of the affected environment located upstream of the Delta or substantially degrade the quality of these water bodies, with regard to trace metals.

Delta

For the same reasons stated for the No Action Alternative, Alternative 3 would not result in substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities are expected to be negligible, on a long-term average basis. As such, Alternative 3 would not be expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 3 would not result in
3 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
4 from the Sacramento River through the proposed conveyance facilities. As such, there is not
5 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
6 area waters under Alternative 3, relative to Existing Conditions and the No Action Alternative. As
7 such, Alternative 3 would not be expected to substantially increase the frequency with which
8 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
9 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to trace metals.

11 **NEPA Effects:** In summary, Alternative 3, relative to the No Action Alternative, would not cause a
12 substantial increase in long-term average trace metals concentrations within the affected
13 environment, nor would it cause an increased frequency of water quality objective/criteria
14 exceedances within the affected environment. The effect on trace metals is determined not to be
15 adverse.

16 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 3 would be similar to those
17 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
18 significance (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA
19 impact determination for this constituent. For additional details on the effects assessment findings
20 that support this CEQA impact determination, see the effects assessment discussion under
21 Alternative 1A.

22 While greater water demands under the Alternative 3 would alter the magnitude and timing of
23 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
24 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
25 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
26 therefore, changes in river flows would not be expected to cause a substantial long-term change in
27 trace metal concentrations upstream of the Delta.

28 Average and 95th percentile trace metal concentrations are very similar across the primary source
29 waters to the Delta. Given this similarity, very large changes in source water fraction would be
30 necessary to effect a relatively small change in trace metal concentration at a particular Delta
31 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
32 waters are all below their respective water quality criteria, including those that are hardness-based
33 without a WER adjustment. No mixing of these three source waters could result in a metal
34 concentration greater than the highest source water concentration, and given that trace metals do
35 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
36 not be expected to occur under the Alternative 3.

37 The assessment of the Alternative 3 effects on trace metals in the SWP/CVP Export Service Areas is
38 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
39 As just discussed regarding similarities in Delta source water trace metal concentrations, the
40 Alternative 3 is not expected to result in substantial changes in trace metal concentrations in Delta
41 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
42 in the SWP/CVP Export Service Area are expected to be negligible.

1 Based on the above, there would be no substantial long-term increase in trace metal concentrations
2 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
3 service area waters under Alternative 3 relative to Existing Conditions. As such, this alternative is
4 not expected to cause additional exceedance of applicable water quality objectives by frequency,
5 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
6 in the affected environment. Because trace metal concentrations are not expected to increase
7 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
8 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
9 trace metal concentrations that may occur in water bodies of the affected environment would not be
10 expected to make any existing beneficial use impairments measurably worse. The trace metals
11 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
12 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
13 significant. No mitigation is required.

14 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 15 **CM2–CM21**

16 *NEPA Effects:* CM2–CM21 proposed under Alternative 3 would be the same as those proposed
17 under Alternative 1A. As such, effects on trace metals resulting from the implementation of CM2–
18 CM21 would be similar to those previously discussed for Alternative 1A. As they pertain to trace
19 metals, implementation of CM2–CM21 would not be expected to adversely affect beneficial uses of
20 the affected environment or substantially degrade water quality with respect to trace metals.

21 In summary, implementation of CM2–CM21 under Alternative 3, relative to the No Action
22 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
23 metals from implementing CM2–CM21 is determined not to be adverse.

24 *CEQA Conclusion:* Implementation of CM2–CM21 under Alternative 3 would not cause substantial
25 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
26 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
27 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
28 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
29 environment. Because trace metal concentrations are not expected to increase substantially, no
30 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
31 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
32 concentrations that may occur throughout the affected environment would not be expected to make
33 any existing beneficial use impairments measurably worse. The trace metals discussed in this
34 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
35 problems in aquatic life or humans. This impact is considered to be less than significant. No
36 mitigation is required.

37 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 38 **Maintenance (CM1)**

39 *NEPA Effects:* Effects of CM1 on TSS and turbidity under Alternative 3 would be the same as those
40 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
41 to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 3 would be similar to those
 2 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 3 significance (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA
 4 impact determination for this constituent. For additional details on the effects assessment findings
 5 that support this CEQA impact determination, see the effects assessment discussion under
 6 Alternative 1A.

7 Changes river flow rate and reservoir storage that would occur under Alternative 3, relative to
 8 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
 9 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 10 suspended sediment concentrations are more affected by season than flow. Site-specific and
 11 temporal exceptions may occur due to localized temporary construction activities, dredging
 12 activities, development, or other land use changes would be site-specific and temporal, which would
 13 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 14 than substantial levels.

15 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 16 usually gradual, occurring over years, and high storm event inflows would not be substantially
 17 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 18 would not be substantially different from the levels under Existing Conditions. Consequently, this
 19 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 20 region, relative to Existing Conditions.

21 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 22 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 3, relative to Existing
 23 Conditions, because this alternative is not expected to result in substantial changes in TSS
 24 concentrations and turbidity levels at the south Delta export pumps, relative to Existing Conditions.

25 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 26 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 27 concentrations and turbidity levels are not expected to be substantially different, long-term water
 28 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 29 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act Section 303(d)
 30 listed constituents. This impact is considered to be less than significant. No mitigation is required.

31 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

32 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 3 would be the same as
 33 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
 34 is determined to not be adverse.

35 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 3 would be similar to those proposed
 36 under Alternative 1A. As such, effects on TSS and turbidity resulting from the implementation of
 37 CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 38 considered to be less than significant. No mitigation is required.

39 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 40 **(CM1–CM21)**

41 **NEPA Effects:** The conveyance features for CM1 under Alternative 3 would be very similar to those
 42 discussed for Alternative 1A. The primary difference between Alternative 3 and Alternative 1A is

1 that under Alternative 3, there would be three fewer intakes and three fewer pumping plants
 2 constructed, which would result reduce the level of construction activity. However, construction
 3 techniques and locations of major features of the conveyance system within the Delta would be
 4 similar. The remainder of the facilities constructed under Alternative 3, including CM2–CM21, would
 5 be very similar to, or the same as, those to be constructed for Alternative 1A.

6 The types and magnitude of potential construction-related water quality effects associated with
 7 implementation of CM1 under Alternative 3 would be very similar to the effects discussed for
 8 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
 9 identical. Nevertheless, the construction of CM1, and any individual components necessitated by
 10 CM2, and CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 11 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements would result
 12 in the potential water quality effects being largely avoided and minimized. The specific
 13 environmental commitments that would be implemented under Alternative 3 would be similar to
 14 those described for Alternative 1A. Consequently, relative to the No Action Alternative, Alternative 3
 15 would not be expected to cause exceedance of applicable water quality objectives/criteria or
 16 substantial water quality degradation with respect to constituents of concern, and thus would not
 17 adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP
 18 service area.

19 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 20 construction-related water quality effects are considered to be not adverse.

21 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 3
 22 for construction-related activities along with agency-issued permits that also contain construction
 23 requirements to protect water quality, the construction-related effects, relative to Existing
 24 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 25 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 26 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 27 water quality with respect to the constituents of concern on a long-term average basis, and thus
 28 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 29 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 30 would be temporary and intermittent in nature, the construction would involve negligible
 31 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 32 environment. As such, construction activities would not contribute measurably to bioaccumulation
 33 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 34 Based on these findings, this impact is determined to be less than significant. No mitigation is
 35 required.

36 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 37 **and Maintenance (CM1)**

38 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
 39 concentrations, in water bodies of the affected environment under Alternative 3 would be very
 40 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
 41 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
 42 Services Areas under Alternative 1A would similarly change under Alternative 3, relative to Existing
 43 Conditions and the No Action Alternative. For the Delta in particular, there are differences in the
 44 direction and magnitude of water residence time changes during the *Microcystis* bloom period

1 among the six Delta sub-regions under Alternative 3 compared to Alternative 1A, relative to Existing
2 Conditions and No Action Alternative. However, under Alternative 3, relative to Existing Conditions
3 and No Action Alternative, water residence times during the *Microcystis* bloom period in various
4 Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A, lead to
5 an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout
6 the Delta.

7 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
8 would occur in the Delta under Alternative 3, which could lead to earlier occurrences of *Microcystis*
9 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
10 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
11 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
12 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative 3
13 may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
14 because water temperatures will increase in the Export Service Areas due to the expected increase
15 in ambient air temperatures resulting from climate change.

16 **NEPA Effects:** Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
17 affected environment under Alternative 3 would be very similar to (i.e., nearly the same) to those
18 discussed for Alternative 1A. In summary, Alternative 3 operations and maintenance, relative to the
19 No Action Alternative, would result in long-term increases in hydraulic residence time of various
20 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
21 increased residence time could result in a concurrent increase in the frequency, magnitude, and
22 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
23 As a result, Alternative 3 operation and maintenance activities would cause further degradation to
24 water quality with respect to *Microcystis* in the Delta. Under Alternative 3, relative to No Action
25 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
26 affected source water from the south Delta intakes and unaffected source water from the
27 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
28 and maintenance under Alternative 3 will result in increased or decreased levels of *Microcystis* and
29 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
30 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
31 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
32 *Microcystis* from implementing CM1 is determined to be adverse.

33 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
34 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
35 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
36 constituent. For additional details on the effects assessment findings that support this CEQA impact
37 determination, see the effects assessment discussion that immediately precedes this conclusion.

38 Under Alternative 3, additional impacts from *Microcystis* in the reservoirs and watersheds upstream
39 of the Delta are not expected, relative to Existing Conditions. Operations and maintenance occurring
40 under Alternative 3 is not expected to change nutrient levels in upstream reservoirs or
41 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
42 conducive to *Microcystis* production.

43 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
44 expected to increase under Alternative 3, resulting in an increase in the frequency, magnitude and

1 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
2 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
3 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
4 throughout the Delta during the summer and fall bloom period, due in small part to climate change
5 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
6 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
7 production expected within any Delta sub-region is unknown because conditions will vary across
8 the complex networks of intertwining channels, shallow back water areas, and submerged islands
9 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
10 to Alternative 3. Consequently, it is possible that increases in the frequency, magnitude, and
11 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
12 maintenance of Alternative 3 and the hydrodynamic impacts of restoration (CM2 and CM4).

13 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
14 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
15 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
16 Under Alternative 3, relative to Existing Conditions, the potential for *Microcystis* to occur in the
17 Export Service Area is expected to increase due to increasing water temperature, but this impact is
18 driven entirely by climate change and not Alternative 3. Water exported from the Delta to the Export
19 Service Area is expected to be a mixture of *Microcystis*-affected source water from the south Delta
20 intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
21 determined whether operations and maintenance under Alternative 3, relative to existing
22 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
23 of source waters exported from Banks and Jones pumping plants.

24 Based on the above, this alternative would not be expected to cause additional exceedance of
25 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
26 would cause significant impacts on any beneficial uses of waters in the affected environment.
27 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
28 increases that could occur in some areas would not make any existing *Microcystis* impairment
29 measurably worse because no such impairments currently exist. However, because it is possible that
30 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
31 occur due to the operations and maintenance of Alternative 3 and the hydrodynamic impacts of
32 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
33 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
34 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
35 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
36 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
37 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
38 the effects on *Microcystis* from implementing CM1 is determined to be significant.

39 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
40 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
41 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
42 remain significant and unavoidable.

1 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 2 ***Microcystis* Blooms**

3 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

4 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 5 **Water Residence Time**

6 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

7 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 8 **Measures (CM2–CM21).**

9 The effects of CM2–CM21 on *Microcystis* under Alternative 3 would be the same as those discussed
 10 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
 11 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
 12 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters.
 13 Because the hydrodynamic effects associated with implementing CM2 and CM4 were incorporated
 14 into the modeling used to assess CM1, a detailed assessment of the effects of implementing CM2 and
 15 CM4 on *Microcystis* blooms in the Delta via their effects on Delta water residence time is provided
 16 under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation
 17 of Mitigation Measures WQ-32a. The effectiveness of the mitigation measure to result in feasible
 18 measures for reducing water quality effects is uncertain. CM3 and CM5–CM21 would not result in an
 19 increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta.

20 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 3 would be the same as those
 21 discussed for Alternative 1A and are considered to be adverse.

22 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
 23 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 24 extent that would cause significant impacts on any beneficial uses of waters in the affected
 25 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 26 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 27 impairment measurably worse because no such impairments currently exist. Because restoration
 28 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
 29 create local areas of warmer water during the bloom season, it is possible that increases in the
 30 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
 31 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
 32 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 33 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 34 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 35 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
 36 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 37 determined to be significant.

38 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 39 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 40 measures for reducing water quality effects is uncertain, this impact is considered to remain
 41 significant and unavoidable.

1 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 2 ***Microcystis* Blooms**

3 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

4 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 5 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

6 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 7 that Alternative 3 would have a less than significant impact/no adverse effect on the following
 8 constituents in the Delta:

- 9 • Boron
- 10 • Dissolved Oxygen
- 11 • Pathogens
- 12 • Pesticides
- 13 • Trace Metals
- 14 • Turbidity and TSS

15 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 16 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 17 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 18 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 19 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 20 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 21 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 22 quality of the of San Francisco Bay.

23 The effects of Alternative 3 on bromide, chloride, and DOC in the Delta were determined to be
 24 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 25 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 26 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 27 adversely affect any beneficial uses of San Francisco Bay.

28 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
 29 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
 30 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
 31 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
 32 which would be the primary driver of salinity changes, would be two to three orders of magnitude
 33 lower than (and thus minimal compared to) the Bay's tidal flow.

34 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
 35 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
 36 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
 37 Suisun Bay.

1 While effects of Alternative 3 on the nutrients ammonia, nitrate, and phosphorus were determined
2 to be less than significant/not adverse, these constituents are addressed further below because the
3 response of the seaward bays to changed nutrient concentrations/loading may differ from the
4 response of the Delta. Selenium and mercury are discussed further, because they are
5 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
6 and exports are of concern.

7 ***Nutrients: Ammonia, Nitrate, and Phosphorus***

8 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 3 would be
9 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
10 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
11 decrease by 33%, relative to Existing Conditions, and decrease by 9%, relative to the No Action
12 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
13 Suisun and San Pablo Bays under Alternative 3 would not adversely impact primary productivity in
14 these embayments because light limitation and grazing currently limit algal production in these
15 embayments. To the extent that algal growth increases in relation to a change in ammonia
16 concentration, this would have net positive benefits, because current algal levels in these
17 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
18 cyanobacteria levels in the North Bay.

19 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 3 is
20 estimated to decrease by 1%, relative to Existing Conditions and by 6% relative to the No Action
21 Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus loads to
22 Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary
23 productivity. However, there is uncertainty regarding the impact of nutrient ratios on
24 phytoplankton community composition and abundance. Any effect on phytoplankton community
25 composition would likely be small compared to the effects of grazing from introduced clams and
26 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
27 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
28 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
29 would result in adverse effects to beneficial uses.

30 ***Mercury***

31 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
32 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
33 are estimated to change relatively little due to changes in source water fractions and net Delta
34 outflow that would occur under Alternative 3. Mercury load to the Bay is estimated to decrease by 2
35 kg/year (1%), relative to Existing Conditions, and to decrease by 5 kg/year (2%), relative to the No
36 Action Alternative. Methylmercury load is estimated to decrease by 0.04 kg/year (1%), relative to
37 Existing Conditions, and by 0.13 kg/year (4%) relative to the No Action Alternative. The estimated
38 total mercury load to the Bay is 258 kg/year, which would be less than the San Francisco Bay
39 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
40 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
41 term average net Delta outflow and the long-term average mercury and methylmercury
42 concentrations in Delta source waters. The estimated changes in mercury load under the alternative
43 would also be substantially less than the considerable differences among estimates in the current

1 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
2 David et al. 2009).

3 Given that the estimated incremental increases of mercury and methylmercury loading to San
4 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
5 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
6 Francisco Bay due to Alternative 3 are not expected to result in adverse effects to beneficial uses or
7 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
8 303(d) impairment measurably worse.

9 **Selenium**

10 Changes in source water fraction and net Delta outflow under Alternative 3, relative to Existing
11 Conditions, are projected to cause the total selenium load to the North Bay to increase by 1%,
12 relative to Existing Conditions, and decrease by 2%, relative to the No Action Alternative (Appendix
13 80, Table O-3). Changes in long-term average selenium concentrations of the North Bay are assumed
14 to be proportional to changes in North Bay selenium loads. Under Alternative 3, the long-term
15 average total selenium concentration of the North Bay is estimated to be 0.13 µg/L and the dissolved
16 selenium concentration is estimated to be 0.11 µg/L, which would be the same as Existing
17 Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved selenium
18 concentration would be below the target of 0.202 µg/L developed by Presser and Luoma (2013) to
19 coincide with a white sturgeon whole-body fish tissue selenium concentration not greater than 8
20 mg/kg in the North Bay. The incremental increase in dissolved selenium concentrations in the North
21 Bay, relative to Existing Conditions, would be negligible (0.00 µg/L) under this alternative. Thus, the
22 estimated changes in selenium loads in Delta exports to San Francisco Bay due to Alternative 3 are
23 not expected to result in adverse effects to beneficial uses or substantially degrade the water quality
24 with regard to selenium, or make the existing CWA Section 303(d) impairment measurably worse.

25 **NEPA Effects:** Based on the discussion above, Alternative 3, relative to the No Action Alternative,
26 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
27 DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia, nitrate, phosphorus), trace
28 metals, or turbidity and TSS in the San Francisco Bay. Further, changes in these constituent
29 concentrations in Delta outflow would not be expected to cause changes in Bay concentrations of
30 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses. In
31 summary, based on the discussion above, effects on the San Francisco Bay from implementation of
32 CM1–CM21 are considered to be not adverse.

33 **CEQA Conclusion:** Based on the above, Alternative 3 would not be expected to cause long-term
34 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
35 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
36 would result in substantially increased risk for adverse effects to one or more beneficial uses.
37 Further, based on the above, this alternative would not be expected to cause additional exceedance
38 of applicable water quality objectives/criteria in the San Francisco Bay by frequency, magnitude,
39 and geographic extent that would cause significant impacts on any beneficial uses of waters in the
40 affected environment. Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay
41 would not adversely affect beneficial uses, because the uses most affected by changes in these
42 parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial changes in DO,
43 pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta, relative to
44 Existing Conditions; therefore, no substantial changes these constituents' levels in the Bay are

1 anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay salinity, as
 2 the change in Delta outflow would two to three orders of magnitude lower than (and thus minimal
 3 compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in the Delta
 4 would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant of the
 5 Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 33%
 6 decrease in total nitrogen load and 1% decrease in phosphorus load, relative to Existing Conditions,
 7 are expected to have minimal effect on water quality degradation, primary productivity, or
 8 phytoplankton community composition. The estimated reduction in mercury load (2 kg/year; 1%)
 9 and methylmercury load (0.04 kg/year; 1%), relative to Existing Conditions, is within the level of
 10 uncertainty in the mass load estimate and not expected to contribute to water quality degradation,
 11 make the CWA Section 303(d) mercury impairment measurably worse or cause
 12 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
 13 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
 14 load would be 1%, but estimated total and dissolved selenium concentrations under this alternative
 15 would be the same as Existing Conditions, and less than the target associated with white sturgeon
 16 whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium load is not
 17 expected to contribute to water quality degradation, or make the CWA Section 303(d) selenium
 18 impairment measurably worse or cause selenium to bioaccumulate to greater levels in aquatic
 19 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 20 is considered to be less than significant.

21 **8.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel** 22 **and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)**

23 Alternative 4 would comprise physical/structural components similar to those under Alternative
 24 1A; however, there are notable differences. Alternative 4 would convey up to 9,000 cfs of water from
 25 the north Delta to the south Delta and that Alternative 4 would include an operable barrier at the
 26 head of Old River. Diverted water would be conveyed through pipelines/tunnels from three
 27 screened intakes (i.e., Intakes 2, 3, and 5) located on the east bank of the Sacramento River between
 28 Clarksburg and Courtland. Alternative 4 would include a 243-acre intermediate forebay at Glannvale
 29 Tract. Clifton Court Forebay would be dredged and expanded by approximately 690 acres to the
 30 southeast of the existing forebay. Water supply and conveyance operations would follow the
 31 guidelines described as Scenarios H1, H2, H3, or H4, which variously include or exclude
 32 implementation of Fall X2 and/or enhanced spring outflow. CM2–CM21 would be implemented
 33 under this alternative, and would be the same as those under Alternative 1A. See Chapter 3,
 34 *Description of Alternatives*, Section 3.5.9, for additional details on Alternative 4.

35 **Effects of the Alternative on Delta Hydrodynamics**

36 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
 37 substantially affect water quality within the Delta:

- 38 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 39 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 40 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 41 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 42 decreased exports of San Joaquin River water (due to increased Sacramento River water
 43 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows

1 also can affect water residence time and many related physical, chemical, and biological
2 variables.

- 3 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
4 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
5 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
6 and above normal water years) will decrease levels of these constituents, particularly in the
7 west Delta.

8 Under Alternative 4, over the long term, average annual delta exports are anticipated to range from
9 an increase of 112 TAF under Scenario H1 to a decrease by 730 TAF under Scenario H4 relative to
10 Existing Conditions, and an increase by 815 TAF under Scenario H1 to a decrease of 27 TAF under
11 Scenario H4 relative to the No Action Alternative. Because, over the long-term, between 47%
12 (Scenario H1) and 49% (Scenario H4) of the exported water would be from the new north Delta
13 intakes, average monthly diversions at the south Delta intakes would be decreased because of the
14 shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more information).
15 The result of this would be increased San Joaquin River water influence throughout the south, west,
16 and interior Delta, and a corresponding decrease in Sacramento River water influence. This can be
17 seen, for example, in Appendix 8D, ALT 4, H3–Old River at Rock Slough for ALL years (1976–1991),
18 which shows increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC)
19 percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

20 Under Alternative 4, long-term average annual Delta outflow is anticipated to range from a decrease
21 of 114 TAF under Scenario H1 to an increase 744 TAF under Scenario H4 relative to Existing
22 Conditions, due to both changes in operations (including north Delta intake capacity of 9,000 cfs,
23 Fall X2, and numerous other operational components of Scenarios H1 through H4) and climate
24 change/sea level rise (see Chapter 5, *Water Supply*, for more information). Long-term average
25 annual Delta outflow is anticipated to decrease under Alternative 4 by between 864 (Scenario H1)
26 and 5 TAF (Scenario H4) relative to the No Action Alternative, due only to changes in operations.
27 The result of this is increased sea water intrusion in the west Delta. The increase in sea water
28 intrusion (represented by an increase in San Francisco Bay (BAY) percentage) can be seen, for
29 example, in Appendix 8D, ALT 4, H3–Sacramento River at Mallard Island for ALL years (1976–1991).

30 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 31 **Maintenance (CM1)**

32 ***Upstream of the Delta***

33 Substantial point sources of ammonia-N do not exist upstream of the SRWTP in the Sacramento
34 River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras
35 Rivers), or upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of ammonia-
36 N within the watersheds are also relatively low, thus resulting in generally low ammonia-N
37 concentrations in the reservoirs and rivers of the watersheds. Consequently, any modified reservoir
38 operations and subsequent changes in river flows under Alternative 4 (including the different
39 operational components of Scenarios H1–H4) would have negligible, if any, effect on ammonia
40 concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and
41 the No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur in
42 the water bodies of the affected environment located upstream of the Delta would not be of
43 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
44 substantially degrade the quality of these water bodies, with regard to ammonia.

1 **Delta**

2 As summarized in Table 8-40, it is assumed that SRWTP effluent ammonia concentrations would be
3 substantially lower under Alternative 4 than under Existing Conditions, and would be the same as
4 would occur under the No Action Alternative. Relative to Existing Conditions, ammonia-N
5 concentrations downstream of the SRWTP would be substantially lower under Alternative 4
6 (including the different operational components of Scenarios H1–H4) because it is assumed that
7 SRWTP upgrades would be in place, and thus that the average monthly effluent ammonia-N
8 concentration would not exceed 1.5 mg/L-N in April through October or 2.4 mg/L-N in November
9 through March. Consequently, a substantial decrease in Sacramento River ammonia-N
10 concentrations is expected to decrease ammonia concentrations for all areas of the Delta that are
11 influenced by Sacramento River water. Concentrations of ammonia-N at locations not influenced
12 notably by Sacramento River water will change little relative to Existing Conditions, due to the
13 similarity in SJR and BAY concentrations and the lack of expected changes in either of these
14 concentrations. Thus, Alternative 4 would not result in substantial increases in ammonia
15 concentrations in the Plan Area, relative to Existing Conditions.

16 Because the SRWTP discharge ammonia concentrations are assumed to be the same under
17 Alternative 4 as would occur under the No Action Alternative, the primary mechanism that could
18 potentially increase ammonia concentrations in the Delta under Alternative 4, relative to the No
19 Action Alternative, is decreased flows in the Sacramento River, which would lower dilution available
20 to the SRWTP discharge. This change would be attributable only to operations of Alternative 4, since
21 the same assumptions regarding water demands, climate change, and sea level rise are included in
22 both Alternative 1A and the No Action Alternative.

23 To address this possibility, a simple mixing calculation was performed to assess concentrations of
24 ammonia downstream of the SRWTP discharge (i.e., downstream of Freeport) under Alternative 4
25 and the No Action Alternative. Monthly average CALSIM II flows at Freeport and the upstream
26 ammonia concentration (0.04 mg/L-N; Central Valley Regional Water Quality Control Board
27 2010a:5) were used, together with the SRWTP permitted average dry weather flow (181 mgd) and
28 seasonal ammonia concentration (1.5 mg/L-N in Apr–Oct, 2.4 mg/L-N in Nov–Mar), to estimate the
29 average change in ammonia concentrations downstream of the SRWTP. Table 8-67 shows monthly
30 average and long term annual average predicted concentrations under the two scenarios.

31 As Table 8-67 shows, average monthly ammonia-N concentrations in the Sacramento River
32 downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under the four
33 different operational scenarios of Alternative 4 and under the No Action Alternative are expected to
34 be similar (Table 8-67). In comparison to the No Action Alternative, minor increases in monthly
35 average ammonia-N concentrations would occur during February, July through September, and
36 during November for all operational scenarios (H1 through H4). Under operational Scenario H2 and
37 H4, minor increases in ammonia-N concentrations also would occur in the months of January and
38 March. In the month of December, average ammonia-N concentrations would increase slightly for
39 Scenario H4. Minor decreases in ammonia-N concentrations are expected for all Scenarios (H1
40 through H4) in May and June, while minor decreases would also occur in October under Scenario
41 H1.

42 A minor increase in the annual average concentration would occur under the different operational
43 components of Scenarios H1 through H4 of Alternative 4, compared to the No Action Alternative.
44 Moreover, the estimated concentrations downstream of Freeport under Alternative 4 would be
45 similar to existing source water concentrations for the San Francisco Bay and San Joaquin River.

1 Consequently, changes in source water fraction anticipated under Alternative 4, relative to the No
2 Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta
3 locations.

4 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
5 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
6 beneficial uses or substantially degrade the water quality at these locations, with regards to
7 ammonia.

8 **Table 8-67. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
9 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 4**
10 **Operational Scenarios H1, H2, H3, and H4**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Scenario H1	0.073	0.090	0.068	0.060	0.058	0.060	0.058	0.063	0.062	0.062	0.070	0.076	0.067
Scenario H2	0.074	0.088	0.069	0.061	0.058	0.061	0.058	0.063	0.062	0.062	0.070	0.065	0.066
Scenario H3	0.074	0.090	0.069	0.060	0.058	0.060	0.057	0.062	0.066	0.064	0.071	0.075	0.067
Scenario H4	0.074	0.088	0.070	0.061	0.058	0.061	0.057	0.062	0.066	0.064	0.071	0.065	0.066

11

12 ***SWP/CVP Export Service Areas***

13 The assessment of effects on ammonia in the SWP and CVP Export Service Area is based on
14 assessment of ammonia-N concentrations at Banks and Jones pumping plants. The dominant source
15 waters influencing the Banks and Jones pumping plants are the Sacramento and San Joaquin Rivers
16 (see Appendix 8D, *Source Water Fingerprinting Results*). As discussed above for the Plan Area, for
17 areas of the Delta that are influenced by Sacramento River water, including Banks and Jones
18 pumping plants, ammonia-N concentrations are expected to decrease under Alternative 4, relative
19 to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This
20 decrease in ammonia-N concentrations for water exported via the south Delta pumps is not
21 expected to result in an adverse effect on beneficial uses or substantially degrade water quality of
22 exported water, with regards to ammonia.

23 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
24 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
25 under the four different operational scenarios of Alternative 4, relative to No Action Alternative. Any
26 negligible increases in ammonia-N concentrations that could occur at Banks and Jones pumping
27 plants would not be of frequency, magnitude and geographic extent that would adversely affect any
28 beneficial uses or substantially degrade the water quality at these locations, with regards to
29 ammonia.

30 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
31 of CM1 are considered to be not adverse.

32 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
33 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
34 *Determination of Effects*) for the purpose of making the CEQA impact determination for this

1 constituent. For additional details on the effects assessment findings that support this CEQA impact
2 determination, see the effects assessment discussion that immediately precedes this conclusion.

3 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
4 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
5 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
6 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
7 any modified reservoir operations and subsequent changes in river flows under Alternative 4,
8 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
9 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
10 of the Delta in the San Joaquin River watershed.

11 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
12 substantially lower under Alternative 4 (regardless of operational scenario), relative to Existing
13 Conditions, due to upgrades to the SRWTP that are assumed to be in place, and thus, ammonia
14 concentrations for all areas of the Delta that are influenced by Sacramento River water are expected
15 to decrease. At locations which are not influenced notably by Sacramento River water,
16 concentrations are expected to remain relatively unchanged compared to Existing Conditions, due to
17 the similarity in SJR and BAY concentrations and the lack of expected changes in either of these
18 concentrations.

19 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
20 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
21 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
22 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 4,
23 relative to Existing Conditions.

24 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
25 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
26 CVP and SWP service areas under Alternative 4 relative to Existing Conditions. As such, this
27 alternative is not expected to cause additional exceedance of applicable water quality objectives/
28 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
29 beneficial uses of waters in the affected environment. Because ammonia concentrations are not
30 expected to increase substantially, no long-term water quality degradation is expected to occur and,
31 thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
32 affected environment and thus any minor increases that could occur in some areas would not make
33 any existing ammonia-related impairment measurably worse because no such impairments
34 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
35 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
36 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
37 significant. No mitigation is required.

38 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-** 39 **CM21**

40 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
41 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
42 increased biota in those areas as a result of restored habitat may increase ammonia loading
43 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
44 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be

1 expected to substantially increase ammonia concentrations in the Delta. In general, with the
 2 exception of changes in Delta hydrodynamics resulting from habitat restoration, CM2–CM11 would
 3 not substantially increase ammonia concentrations in the water bodies of the affected environment.
 4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 5 and CM4) would affect Delta hydrodynamics, and thus such effects of these restoration measures
 6 were included in the assessment of CM1 facilities operations and maintenance (see Impact WQ-1).
 7 Additionally, implementation of CM12–CM21 would not be expected to substantially alter ammonia
 8 concentrations in the affected environment.

9 The effects of ammonia from implementation of CM2–CM21 are considered to be not adverse.

10 **CEQA Conclusion:** There would be no substantial, long-term increase in ammonia-N concentrations
 11 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 12 CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions. As
 13 such, implementation of these conservations measures would not be expected to cause additional
 14 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 15 extent that would cause significant impacts on any beneficial uses of waters in the affected
 16 environment. Because ammonia concentrations would not be expected to increase substantially
 17 from implementation of these conservation measures, no long-term water quality degradation
 18 would be expected to occur and, thus, no significant impact on beneficial uses would occur.
 19 Ammonia is not 303(d) listed within the affected environment and thus any minor increases that
 20 could occur in some areas would not make any existing ammonia-related impairment measurably
 21 worse because no such impairments currently exist. Because ammonia-N is not bioaccumulative,
 22 minor increases that could occur in some areas would not bioaccumulate to greater levels in aquatic
 23 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 24 is considered less than significant. No mitigation is required.

25 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 26 **Maintenance (CM1)**

27 *Upstream of the Delta*

28 Under Alternative 4 Scenarios H1–H4, there would be no expected change to the sources of boron in
 29 the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 30 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 31 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
 32 River flow at Vernalis would decrease by an estimated 6%, relative to Existing Conditions (in
 33 association with the different operational components of Scenarios H1–H4 for Alternative 4, climate
 34 change, and increased water demands) and would remain virtually the same relative to the No
 35 Action Alternative considering only changes due only to the different operational components of
 36 Scenarios H1–H4 under Alternative 4. The reduced flow would result in possible increases in long-
 37 term average boron concentrations of up to about 3% relative to the Existing Conditions, which
 38 would be nearly identical under each of the H1–H4 scenarios (Appendix 8F, Table Bo-32). The
 39 increased boron concentrations would not increase the frequency of exceedances of any applicable
 40 objectives or criteria and would not be expected to cause further degradation at measurable levels
 41 in the lower San Joaquin River, and thus would not cause the existing impairment there to be
 42 discernibly worse. Consequently, Alternative 4 would not be expected to cause exceedance of boron
 43 objectives/criteria or substantially degrade water quality with respect to boron, and thus would not

1 adversely affect any beneficial uses of the Sacramento River, the eastside tributaries, associated
2 reservoirs upstream of the Delta, or the San Joaquin River.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
9 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3, *Plan Area*, for
10 more information.

11 The effects relative to Existing Conditions and the No Action Alternative are discussed together
12 because the direction and magnitude of predicted change are so similar. Relative to Existing
13 Conditions, the following changes reflect the range of effects that would result from the four
14 potential outcomes under the Alternative 4 H1–H4 Scenarios. There would be generally similar
15 increased long-term average boron concentrations for the 16-year period modeled at interior Delta
16 locations (by as much as 8% at the SF Mokelumne River at Staten Island for all H1–H4 Scenarios,
17 from 12% for H1 to 15% for H4 at Franks Tract, and from 11% for H1 to 18% for H4 at Old River at
18 Rock Slough) (Appendix 8F, Tables Bo-12A through Bo-12D). The comparisons to Existing
19 Conditions reflects changes due to the different operational components of Scenarios H1–H4 for
20 Alternative 4 and climate change/sea level rise. Comparison to the No Action Alternative reflects
21 changes due only to the different operational components of Scenarios H1–H4 for Alternative 4.

22 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
23 concentrations at western Delta assessment locations (more discussion of this phenomenon is
24 included in Section 8.3.1.3, *Plan Area*), and thus would not be anticipated to substantially affect
25 agricultural diversions which occur primarily at interior Delta locations. The long-term annual
26 average and monthly average boron concentrations, for either the 16-year period or drought period
27 modeled, would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or
28 500 µg/L agricultural objective at any of the eleven Delta assessment locations, which represents no
29 change from the Existing Conditions and No Action Alternative (Appendix 8F, Table Bo-3B).
30 Additionally, relative to the Existing Conditions, reductions in long-term average assimilative
31 capacity would be small with respect to the 500 µg/L agricultural objective at interior Delta
32 locations and reductions would be similar for all of the Alternative 4 H1–H4 Scenarios (i.e., range of
33 maximum monthly reductions of 12% (H1) to 13% (H4) at Franks Tract and up to 13% (H1) to 18%
34 (H4) at Old River at Rock Slough (Appendix 8F, Tables Bo-13A through 13D), and the reductions in
35 assimilative capacity relative to the No Action Alternative also would be comparable. However,
36 because the absolute boron concentrations would still be well below the lowest 500 µg/L objective
37 for the protection of the agricultural beneficial use under Alternative 4, the levels of boron
38 degradation would not be of sufficient magnitude to substantially increase the risk of exceeding
39 objectives or cause adverse effects to municipal and agricultural water supply beneficial uses, or any
40 other beneficial uses, in the Delta (Appendix 8F, Figure Bo-3).

41 **SWP/CVP Export Service Areas**

42 Under all of the Alternative 4 H1–H4 Scenarios, long-term average boron concentrations would
43 decrease at the Banks Pumping Plant (ranging from as much as 21% [H1]) to a 9% [H2]) and at
44 Jones Pumping Plant (ranging from 23% [H4] to 19% [H1]) relative to Existing Conditions, and the

1 reductions would be similar compared to No Action Alternative (Appendix 8F, Tables Bo-12A
2 through 12D) as a result of export of a greater proportion of low-boron Sacramento River water.
3 Commensurate with the decrease in exported boron concentrations, boron concentrations in the
4 lower San Joaquin River may be reduced and would likely alleviate or lessen any expected increase
5 in boron concentrations at Vernalis associated with flow reductions (see discussion of Upstream of
6 the Delta), as well as locations in the Delta receiving a large fraction of San Joaquin River water.
7 Reduced export boron concentrations also may contribute to reducing the existing 303(d)
8 impairment in the lower San Joaquin River and associated TMDL actions for reducing boron loading.

9 Maintenance of SWP and CVP facilities under Alternative 4 would not be expected to create new
10 sources of boron or contribute towards a substantial change in existing sources of boron in the
11 affected environment. Maintenance activities would not be expected to cause any substantial
12 increases in boron concentrations or degradation with respect to boron such that objectives would
13 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
14 affected environment.

15 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 4 would
16 result in relatively small increases in long-term average boron concentrations in the Delta and not
17 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
18 would not be expected to cause exceedances of applicable objectives or further measurable water
19 quality degradation, and thus would not constitute an adverse effect on water quality.

20 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
21 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
22 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
23 constituent. For additional details on the effects assessment findings that support this CEQA impact
24 determination, see the effects assessment discussion that immediately precedes this conclusion.

25 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
26 river flow rate and reservoir storage reductions that would occur under the Alternative 4, relative to
27 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
28 Additionally, relative to Existing Conditions, Alternative 4 would not result in reductions in river
29 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
30 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

31 Small increased boron levels predicted for interior and western Delta locations in response (i.e., up
32 to 15% increase) to a shift in the Delta source water percentages and tidal habitat restoration under
33 this alternative would not be expected to cause exceedances of objectives, or substantial
34 degradation of these water bodies. Alternative 4 maintenance also would not result in any
35 substantial increases in boron concentrations in the affected environment. Boron concentrations
36 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
37 reflecting a potential improvement to boron loading in the lower San Joaquin River.

38 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 4
39 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
40 Existing Conditions, Alternative 4 would not result in substantially increased boron concentrations
41 such that frequency of exceedances of municipal and agricultural water supply objectives would
42 increase. The levels of boron degradation that may occur under Alternative 4 would not be of
43 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
44 agricultural beneficial uses within the affected environment. Long-term average boron

1 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
 2 contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower
 3 San Joaquin River. Based on these findings, this impact is determined to be less than significant. No
 4 mitigation is required.

5 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

6 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21), of which
 7 most do not involve land disturbance, present no new direct sources of boron to the affected
 8 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
 9 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 10 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
 11 hydrodynamic conditions is addressed above in the discussion of Impact WQ-3. The potential
 12 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
 13 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-3. Habitat
 14 restoration activities in the Delta (i.e., CM4–CM10), including restored tidal wetlands, floodplain,
 15 and related channel margin and off-channel habitats, while involving increased land and water
 16 interaction within these habitats, would not be anticipated to contribute boron which is primarily
 17 associated with source water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and
 18 Bay source water). Moreover, some habitat restoration conservation measures (CM4–CM10) would
 19 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 20 land uses with restored habitats. The potential reduction in irrigated lands within the Delta may
 21 result in reduced discharges of agricultural field drainage with elevated boron concentrations,
 22 which would be considered an improvement compared to the No Action Alternative. CM3 and CM11
 23 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
 24 themselves, affect boron levels in the Delta. CM12–CM21 involve actions that target reduction in
 25 other stressors at the species level involving actions such as methylmercury reduction management
 26 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
 27 treatment (CM19). None of the CM12–CM21 actions would contribute to substantially increasing
 28 boron levels in the Delta. Consequently, as they pertain to boron, implementation of CM2–CM21
 29 would not be expected to adversely affect any of the beneficial uses of the affected environment.

30 The impact on boron of implementing CM2–CM21 is determined to be not adverse.

31 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 4 would not present new or
 32 substantially changed sources of boron to the affected environment upstream of the Delta, within
 33 Delta, or in the SWP and CVP service area. As such, the their implementation would not be expected
 34 to substantially increase the frequency with which applicable Basin Plan objectives or other criteria
 35 would be exceeded in water bodies of the affected environment located upstream of the Delta,
 36 within the Delta, or in the SWP and CVP Service Area or substantially degrade the quality of these
 37 water bodies, with regard to boron. Based on these findings, this impact is considered to be less than
 38 significant. No mitigation is required.

39 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 40 **Maintenance (CM1)**

41 ***Upstream of the Delta***

42 Under Alternative 4, regardless of operational scenario (i.e., Scenarios H1–H4), there would be no
 43 expected change to the sources of bromide in the Sacramento and eastside tributary watersheds.

1 Bromide loading in these watersheds would remain unchanged and resultant changes in flows from
 2 altered system-wide operations under Alternative 4 would have negligible, if any, effects on the
 3 concentration of bromide in the rivers and reservoirs of these watersheds. Consequently, no
 4 individual operational scenario of Alternative 4 would be expected to adversely affect the MUN
 5 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 6 associated reservoirs upstream of the Delta.

7 Under the four operational scenarios of Alternative 4, modeling indicates that long-term annual
 8 average flows on the San Joaquin River would decrease by 6% relative to Existing Conditions and
 9 would remain virtually the same relative to the No Action Alternative (Appendix 5A,
 10 *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). These similar decreases in flow,
 11 regardless of operational scenario, would result in possible increases in long-term average bromide
 12 concentrations of about 3%, relative to Existing Conditions and less than <1% relative to the No
 13 Action Alternative (Appendix 8E, *Bromide*, Table 24). The small predicted increases in lower San
 14 Joaquin River bromide levels that could occur under Scenarios H1–H4 of Alternative 4, relative to
 15 existing and No Action Alternative conditions, would not be expected to adversely affect the MUN
 16 beneficial use, or any other beneficial uses, of the lower San Joaquin River.

17 **Delta**

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 22 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 23 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 24 more information.

25 Under Operational Scenarios H1–H4 of Alternative 4, the geographic extent of effects pertaining to
 26 long-term average bromide concentrations in the Delta would be similar to those previously
 27 described for Alternative 1A, although the magnitude of predicted long-term change and relative
 28 frequency of concentration threshold exceedances would be different. Using the mass-balance
 29 modeling approach for bromide (see Section 8.3.1.3), relative to Existing Conditions, Scenarios H1–
 30 H4 modeled long-term average bromide concentrations would increase at Staten Island, Emmaton,
 31 and Barker Slough, while Scenarios H1–H4 modeled long-term average bromide concentrations
 32 would decrease at the other assessment locations (Appendix 8E, *Bromide*, Table 10). Overall effects
 33 would be greatest at Barker Slough, with the smallest model predicted increases occurring under
 34 Scenario H3, and the largest model predicted increases occurring under Scenario H2. Under
 35 Scenario H3, predicted long-term average bromide concentrations would increase from 51 µg/L to
 36 62 µg/L (21% relative increase) for the modeled 16-year hydrologic period and would increase
 37 from 54 µg/L to 92 µg/L (72% relative increase) for the modeled drought period. Under Scenario
 38 H2, predicted long-term average bromide concentrations would increase from 51 µg/L to 72 µg/L
 39 (40% relative increase) for the modeled 16-year hydrologic period and would increase from 54
 40 µg/L to 106 µg/L (98% relative increase) for the modeled drought period. At Barker Slough, changes
 41 in exceedance frequency would follow a similar pattern, with the greatest increase in exceedance
 42 frequency occurring under Scenario H2. Under Scenario H2, the predicted 50 µg/L exceedance
 43 frequency would increase from 49% under Existing Conditions to 56% under Alternative 4, and
 44 would increase from 55% to 83% during the drought period. Similarly at Barker Slough, the
 45 predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to

1 20% under Scenario H2, and would increase from 0% to 47% during the drought period. In contrast,
2 increases in bromide at Staten Island would result in a 50 µg/L bromide threshold exceedance
3 increase from 47% under Existing Conditions to 76% under Scenario H2 (52% to 83% during the
4 modeled drought period). However, unlike Barker Slough, modeling shows that long-term average
5 bromide concentration at Staten Island would exceed the 100 µg/L assessment threshold
6 concentration 1% under Existing Conditions and 3% under all operational scenarios (0% to 2%
7 during the modeled drought period for all operational scenarios). The highest long-term average
8 bromide concentrations would occur under Scenario H2, and would be 76 µg/L (83 µg/L for the
9 modeled drought period) at Staten Island. Changes in exceedance frequency of the 50 µg/L and 100
10 µg/L concentration thresholds, as well as relative change in long-term average concentration, at
11 other assessment locations would be less substantial for all operational scenarios. This comparison
12 to Existing Conditions reflects changes in bromide due to both Alternative 4 operations (including
13 north Delta intake capacity of 9,000 cfs and the different components of Operational Scenarios H1–
14 H4) and climate change/sea level rise.

15 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
16 changes in long-term average bromide concentrations and changes in exceedance frequencies
17 relative to the No Action Alternative would be generally of similar magnitude to those previously
18 described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 10). Relative to the
19 No Action Alternative, modeled long-term average bromide concentration increases would similarly
20 be greatest at Barker Slough under Scenario H2, where long-term average concentrations are
21 predicted to increase by 44% (97% for the modeled drought period). However, unlike the Existing
22 Conditions comparison, under the No Action Alternative long-term average bromide concentrations
23 at Buckley Cove would increase for all operational scenarios, although the increases would be
24 relatively small ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No
25 Action Alternative reflects changes in bromide due only to the different components of Operational
26 Scenarios H1–H4 of Alternative 4.

27 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
28 conditions are very similar (Appendix 8E, *Bromide*, Tables 10 and 11). Such similarity demonstrates
29 that the modeled Alternative 4 change in bromide is almost entirely due to Alternative 4 operations,
30 and not climate change/sea level rise, regardless of the specific different components of Operational
31 Scenarios H1–H4. Therefore, operations are the primary driver of effects on bromide at Barker
32 Slough, regardless of whether and particular operational scenario of Alternative 4 is compared to
33 Existing Conditions, or compared to the No Action Alternative.

34 Results of the modeling approach which used relationships between EC and chloride and between
35 chloride and bromide (see Section 8.3.1.3, *Plan Area*) differed somewhat from what is presented
36 above for the mass-balance approach (see Appendix 8E, Table 11). For most locations, the frequency
37 of exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the
38 methods was predicted for Barker Slough. Under all of the operational scenarios, the increases in
39 frequency of exceedance of the 100 µg/L threshold, relative to Existing Conditions and the No Action
40 Alternative, were not as great using this alternative EC to chloride and chloride to bromide
41 relationship modeling approach as compared to that presented above from the mass-balance
42 modeling approach. Model predicted increases under Scenario H2 were still the greatest, and
43 increases under the other operational scenarios were still substantial. At Barker Slough, the
44 predicted 100 µg/L exceedance frequency for the 16-year hydrologic period would increase from
45 1% under Existing Conditions and 2% under the No Action Alternative to as much as 11% under the
46 Scenario H2. For the modeled drought period, the predicted 100 µg/L exceedance frequency would

1 increase from 0% under Existing Conditions and the No Action Alternative to as much as 25% under
2 Scenario H2. Because the mass-balance approach predicts a greater level of impact at Barker Slough,
3 determination of impacts was based on the mass-balance results.

4 Although Scenario H2 would result in the greatest relative increase in long-term average bromide
5 concentrations and greatest relative increase in exceedance frequency at Barker Slough, the
6 difference between operational scenarios is very small. Regardless of particular Alternative 4
7 operational scenario, the increase in long-term average bromide concentrations predicted at Barker
8 Slough, principally the relative increase in 100 µg/L exceedance frequency, would result in a
9 substantial change in source water quality for existing drinking water treatment plants drawing
10 water from the North Bay Aqueduct. As discussed for Alternative 1A, drinking water treatment
11 plants obtaining water via the North Bay Aqueduct utilize a variety of conventional and enhanced
12 treatment technologies in order to achieve DBP drinking water criteria. While the implications of
13 such a modeled change in bromide at Barker Slough are difficult to predict, the substantial modeled
14 increases could lead to adverse changes in the formation of disinfection byproducts such that
15 considerable treatment plant upgrades may be necessary in order to achieve equivalent levels of
16 health protection. Because many of the other modeled locations already frequently exceed the 100
17 µg/L threshold under Existing Conditions and the No Action Alternative, these locations likely
18 already require treatment plant technologies to achieve equivalent levels of health protection, and
19 thus no additional treatment technologies would be triggered by the small increases in the
20 frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the drinking water
21 beneficial use would be expected at these locations.

22 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
23 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
24 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
25 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
26 Slough and City of Antioch under Scenarios H1–H4 of Alternative 4 would experience a period
27 average increase in bromide during the months when these intakes would most likely be utilized.
28 For those wet and above normal water year types where mass balance modeling would predict
29 water quality typically suitable for diversion, change would be greatest for Scenarios H1 and H3,
30 where predicted long-term average bromide concentrations would increase from 103 µg/L to 155
31 µg/L (51% increase) at City of Antioch and would increase from 150 µg/L to 201 µg/L (41%
32 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25). Under
33 Scenarios H2 and H4, predicted increases would also occur, but would be somewhat less, with
34 approximate 40% increases at the City of Antioch and approximate 34% increases at Mallard
35 Slough. Increases would be similar for the No Action Alternative comparison, with slightly lower
36 relative increases at City of Antioch (i.e., 33–44% depending on operational scenario), and slightly
37 higher relative increases at Mallard Slough (i.e., 36–47% depending on operational scenario).
38 Modeling results using the EC to chloride and chloride to bromide relationships show increases
39 during these months, but the relative magnitude of the increases is much lower (Appendix 8E,
40 *Bromide*, Table 26). Regardless of the differences in the data between the two modeling approaches,
41 the decisions surrounding the use of these seasonal intakes is largely driven by acceptable water
42 quality, and thus have historically been opportunistic. Opportunity to use these intakes would
43 remain, and the predicted increases in bromide concentrations at the City of Antioch and Mallard
44 Slough intake would not be expected to adversely affect MUN beneficial uses, or any other beneficial
45 use, at these locations.

1 Important to the results presented above is the assumed habitat restoration footprint on both the
2 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
3 indicated that habitat restoration (which is reflected in the modeling—see Section 8.3.1.3, *Plan*
4 *Area*), not operations covered under CM1, are the driving factor in the modeled bromide increases.
5 The timing, location, and specific design of habitat restoration will have effects on Delta
6 hydrodynamics, and any deviations from modeled habitat restoration and implementation schedule
7 will lead to different outcomes. Although habitat restoration near Barker Slough is an important
8 factor contributing to modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat
9 restoration elsewhere in the Delta can also have large effects. Because of these uncertainties, and the
10 possibility of adaptive management changes to BDCP restoration activities, including location,
11 magnitude, and timing of restoration, the estimates are not predictive of the bromide levels that
12 would actually occur in Barker Slough or elsewhere in the Delta.

13 ***SWP/CVP Export Service Areas***

14 Under the various operational scenarios of Alternative 4, improvement in long-term average
15 bromide concentrations would occur at the Banks and Jones pumping plants, with the largest
16 improvement predicted to occur under Scenario H4 and the smallest improvement predicted to
17 occur under Scenario H1. Under Scenario H4, long-term average bromide concentrations for the
18 modeled 16-year hydrologic period at Banks and Jones pumping plants would decrease by as much
19 as 46% relative to Existing Conditions and 38% relative to the No Action Alternative. Relative
20 change in long-term average bromide concentration under Scenario H4 would be less during
21 drought conditions ($\leq 36\%$), but would still represent considerable improvement (Appendix 8E,
22 *Bromide*, Table 10). Decreased long-term average bromide concentrations under the other
23 operational scenarios would also be predicted, but would be slightly less. Under Scenario H1, long-
24 term average bromide concentrations for the modeled 16-year hydrologic period at Banks and Jones
25 pumping plants would decrease by as much as 37% relative to Existing Conditions and 28% relative
26 to the No Action Alternative. Relative change in long-term average bromide concentration under
27 Scenario H1 would be less during drought conditions ($\leq 28\%$) (Appendix 8E, *Bromide*, Table 10). As
28 a result, and regardless of operational scenario, less frequent bromide concentration exceedances of
29 the 50 $\mu\text{g/L}$ and 100 $\mu\text{g/L}$ assessment thresholds would be predicted and an overall improvement in
30 Export Service Areas water quality would be experienced respective to bromide. Commensurate
31 with the decrease in exported bromide, an improvement in lower San Joaquin River bromide would
32 also be observed since bromide in the lower San Joaquin River is principally related to irrigation
33 water deliveries from the Delta. While the magnitude of this expected lower San Joaquin River
34 improvement in bromide is difficult to predict, the relative decrease in overall loading of bromide to
35 the Export Service Areas would likely alleviate or lessen any expected increase in bromide
36 concentrations at Vernalis (see discussion of Upstream of the Delta) as well as locations in the Delta
37 receiving a large fraction of San Joaquin River water, such as much of the south Delta.

38 The discussion above is based on results of the mass-balance modeling approach. Results of the
39 modeling approach which used relationships between EC and chloride and between chloride and
40 bromide (see Section 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment
41 of bromide using these data results in the same conclusions as are presented above for the mass-
42 balance approach (see Appendix 8E, Table 11).

43 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
44 facilities under Scenarios H1–H4 of Alternative 4 would not be expected to create new sources of
45 bromide or contribute towards a substantial change in existing sources of bromide in the affected

1 environment. Maintenance activities would not be expected to cause any substantial change in
2 bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected
3 anywhere in the affected environment.

4 **NEPA Effects:** In summary, the operations and maintenance activities under Scenarios H1–H4 of
5 Alternative 4, relative to the No Action Alternative, would result in small increases (i.e., <1%) in
6 long-term average bromide concentrations at Vernalis related to relatively small declines in long-
7 term average flow on the San Joaquin River. However, the operations and maintenance activities
8 under Scenarios H1–H4 of Alternative 4 would cause substantial degradation to water quality with
9 respect to bromide at Barker Slough, source of the North Bay Aqueduct. This substantial
10 degradation would be predicted to occur regardless of operational scenario, but would be greatest
11 under Scenario H2. Resultant substantial change in long-term average bromide at Barker Slough
12 could necessitate changes in water treatment plant operations or require treatment plant upgrades
13 in order to maintain DBP compliance, and thus would constitute an adverse effect on water quality.
14 Mitigation Measure WQ-5 is available to reduce these effects. Implementation of this measure along
15 with a separate, other commitment as set forth in EIR/EIS Appendix 3B, *Environmental*
16 *Commitments, AMMs, and CMs*, relating to the potential increased treatment costs associated with
17 bromide-related changes would reduce these effects.

18 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
20 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
21 constituent. For additional details on the effects assessment findings that support this CEQA impact
22 determination, see the effects assessment discussion that immediately precedes this conclusion.

23 Under Operational Scenarios H1–H4 of Alternative 4 there would be no expected change to the
24 sources of bromide in the Sacramento and eastside tributary watersheds. Bromide loading in these
25 watersheds would remain unchanged and resultant changes in flows from altered system-wide
26 operations under any operational scenario of Alternative 4 would have negligible, if any, effects on
27 the concentration of bromide in the rivers and reservoirs of these watersheds. However, south of the
28 Delta, the San Joaquin River is a substantial source of bromide, primarily due to the use of irrigation
29 water imported from the southern Delta. Concentrations of bromide at Vernalis are inversely
30 correlated to net river flow. Under all operational scenarios of Alternative 4, long-term average
31 flows at Vernalis would decrease only slightly, resulting in less than substantial predicted increases
32 in long-term average bromide of about 3% relative to Existing Conditions.

33 Relative to Existing Conditions, all operational scenarios of Alternative 4 would result in small
34 decreases in long-term average bromide concentration at most Delta assessment locations, with
35 principal exceptions being the North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on
36 the Sacramento River. Overall effects would be greatest at Barker Slough, where substantial
37 increases in long-term average bromide concentrations under all operational scenarios would be
38 predicted, but would be greatest for Scenario H2. While the predicted increase in long-term average
39 bromide concentrations at Barker Slough would be greatest for Scenario H2, the relative increases
40 regardless of particular operational scenario would result in a substantial change in source water
41 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
42 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
43 formation of disinfection byproducts at drinking water treatment plants such that considerable
44 water treatment plant upgrades could be necessary in order to achieve equivalent levels of drinking
45 water health protection.

1 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
2 of changes in bromide concentrations at Banks and Jones pumping plants. Under all of the
3 operational scenarios of Alternative 4, substantial improvement would occur at the Banks and Jones
4 pumping plants, where long-term average bromide concentrations are predicted to decrease by as
5 much as 44% relative to Existing Conditions. As a result, an overall improvement in bromide-related
6 water quality would be predicted in the SWP/CVP Export Service Areas.

7 Based on the above, the operations and maintenance activities under Scenarios H1–H4 of
8 Alternative 4 would not result in any substantial change in long-term average bromide
9 concentration upstream of the Delta. Furthermore, under all of the operational scenarios of
10 Alternative 4, water exported from the Delta to the SWP/CVP service area would be substantially
11 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
12 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
13 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. The operations
14 and maintenance activities under Scenarios H1–H4 of Alternative 4 would not cause substantial
15 long-term degradation to water quality respective to bromide with the exception of water quality at
16 Barker Slough, source of the North Bay Aqueduct. At Barker Slough, modeled long-term annual
17 average concentrations of bromide would increase by as much as 40%, and 98% during the modeled
18 drought period. For the modeled 16-year hydrologic period the frequency of predicted bromide
19 concentrations exceeding 100 µg/L would increase from 0% under Existing Conditions to as much
20 as 20% under Alternative 4, while for the modeled drought period, the frequency would increase
21 from 0% to as much as 47%. The substantial changes in long-term average bromide predicted for
22 Barker Slough under all operational scenarios of Alternative 4 could necessitate changes in
23 treatment plant operation or require treatment plant upgrades in order to maintain DBP
24 compliance. The model predicted change at Barker Slough is substantial and, therefore, would
25 represent a substantially increased risk for adverse effects on existing MUN beneficial uses should
26 treatment upgrades not be undertaken. The impact is considered significant.

27 Implementation of Mitigation Measure WQ-5 along with a separate, other commitment relating to
28 the potential increased treatment costs associated with bromide-related changes would reduce
29 these effects. While mitigation measures to reduce these water quality effects in affected water
30 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
31 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
32 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
33 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
34 significant and unavoidable.

35 In addition to and to supplement Mitigation Measure WQ-5, the project proponents have
36 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
37 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
38 costs that could result from bromide-related concentration effects on municipal water purveyor
39 operations. Potential options for making use of this financial commitment include funding or
40 providing other assistance towards implementation of the North Bay Aqueduct AIP, acquiring
41 alternative water supplies, or other actions to indirectly reduce the effects of elevated bromide and
42 DOC in existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
43 potential actions that could be taken pursuant to this commitment in order to reduce the water
44 quality treatment costs associated with water quality effects relating to chloride, electrical
45 conductivity, and bromide.

1 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 2 **Conditions; Site and Design Restoration Sites to Reduce Bromide Increases in Barker**
 3 **Slough**

4 It remains to be determined whether, or to what degree, the available and existing salinity
 5 response and countermeasure actions of SWP and CVP facilities or municipal water purveyors
 6 would be capable of offsetting the actual level of changes in bromide that may occur from
 7 implementation of Alternative 4. Therefore, in order to determine the feasibility of reducing the
 8 effects of increased bromide levels, and potential adverse effects on beneficial uses associated
 9 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), the proposed
 10 mitigation requires a series of phased actions to identify and evaluate existing and possible
 11 feasible actions, followed by development and implementation of the actions, if determined to
 12 be necessary. The development and implementation of any mitigation actions shall be focused
 13 on those incremental effects attributable to implementation of Alternative 4 operations only.
 14 Development of mitigation actions for the incremental bromide effects attributable to climate
 15 change/sea level rise are not required because these changed conditions would occur with or
 16 without implementation of Alternative 4. The goal of specific actions would be to reduce/avoid
 17 additional degradation of Barker Slough water quality conditions with respect to the CALFED
 18 bromide goal.

19 The project proponents shall consider effects of site-specific restoration areas proposed under
 20 CM4 on bromide concentrations in Barker Slough. Design and siting of restoration areas shall
 21 attempt to reduce potential effects to the extent possible without compromising proposed
 22 benefits of the restoration areas. It is anticipated that these efforts will be able to reduce the
 23 level of projected increase, though it is unknown whether it would be able to completely
 24 eliminate any increases.

25 Additionally, following commencement of initial operations of CM1, the project proponents will
 26 conduct additional evaluations described herein, and develop additional modeling (as
 27 necessary), to define the extent to which modified operations could reduce or eliminate the
 28 increased bromide concentrations currently modeled to occur under Alternative 4. The
 29 additional evaluations should also consider specifically the changes in Delta hydrodynamic
 30 conditions associated with tidal habitat restoration under CM4 (in particular the potential for
 31 increased bromide concentrations that could result from increased tidal exchange) once the
 32 specific restoration locations are identified and designed. The evaluations will also consider up-
 33 to-date estimates of climate change and sea level rise, if and when such information is available.
 34 If sufficient operational flexibility to offset bromide increases is not feasible under Alternative 4
 35 operations, and/or siting and design of restoration areas cannot feasibly reduce bromide
 36 increases to a less-than-significant level without compromising the benefits of the proposed
 37 areas, achieving bromide reduction pursuant to this mitigation measure would not be feasible
 38 under this alternative.

39 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 40 **CM21**

41 **NEPA Effects:** CM2–CM21 would present no new sources of bromide to the affected environment,
 42 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 43 As they pertain to bromide, implementation of these conservation measures would not be expected
 44 to adversely affect MUN beneficial use, or any other beneficial uses, of the affected environment.

1 With exception to habitat restoration areas that would effectively alter Delta hydrodynamics, habitat
2 restoration and the various land-disturbing conservation measures proposed for Alternative 4
3 would not present new or substantially changed sources of bromide to the study area. Modeling
4 scenarios included assumptions regarding how certain habitat restoration activities would affect
5 Delta hydrodynamics (CM2 and CM4), and thus such hydrodynamic effects of these restoration
6 measures were included in the assessment of CM1 facilities operations and maintenance (see Impact
7 WQ-5).

8 Some habitat restoration activities would occur on lands in the Delta formerly used for irrigated
9 agriculture. Such replacement or substitution of land use activity would not be expected to result in
10 new or increased sources of bromide to the Delta. Implementation of CM2–CM11 would not be
11 expected to adversely affect MUN beneficial use, or any other beneficial uses, within the affected
12 environment.

13 In summary, implementation of CM2–CM21 under Alternative 4, relative to the No Action
14 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
15 from implementing CM2–CM21 are determined to not be adverse.

16 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 4 would not present new or
17 substantially changed sources of bromide to the study area. Some conservation measures may
18 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
19 would not be expected to substantially increase or present new sources of bromide. Implementation
20 of CM2–CM21 would have negligible, if any, effects on bromide concentrations throughout the
21 affected environment, would not cause exceedance of applicable state or federal numeric or
22 narrative water quality objectives/criteria because none exist for bromide, and would not cause
23 changes in bromide concentrations that would result in significant impacts on any beneficial uses
24 within affected water bodies. Implementation of CM2–CM21 would not cause significant long-term
25 water quality degradation such that there would be greater risk of significant impacts on beneficial
26 uses, would not cause greater bioaccumulation of bromide, and would not further impair any
27 beneficial uses due to bromide concentrations because no uses are currently impaired due to
28 bromide levels. This impact is therefore considered less than significant. No mitigation is required.

29 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 Under Alternative 4, Scenarios H1–H4, there would be no expected change to the sources of chloride
33 in the Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would
34 remain unchanged and resultant changes in flows from altered system-wide operations would have
35 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
36 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
37 would decrease slightly compared to Existing Conditions (in association with the different
38 components of Operational Scenarios H1–H4 for Alternative 4, climate change, and increased water
39 demands) and be similar compared to the No Action Alternative (considering only changes due only
40 to the different components of Operational Scenarios H1–H4 under Alternative 4). The reduced flow
41 would result in possible increases in long-term average chloride concentrations of about 2%,
42 relative to the Existing Conditions, which would be nearly identical under each of the H1–H4
43 scenarios, and no change relative to No Action Alternative (Appendix 8G, Table CI-62).

1 Consequently, the Alternative 4 H1–H4 Scenarios would not be expected to cause exceedances of
 2 chloride objectives/criteria or substantially degrade water quality with respect to chloride, and thus
 3 would not adversely affect any beneficial uses of the Sacramento River, the eastside tributaries,
 4 associated reservoirs upstream of the Delta, or the San Joaquin River.

5 **Delta**

6 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 7 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 8 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 9 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 10 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 11 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 12 more information.

13 Relative to Existing Conditions, modeling predicts that the Alternative 4 H1–H4 Scenarios would
 14 result in similar or reduced long-term average chloride concentrations for the 16-year period
 15 modeled at most of the assessment locations. The mass-balance modeling results indicate similar,
 16 but slightly larger increases in chloride concentrations compared to estimates generated using EC-
 17 chloride relationships and DSM2 EC output (see Section 8.3.1.3). Increased long-term average
 18 chloride concentrations would occur at the North Bay Aqueduct at Barker Slough (i.e., range from up
 19 to 33% [H2] to 16% [H3]) and SF Mokelumne River at Staten Island (i.e., similar increase of 22–23%
 20 for all H1–H4 Scenarios) (Appendix 8G, *Chloride*, Tables CI-25A through 25D [mass balance model
 21 results] and Tables CI-26A through 26D [EC-chloride relationship results]). Changes in long-term
 22 average concentrations in the western Sacramento River at Emmaton would range from an increase
 23 for Scenarios H1 and H2 (14 to 16%) to no measureable change for Scenarios H3 and H4 (i.e., -1%).
 24 Long-term average chloride concentration would decrease at other assessment locations, with the
 25 largest reductions occurring under Scenarios H3 and H4 (i.e., up to -24% at Franks Tract) and less
 26 reduction under Scenarios H1 and H2 (i.e., up to -12% at Franks Tract). Additionally,
 27 implementation of tidal habitat restoration under CM4 would increase the tidal exchange volume in
 28 the Delta, and thus may contribute to increased chloride concentrations in the Bay source water as a
 29 result of increased salinity intrusion. More discussion of this phenomenon is included in Section
 30 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may be greater than
 31 indicated herein and would affect the western Delta assessment locations the most which are
 32 influenced to the greatest extent by the Bay source water. This comparison to Existing Conditions
 33 reflects changes in chloride due to both the different components of Operational Scenarios H1–H4
 34 for Alternative 4 and climate change/sea level rise.

35 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
 36 indicated that the Alternative 4 Scenarios H1–H4 would result in similar increases in long-term
 37 average chloride concentrations for the 16-year period as described above compared to Existing
 38 Conditions: SF Mokelumne River at Staten Island (i.e., up to 25 to 27% for all H1–H4 Scenarios),
 39 North Bay Aqueduct at Barker Slough (i.e., range of 20% [H3] up to 37% [H2]), and for the
 40 Sacramento River at Emmaton (i.e., ranging from an increase for Scenarios H1–H2 of up to 17% to
 41 reduction under Scenarios H3–H4 [-1%]) (Appendix 8G, Table CI-25A through 25D [mass balance
 42 model results] and Tables CI-26A through 26D [EC-chloride relationship results]). Relative to the No
 43 Action Alternative, the long-term average chloride concentrations based on EC to chloride
 44 relationships indicate that most of the other interior and western Delta assessment locations under
 45 Scenarios H1 and H2 would exhibit similar increases ranging from up to 3% at San Joaquin River at

1 Buckley Cove to 9% at the Sacramento River at Mallard Island. The comparison to the No Action
2 Alternative reflects chloride changes due only to the different components of Operational Scenarios
3 H1–H4 for Alternative 4.

4 The following outlines the modeled chloride changes relative to the applicable objectives and
5 beneficial uses of Delta waters.

6 *Municipal Beneficial Uses—Relative to Existing Conditions*

7 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
8 (see Section 8.3.1.3, *Plan Area*) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for
9 municipal and industrial beneficial uses on a basis of the percentage of years the chloride objective
10 is exceeded for the modeled 16-year period. The objective is exceeded if chloride concentrations
11 exceed 150 mg/L for a specified number of days in a given water year at both the Antioch and
12 Contra Costa Pumping Plant #1 locations. For the Alternative 4 Scenarios H1–H4, the modeled
13 frequency of objective exceedance would be unchanged relative to Existing Conditions at the Contra
14 Costa Pumping Plant #1 at 7% (Appendix 8G, Table CI-64).

15 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
16 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
17 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
18 basis for the evaluation was the predicted number of days the objective was exceeded for the
19 modeled 16-year period. For Alternative 4, the modeled frequency of objective exceedance would
20 decrease similarly for the H1–H4 Scenarios by approximately one half, from 6% of modeled days
21 under Existing Conditions, to 3–4% of modeled days under the Alternative 4 operational scenarios
22 (Appendix 8G, Table CI-63).

23 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
24 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
25 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
26 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
27 approach to model monthly average chloride concentrations for the 16-year period, the predicted
28 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
29 Pumping Plant #1 from an exceedance frequency of 24% under Existing Conditions to a range of
30 18% (for H1) to 12–13% (for H3 and H4) (Appendix 8G, Table CI-27 and Figure CI-5). However, the
31 frequency of exceedances would increase slightly for the 16-year period modeled at the San Joaquin
32 River at Antioch (i.e., from 66% under Existing Conditions to 68% to 70% for the H1–H4 Scenarios)
33 and Sacramento River at Mallard Island (i.e., from 85% under Existing Conditions to 86% to 88% for
34 the H1–H4 Scenarios) (Appendix 8G, Table CI-27). Although these changes are within the
35 uncertainty of the modeling approach, the mass balance results also indicate that the increased
36 concentrations would reduce assimilative capacity with respect to the 250 mg/L objective, thus
37 causing further degradation at Antioch in March and April, with similar maximum reductions under
38 H1 and H3 of up to 54% to maximum reductions of up to 42% for H3 and H4 for the 16-year period
39 modeled, and 100% reduction, or elimination of assimilative capacity, for all of the H1–H4 Scenarios
40 during the drought period modeled) (Appendix 8G, Tables CI-29A through 29D and Figure CI-5).
41 Assimilative capacity at the Contra Costa Canal at Pumping Plant #1 also would be similarly reduced
42 in September and October under the H1 and H2 scenarios (i.e., up to 100%, or elimination) when
43 chloride concentrations would be near, or exceed, the objectives, thus increasing the risk of

1 exceeding objectives (Appendix 8G, Figure Cl-5), but would not be substantially reduced under the
2 H3 or H4 scenarios.

3 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
4 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
5 capacity would be similar to those discussed when utilizing the mass balance modeling approach
6 (Appendix 8G, *Chloride*, Table Cl-28 and Tables Cl-30A through 30D). However, as with Alternative
7 1A the modeling approach utilizing the chloride-EC relationships predicted changes of lesser
8 magnitude, where predictions of change utilizing the mass balance approach were generally of
9 greater magnitude, and thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of
10 such disagreement, the approach that yielded the more conservative predictions was used as the
11 basis for determining adverse impacts.

12 Based on the long-term average water quality degradation in the western Delta, the potential exists
13 for substantial adverse effects under all of the Alternative 4 H1–H4 Scenarios on the municipal and
14 industrial beneficial uses through reduced opportunity for diversion of water with acceptable
15 chloride levels.

16 *303(d) Listed Water Bodies—Relative to Existing Conditions*

17 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
18 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
19 nearest DSM2-modeled location to Tom Paine Slough in the south Delta, would generally be similar
20 under all of the Alternative 4 H1–H4 Scenarios compared to Existing Conditions, and thus, would not
21 be further degraded on a long-term basis (Appendix 8G, Figure Cl-6).

22 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
23 modeled would generally increase under all of the Alternative 4 H1–H4 Scenarios compared to
24 Existing Conditions in the months of March through May at the Sacramento River at Collinsville
25 (Appendix 8G, Figure Cl-7), Mallard Island (Appendix 8G, Figure Cl-5), and increase substantially at
26 Montezuma Slough at Beldon’s Landing (i.e., over a doubling of concentration in December through
27 February) (Appendix 8G, Figure Cl-8). Although modeling of Alternative 4 assumed no operation of
28 the Montezuma Slough Salinity Control Gates, the project description assumes continued operation
29 of the Salinity Control Gates, consistent with assumptions included in the No Action Alternative. A
30 sensitivity analysis modeling run conducted for Alternative 4 with the gates operational consistent
31 with the No Action Alternative resulted in substantially lower EC levels than indicated in the original
32 Alternative 4 modeling results for Suisun Marsh, but EC levels were still somewhat higher than EC
33 levels under Existing Conditions for several locations and months. Although chloride was not
34 specifically modeled in this sensitivity analysis, it is expected that chloride concentrations would be
35 nearly proportional to EC levels in Suisun Marsh. Another modeling run with the gates operational
36 and restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions,
37 indicating that design and siting of restoration areas has notable bearing on EC levels at different
38 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
39 sensitivity analyses). These analyses also indicate that increases in salinity are related primarily to
40 the hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity
41 analyses, optimizing the design and siting of restoration areas may limit the magnitude of long-term
42 chloride increases in the Marsh. However, the chloride concentration increases at certain locations
43 could be substantial, depending on siting and design of restoration areas. Thus, these increased
44 chloride levels in Suisun Marsh are considered to contribute to additional, measureable long-term

1 degradation that potentially would adversely affect the necessary actions to reduce chloride loading
2 for any TMDL that is developed.

3 *Municipal Beneficial Uses—Relative to No Action Alternative*

4 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
5 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3, *Plan Area*) were
6 used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial
7 uses. For Alternative 4, the modeled frequency of objective exceedance would increase at the Contra
8 Costa Pumping Plant #1 from 0% under the No Action Alternative to 7% of years under all of the
9 Alternative 4 H1–H4 Scenarios (Appendix 8G, Table Cl-64). The increase was due to a single year,
10 1977, which fell just short of the required number of days (i.e., was within 10 days minimum
11 number of required days < 150 mg/L). Given the uncertainty in the chloride modeling approach, it is
12 likely that real time operations of the SWP and CVP could achieve compliance with this objective
13 (see Section 8.3.1.1 for a discussion of chloride compliance modeling uncertainties and a description
14 of real time operations of the SWP and CVP).

15 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
16 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
17 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. For Alternative
18 4, the modeled frequency of objective exceedance would decrease minimally under all the H1–H4
19 Scenarios, from 5% of modeled days under the No Action Alternative to 4–3% of modeled days
20 under the Alternative 4 scenarios (Appendix 8G, Table Cl-64).

21 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
22 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
23 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
24 model monthly average chloride concentrations for the 16-year period, a small increase in
25 exceedance frequency would be predicted at the Sacramento River at Mallard Island (i.e., from 86%
26 for the No Action Alternative to a slight 2% increase [up to 88%] for H1 and H3), with no change in
27 exceedances under H2 or H4 (Appendix 8G, Table Cl-27). The frequency of exceedances would
28 decrease slightly at the San Joaquin River at Antioch (i.e., from 73% for the No Action Alternative to
29 a range of 68% [H2 and H4] to 70% [H1]), and the frequency of exceedances at the Contra Costa
30 Canal at Pumping Plant #1 would depend on the scenario from 14% under the No Action Alternative
31 increasing by 2–4% for H1 and H2 (i.e., up to 18%) and decreasing at H3 and H4 [to 12%]
32 (Appendix 8G, Table Cl-27). Although these changes are within the uncertainty of the modeling
33 approach, substantial reductions in available assimilative capacity compared to the No Action
34 Alternative condition would occur at Antioch under H1 and H3 (i.e., 24% in April) and no substantial
35 reduction under H2/H4 for the 16-year period modeled, and up to 100% in April [i.e., eliminated]
36 for the drought period for all H1–H4 scenarios). Assimilative capacity also would be reduced
37 substantially at the Contra Costa Canal at Pumping Plant #1 at similar levels for H1 and H2 in August
38 through November (i.e., up to 100% elimination in October) to only in August and September under
39 H3 and H4 (i.e., up to 29%) for the 16-year period modeled, with 100% elimination in at least one
40 month under all of the H1–H4 scenarios for the drought period) (Appendix 8G, Tables Cl-29A
41 through 29D), reflecting substantial degradation during months when average concentrations
42 would be near, or exceed, the objective.

43 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
44 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative

1 capacity would be similar to those discussed when utilizing the mass balance modeling approach
2 (Appendix 8G, Tables Cl-30A through 30D). However, as with Alternative 1A, the modeling approach
3 utilizing the chloride-EC relationships predicted changes of lesser magnitude, where predictions of
4 change utilizing the mass balance approach were generally of greater magnitude, and thus more
5 conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the approach
6 that yielded the more conservative predictions was used as the basis for determining adverse
7 impacts.

8 Based on the long-term average water quality degradation in the western Delta, the potential exists
9 for substantial adverse effects under all of the Alternative 4 H1–H4 Scenarios on the municipal and
10 industrial beneficial uses through reduced opportunity for diversion of water with acceptable
11 chloride levels.

12 *303(d) Listed Water Bodies—Relative to No Action Alternative*

13 With respect to the 303(d) listing for chloride for Tom Paine Slough, Alternative 4 would generally
14 result in similar changes for all of the Alternative 4 H1–H4 Scenarios to those discussed for the
15 comparison to Existing Conditions. Monthly average chloride concentrations at the Old River at
16 Tracy Road, which represents the nearest DSM2-modeled location to Tom Paine in the south Delta,
17 would not be further degraded on a long-term basis (Appendix 8G, Figure Cl-6).

18 Modeling results indicate that monthly average chloride concentrations at source water channel
19 locations for the Suisun Marsh (Appendix 8G, Figures Cl-5, Cl-7, and Cl-8) would increase
20 substantially in some months during October through May compared to the No Action Alternative
21 conditions, but sensitivity analyses suggest that operation of the Salinity Control Gates and
22 restoration area siting and design considerations could reduce these increases. However, the
23 chloride concentration increases at certain locations could be substantial, depending on siting and
24 design of restoration areas. Thus, these increased chloride levels in Suisun Marsh are considered to
25 contribute to additional, measureable long-term degradation in Suisun Marsh that potentially would
26 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

27 *SWP/CVP Export Service Areas*

28 Under the Alternative 4 H1–H4 Scenarios, long-term average chloride concentrations based on the
29 mass balance analysis of modeling results for the 16-year period modeled at the Banks and Jones
30 pumping plants would decrease compared to Existing Conditions. Reductions at Banks would be
31 slightly larger than at Jones, ranging from 37% (H1) to 45% (H4) (Appendix 8G, *Chloride*, Table Cl-
32 25A through 25D). Compared to No Action Alternative, the pattern of reductions would be similar
33 with Banks ranging from 32% (H1) to 38% (H4). The modeled frequency of exceedances of
34 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
35 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
36 *Chloride*, Table Cl-27). Consequently, water exported into the SWP/CVP service area would
37 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
38 the No Action Alternative conditions.

39 Results of the modeling approach which used relationships between EC and chloride (see Section
40 8.3.1.3, *Plan Area*) were consistent with the discussion above, and assessment of chloride using
41 these data results in the same conclusions as are presented above for the mass-balance approach
42 (Appendix 8G, Tables Cl-26A through 26D [for concentration changes] and Table Cl-28 [for
43 frequency of exceedances]).

1 Commensurate with the reduced chloride concentrations in water exported to the service area,
2 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
3 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
4 San Joaquin River flows (see discussion of Upstream of the Delta).

5 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
6 contribute towards a substantial change in existing sources of chloride in the affected environment.
7 Maintenance activities would not be expected to cause any substantial change in chloride such that
8 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
9 affected anywhere in the affected environment.

10 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, the Alternative 4 H1–H4
11 Scenarios are not expected to result in substantial additional exceedances of the 150 mg/L or 250
12 mg/L water quality objectives. All of the Alternative 4 H1–H4 Scenarios would result in increased
13 water quality degradation with respect to the 250 mg/L municipal and industrial objective at
14 western Delta locations on a monthly average basis, and could contribute measureable water quality
15 degradation relative to the 303(d) impairment in Suisun Marsh (see Mitigation Measure WQ-7;
16 implementation of this measure along with a separate, other commitment relating to the potential
17 increased chloride treatment costs would reduce these effects). The predicted chloride increases
18 constitute an adverse effect on water quality. Additionally, the predicted changes relative to the No
19 Action Alternative conditions indicate that in addition to the effects of climate change/sea level rise,
20 implementation of CM1 and CM4 under the Alternative 4 H1–H4 Scenarios would contribute
21 substantially to the adverse water quality effects.

22 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
23 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
24 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
25 constituent. For additional details on the effects assessment findings that support this CEQA impact
26 determination, see the effects assessment discussion that immediately precedes this conclusion.

27 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
28 thus river flow rate and reservoir storage reductions that would occur under any of the Alternative
29 4 H1–H4 Scenarios, relative to Existing Conditions, would not be expected to result in a substantial
30 adverse change in chloride levels. Additionally, relative to Existing Conditions, the Alternative 4 H1–
31 H4 Scenarios would not result in reductions in river flow rates (i.e., less dilution) or increased
32 chloride loading such that there would be any substantial increase in chloride concentrations
33 upstream of the Delta in the San Joaquin River watershed.

34 Relative to Existing Conditions, the Alternative 4 H1–H4 Scenarios would not increase the frequency
35 of exceeding the 150 mg/L Bay-Delta WQCP objective. Modeling results indicate that the frequency
36 of exceedance of the 250 mg/L Bay-Delta WQCP objective would increase at the San Joaquin River at
37 Antioch and at Mallard Slough (ranging by up to 2 to 4% for the H1–H4 Scenarios), but these
38 frequencies are expected to be within the uncertainty present in the chloride modeling procedure.
39 Substantial long-term degradation may occur at Antioch under all of the H1–H4 Scenarios, and at the
40 Contra Costa Canal at Pumping Plant #1 under the H1-H2 Scenarios, that may result in adverse
41 effects on the municipal and industrial water supply beneficial use (see Mitigation Measure WQ-7;
42 implementation of this measure along with a separate, other commitment relating to the potential
43 increased chloride treatment costs would reduce these effects). Relative to the Existing Conditions,
44 the modeled increased chloride concentrations and degradation in the western Delta under all of the

1 H1–H4 Scenarios could further contribute, at measurable levels, to the existing 303(d) listed
2 impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.

3 Chloride concentrations would be reduced under all of the H1–H4 Scenarios in water exported from
4 the Delta to the CVP/SWP Export Service Areas, thus reflecting a potential improvement to chloride
5 loading in the lower San Joaquin River.

6 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the
7 Alternative 4 H1–H4 Scenarios would not result in substantial chloride bioaccumulation impacts on
8 aquatic life or humans. Alternative 4 maintenance would not result in any substantial changes in
9 chloride concentration upstream of the Delta or in the SWP/CVP Export Service Areas. However,
10 based on these findings, this impact is determined to be significant due to increased chloride
11 concentrations and degradation at western Delta locations and its potential effects on municipal and
12 industrial water supply and fish and wildlife beneficial uses.

13 Implementation of Mitigation Measure WQ-7 along with a separate, other commitment relating to
14 the potential increased costs associated with chloride-related changes would reduce these effects.
15 Although it is not known whether implementation of WQ-7 will be able to feasibly reduce water
16 quality degradation in the western Delta, implementation of Mitigation Measure WQ-7 is
17 recommended to attempt to reduce the effect that increased chloride concentrations may have on
18 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
19 feasible measures for reducing these water quality effects is uncertain, this impact is considered to
20 remain significant and unavoidable. Based on sensitivity analyses conducted to date (see Appendix
21 8H, Attachment 1), it is expected that implementation of Mitigation Measure WQ-7d would reduce
22 impacts on chloride in Suisun Marsh to a less-than-significant level.

23 In addition to and to supplement Mitigation Measure WQ-7, the project proponents have
24 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
25 *AMMs, and CMs*, a separate, other commitment to address the potential increased water treatment
26 costs that could result from chloride concentration effects on municipal, industrial and agricultural
27 water purveyor operations. Potential options for making use of this financial commitment include
28 funding or providing other assistance towards acquiring alternative water supplies or towards
29 modifying existing operations when chloride concentrations at a particular location reduce
30 opportunities to operate existing water supply diversion facilities. Please refer to Appendix 3B for
31 the full list of potential actions that could be taken pursuant to this commitment in order to reduce
32 the water quality treatment costs associated with water quality effects relating to chloride, electrical
33 conductivity, and bromide.

34 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
35 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

36 It is currently unknown whether the effects of increased chloride levels, and potential adverse
37 effects on municipal and industrial water supply and fish and wildlife beneficial uses associated
38 with CM1 operations (and hydrodynamic effects of tidal restoration under CM4), can be
39 mitigated through modifications to initial operations and/or site-specific design of tidal
40 restoration areas under CM4. Therefore, the proposed mitigation measures require a series of
41 actions to identify and evaluate potentially feasible actions, to achieve reduced chloride levels in
42 order to reduce or avoid impacts to beneficial uses.

1 Regarding exceedance of Bay Delta WQCP water quality objectives for chloride, staff from DWR
2 and Reclamation shall continue to monitor Delta water quality conditions and adjust operations
3 of the SWP and CVP in real time as necessary to meet water quality objectives. These decisions
4 take into account real-time conditions and are able to account for many factors that the best
5 available models cannot simulate. DWR and Reclamation have a good history of compliance with
6 water quality objectives (see Sections 8.1.3.4 and 8.1.3.7 for more detail). Considering these
7 real-time actions, the good history of compliance with objectives, and the uncertainty inherent
8 in the modeling approach (as discussed in Sections 8.3.1.1 and 8.3.1.3), it is likely that objective
9 exceedance, should any be predicted to occur, could be avoided through real-time operation of
10 the SWP and CVP.

11 Nevertheless, water quality degradation could occur that may not be addressed through real-
12 time operations. The development and implementation of any mitigation actions shall be
13 focused on those incremental effects attributable to implementation of Alternative 4 operations
14 only. Development of mitigation actions for the incremental chloride effects attributable to
15 climate change/sea level rise are not required because these changed conditions would occur
16 with or without implementation of Alternative 4.

17 **Mitigation Measure WQ-7a: Conduct Additional Evaluation of Operational Ability to**
18 **Reduce or Eliminate Water Quality Degradation in Western Delta Incorporating Site-**
19 **Specific Restoration Areas and Updated Climate Change/Sea Level Rise Projections, if**
20 **Available**

21 The project proponents will conduct additional evaluations and develop additional modeling (as
22 necessary) to define the extent to which modified operations of the SWP and CVP could reduce
23 or eliminate water quality degradation relative to the 250 mg/L Bay-Delta WQCP objective for
24 chloride currently modeled to occur under Alternative 4. The additional evaluations will be
25 conducted to consider specifically the changes in Delta hydrodynamic conditions associated
26 with tidal habitat restoration under CM4 once the specific restoration locations and timing of
27 their construction are identified and designed. The evaluations will also consider up-to-date
28 estimates of climate change and sea level rise, if and when such information is available. These
29 evaluations will be conducted concurrently with Mitigation Measure WQ-7b. Together, findings
30 from WQ-7a and WQ-7b will indicate whether sufficient flexibility to prevent or offset chloride
31 increases is feasible under Alternative 4.

32 **Mitigation Measure WQ-7b: Site and Design Restoration Sites to Reduce or Eliminate**
33 **Water Quality Degradation in the Western Delta**

34 The project proponents shall consider effects of site-specific restoration areas proposed under
35 CM4 on chloride concentrations in the western Delta. Design and siting of restoration areas shall
36 attempt to reduce water quality degradation with respect to the 250 mg/L chloride objective in
37 the western Delta to the extent possible without compromising proposed benefits of the
38 restoration areas. These evaluations will be conducted concurrently with Mitigation Measure
39 WQ-7a. Together, findings from WQ-7a and WQ-7b will indicate whether sufficient flexibility to
40 prevent or offset chloride increases is feasible under Alternative 4.

1 **Mitigation Measure WQ-7c: Consult with Delta Water Purveyors to Identify Means to**
 2 **Avoid, Minimize, or Offset for Reduced Seasonal Availability of Water That Meets**
 3 **Applicable Water Quality Objectives**

4 To determine the feasibility of reducing the effects of CM1/CM4 operations on increased
 5 chloride concentrations as shown in modeling estimates to occur to municipal and industrial
 6 water purveyors at the Antioch, Mallard Slough, and Contra Costa Canal at Pumping Plant #1
 7 locations, the project proponents will consult with the purveyors to identify any feasible
 8 operational means to either avoid, minimize, or offset for reduced seasonal availability of water
 9 that either meets applicable water quality objectives or that results in levels of degradation that
 10 do not substantially increase the risk of adversely affecting the municipal and industrial
 11 beneficial use. Any such action will be developed following, and in conjunction with, the
 12 completion of the evaluation and development of any potentially feasible actions described in
 13 Mitigation Measure WQ-7a and WQ-7b.

14 **Mitigation Measure WQ-7d: Site and Design Restoration Sites and consult with**
 15 **CDFW/USFWS, and Suisun Marsh Stakeholders to Identify Potential Actions to Avoid or**
 16 **Reduce Chloride Concentration Increases in the Marsh**

17 The project proponents shall consider effects of site-specific restoration areas proposed under
 18 CM4 on chloride concentrations in Suisun Marsh. Design and siting of restoration areas shall
 19 attempt to reduce potential effects to the extent possible without compromising proposed
 20 benefits of the restoration areas. The project proponents will also consult with CDFW/USFWS,
 21 and Suisun Marsh stakeholders, to identify potential actions to avoid or minimize the chloride
 22 increases in the marsh, with the goal of maintaining chloride at levels that would not further
 23 impair fish and wildlife beneficial uses in Suisun Marsh. Potential actions may include
 24 modifications of the existing Suisun Marsh Salinity Control Gates for effective salinity control
 25 and evaluation of the efficacy of additional physical salinity control facilities or operations for
 26 the marsh to reduce the effects of increased chloride levels. These actions are identical to the
 27 actions discussed in Mitigation Measure WQ-11b regarding levels of electrical conductivity in
 28 Suisun Marsh.

29 **Mitigation Measure WQ-7e: Implement Terms of the Contra Costa Water District**
 30 **Settlement Agreement**

31 DWR and Contra Costa Water District (CCWD) entered into a settlement agreement
 32 (Agreement) for reducing potential impacts to CCWD water supply in the Delta related to
 33 construction and operation of the BDCP/California WaterFix. This mitigation measure includes
 34 conveyance of water to CCWD that meets specified water quality requirements, in quantities and
 35 on a schedule defined in the Agreement. The Agreement ensures that the quality of the water
 36 CCWD delivers to its customers is not impacted as a result of the BDCP/California WaterFix. The
 37 Agreement does not increase the total amount of water that CCWD would otherwise be entitled
 38 to divert.

39 DWR would convey mitigation water to CCWD in one of two ways: 1) the primary method of
 40 conveying the water would be through the existing Freeport Regional Water Authority Intake
 41 (Freeport Intake) and the existing interconnection between EBMUD's Mokelumne Aqueduct and
 42 CCWD's Los Vaqueros Pipeline; and 2) the secondary method of conveying the water would be
 43 through the BDCP/California WaterFix's northern intakes and new Interconnection Facilities
 44 between the water conveyance facilities and existing CCWD facilities. Two different options for

1 the new Interconnection Facilities are being considered: one on Victoria Island between the
 2 water conveyance facilities and the existing CCWD Middle River pipeline; and one at Clifton
 3 Court Forebay between the Clifton Court Forebay and the CCWD Los Vaqueros pipeline. No new
 4 facilities are required for the EBMUD/Freeport Intake conveyance method. DWR would be
 5 responsible for design and construction of the Victoria Island or Clifton Court Forebay facilities.

6 The Agreement requires an initial conveyance to CCWD of 30 TAF of water. For each year after
 7 the initial conveyance, a specified amount of water based on the prior year's operations would
 8 be conveyed in arrears. Under the Agreement, CCWD would take the same quantity of water that
 9 it would take absent the agreement, but the location and timing of diversions would change.
 10 Annual average diversions of mitigation water would be on the order of 30 TAF, and the rate of
 11 diversion of the mitigation water would be 150 cfs, with a maximum rate of diversion of 250 cfs
 12 upon mutual agreement between DWR and CCWD.

13 Additional description of the Agreement actions and analysis of the potential effects of this
 14 mitigation measure are provided in Appendix 31B. Terms of the Agreement are presented in
 15 Attachment 1 to Appendix 31B.

16 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2-** 17 **CM21**

18 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21), of which
 19 most do not involve land disturbance, present no new direct sources of chloride to the affected
 20 environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export
 21 Service Area, nor would they affect channel flows or Delta hydrodynamic conditions. As noted
 22 above, the potential effects of implementation of tidal habitat restoration (i.e., CM4) on Delta
 23 hydrodynamic conditions is addressed above in the discussion of Impact WQ-8. The potential
 24 channel flow effects of CM2 for actions in the Yolo Bypass also were accounted for in the CALSIM II
 25 and DSM2 modeling, and thus were addressed in the discussion for Impact WQ-8. CM3 and CM11
 26 provide the mechanism, guidance, and planning for the land acquisition and thus would not,
 27 themselves, affect chloride levels in the Delta. CM12–CM21 involve actions that target reduction in
 28 other stressors at the species level involving actions such as methylmercury reduction management
 29 (CM12), improving DO in the Stockton Deep Water Ship Channel (CM14), and urban stormwater
 30 treatment (CM19). None of CM12–CM21 would contribute to substantially increasing chloride levels
 31 in the Delta. Consequently, as they pertain to chloride, implementation of CM2–CM21 would not be
 32 expected to adversely affect any of the beneficial uses of the affected environment. Moreover, some
 33 habitat restoration conservation measures (CM4–CM10) would occur on lands within the Delta
 34 currently used for irrigated agriculture, thus replacing agricultural land uses with restored tidal
 35 wetlands, floodplain, and related channel margin and off-channel habitats. The potential reduction
 36 in irrigated lands within the Delta may result in reduced discharges of agricultural field drainage
 37 with elevated chloride concentrations, which would be considered an improvement compared to the
 38 No Action Alternative.

39 In summary, based on the discussion above, the effects on chloride from implementing CM2–CM21
 40 are considered to be not adverse.

41 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 4 would not present new or
 42 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 43 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 44 with habitat restoration conservation measures may result in some reduction in discharge of

1 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
2 quality conditions. Based on these findings, this impact is considered to be less than significant. No
3 mitigation is required.

4 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 5 **Maintenance (CM1)**

6 *Upstream of the Delta*

7 DO levels in the reservoirs and rivers are primarily affected by water temperature, flow velocity,
8 turbulence, amounts of oxygen demanding substances present (e.g., ammonia, organics), and rates
9 of photosynthesis (which is influenced by nutrient levels), respiration, and decomposition. Water
10 temperature and salinity affect the maximum DO saturation level (i.e., the highest amount of oxygen
11 the water can dissolve). Flow velocity affects the turbulence and re-aeration of the water (i.e., the
12 rate at which oxygen from the atmosphere can be dissolved in water). High nutrient content can
13 support aquatic plant and algae growth, which in turn generates oxygen through photosynthesis and
14 consumes oxygen through respiration and decomposition.

15 A reservoir can exhibit seasonal changes in the DO profile from the water surface to the sediments
16 that is affected by its degree of thermal stratification, where oxygenated inflows enter and mix with
17 the reservoir, its level of productivity that contributes DO through photosynthesis and consumes DO
18 through respiration and decomposition, as well as the prevailing winds that cause mixing within the
19 reservoir. Water temperature also is a factor in that it affects the level (between the surface and the
20 bottom) at which oxygenated river inflows enter the reservoir, the DO saturation level, and
21 photosynthesis and respiration rates. Cold inflows tend to move deep into the reservoir due to the
22 lower density of cold water, whereas warm water inflows tend to mix with the surface waters,
23 particularly when the reservoir is thermally stratified. Under Alternative 4, the primary factor that
24 would change relative to Existing Conditions is that end-of-September carryover storage may be
25 lower in some years (see Chapter 5, *Water Supply*, Section 5.3.3.9), which would affect the
26 temperature profile of the reservoirs at the end of summer. Nevertheless, the reservoirs would
27 continue to thermally stratify seasonally, as they do under Existing Conditions. Given the size of the
28 reservoirs—Lake Oroville, Trinity Lake, Shasta Lake, and Folsom Lake—and their significant surface
29 area, inflows and wind fetch that would still contribute to oxygenating these water bodies, the lower
30 carryover storage that could occur in some years under Alternative 4 is not expected to cause DO
31 depletions or substantial changes in DO that would adversely affect the beneficial uses of these
32 water bodies.

33 The four operational scenarios of Alternative 4 would alter the magnitude and timing of water
34 releases from reservoirs upstream of the Delta relative to Existing Conditions and the No Action
35 Alternative, which would consequently alter downstream river flows. There would be some
36 increases and decreases in the mean monthly river flows, depending on month and year. Mean
37 monthly flows would remain within the range historically seen under Existing Conditions and the
38 No Action Alternative. Moreover, these are large, turbulent rivers with flow velocities typically in the
39 range of 0.5 fps to 2.0 fps or higher. Consequently, flow changes that would occur under any
40 operational scenario of Alternative 4 would not be expected to have substantial effects on river DO
41 levels; likely, the changes would be immeasurable. This is because sufficient turbulence and
42 interaction of river water with the atmosphere would continue to occur under this alternative to
43 maintain water saturation levels (due to these factors) at levels similar to that of Existing Conditions
44 and the No Action Alternative.

1 The changes in the magnitude and timing of water releases from reservoirs upstream of the Delta,
 2 relative to Existing Conditions and the No Action Alternative, could affect downstream river
 3 temperatures, depending on month and year. Water temperature affects the maximum DO
 4 saturation level; as temperature increases, the DO saturation level decreases. When holding
 5 constant for barometric pressure (e.g., 760 mm mercury), the DO saturation level ranges from 7.5
 6 mg/L at 30°C (86°F) to 11 mg/L at 10°C (50°F) (Tchobanoglous and Schroeder 1987:735). As
 7 described in Section 8.1, *Environmental Setting/Affected Environment*, DO in the Sacramento River at
 8 Keswick, Feather River at Oroville, and lower American River ranged from 7.3 to 15.6 mg/L, 7.4 to
 9 12.5 mg/L, and 6.5 to 13.0 mg/L, respectively. Thus, these rivers are well oxygenated and
 10 experience periods of supersaturation (i.e., when DO level exceeds the saturation concentration).
 11 Because these are large, turbulent rivers, any reduced DO saturation level that would be caused by
 12 an increase in temperature under any operational scenario of Alternative 4 would not be expected
 13 to cause DO levels to be outside of the range seen historically. This is because sufficient turbulence
 14 and interaction of river water with the atmosphere would continue to occur under this alternative to
 15 maintain saturation levels.

16 Amounts of oxygen demanding substances present (e.g., ammonia, organics) in the reservoirs and
 17 rivers upstream of the Delta, rates of photosynthesis (which is influenced by nutrient
 18 levels/loading), and respiration and decomposition of aquatic life is not expected to change
 19 sufficiently under Alternative 4 to substantially alter DO levels relative to Existing Conditions or the
 20 No Action Alternative. Any minor reductions in DO levels that may occur under this alternative
 21 would not be expected to be of sufficient frequency, magnitude and geographic extent to adversely
 22 affect beneficial uses, or substantially degrade the quality of these water bodies, with regard to DO.

23 An effect on salinity (expressed as EC) would not be expected in the rivers and reservoirs upstream
 24 of the Delta. Thus, these parameters would not be expected to measurably change DO levels under
 25 any of the operational scenarios of Alternative 4, relative to Existing Conditions or the No Action
 26 Alternative.

27 **Delta**

28 Similar to the reservoirs and rivers upstream of the Delta, DO levels in the Delta are primarily
 29 affected by water temperature, salinity, Delta channel flow velocities, nutrients (i.e., phosphorus and
 30 nitrogen) and aquatic organisms (i.e., photosynthesis, respiration, and decomposition). Sediment
 31 oxygen demand of organic material deposited in the low velocity channels also affects Plan Area DO
 32 levels.

33 Under all operational scenarios of Alternative 4, minor DO level changes could occur due to nutrient
 34 loading to the Delta relative to Existing Conditions and the No Action Alternative (see WQ-1, WQ-15,
 35 WQ-23). The state has begun to aggressively regulate point-source discharge effects on Delta
 36 nutrients, and is expected to further regulate nutrients upstream of and in the Delta in the future.
 37 Although population increased in the affected environment between 1983 and 2001, average
 38 monthly DO levels during this period of record show no trend in decline in the presence of
 39 presumed increases in anthropogenic sources of nutrients (see Table 8-11). Based on these
 40 considerations, excessive nutrients that would cause low DO levels would not be expected to occur
 41 under any operational scenario of Alternative 4.

42 Various areas of the Delta could experience salinity increases due to change in quantity of Delta
 43 inflows (see WQ-11) For a 5 ppt salinity increase at 68°Fahrenheit, the saturation level of oxygen
 44 dissolved in the water is reduced by only about 0.25 mg/L. Thus, increased salinity under

1 Alternative 4 would generally have relatively minor effects on Delta DO levels where salinity is
2 increased on the order of 5 ppt or less.

3 The relative degree of tidal exchange of flows and turbulence, which contributes to exposure of
4 Delta waters to the atmosphere for reaeration, would not be expected to substantially change
5 relative to Existing Conditions or the No Action Alternative, such that these factors would reduce
6 Delta DO levels below objectives or levels that protect beneficial uses.

7 Effects of climate change on air and Delta water temperatures are discussed in Appendix 29C,
8 *Climate Change and the Effects of Reservoir Operations on Water Temperatures in the Study Area*. In
9 general, waters of the Delta would be expected to warm less than 5 degrees F under Alternative 4,
10 relative to Existing Conditions, due to climate change, which translates into a < 0.5 mg/L decrease in
11 DO saturation. Thus, increased temperature under Alternative 4 due to climate change would
12 generally have relatively minor effects on Delta DO levels, relative to Existing Conditions.

13 Some waterways in the eastern, southern, and western Delta, and Suisun Marsh are listed on the
14 state's Clean Water Act Section 303(d) list as impaired due to low oxygen levels. A TMDL for the
15 Deep Water Ship channel in the eastern Delta has been approved and identifies the factors
16 contributing to low DO in the Deep Water Ship Channel as oxygen demanding substances from
17 upstream sources, Deep Water Ship Channel geometry, and reduced flow through the Deep Water
18 Ship Channel (Central Valley Regional Water Quality Control Board 2005:28). The TMDL takes a
19 phased approach to allow more time to gather additional informational on sources and linkages to
20 the DO impairment, while at the same time moving forward on making improvements to DO
21 conditions. One component of the TMDL implementation activities is an aeration device
22 demonstration project.

23 In the Deep Water Ship Channel, low DO events have historically occurred in May-October, and
24 typically in drier years and when flows in the San Joaquin River at Stockton are less than 1,000 cfs
25 (Central Valley Regional Water Quality Control Board 2014, ICF International 2010). Concerns have
26 been raised that flows on the San Joaquin River at Stockton may increase, causing the location of the
27 minimum DO point to shift downstream.

28 Figure 8-65a shows a box-and-whisker plot of the monthly average flows in the San Joaquin River at
29 Stockton for the months of May–October for Dry and Critical water year types. The figure shows that
30 while flows do change somewhat, they are generally within the range of flows seen under Existing
31 Conditions. Reports indicate that the aeration facility performs adequately under the range of flows
32 from 250–1,000 cfs (ICF International 2010). Based on the above, the expected changes in flows in
33 the San Joaquin River at Stockton are not expected to substantially move the point of minimum DO,
34 and therefore the aeration facility will likely still be located appropriately to keep DO levels above
35 Basin Plan objectives.

36 Overall, assuming continued operation of the aerators, the alternative is not expected to have a
37 substantial impact on DO in the Deep Water Ship Channel. It is expected that under Alternative 4
38 that DO levels in the Deep Water Ship Channel would remain similar to those under Existing
39 Conditions and the No Action Alternative or improve as the TMDL-required studies are completed
40 and actions are implemented to improve DO levels. DO levels in other Clean Water Act Section
41 303(d)-listed waterways would not be expected to change relative to Existing Conditions or the No
42 Action Alternative, as the circulation of flows, tidal flow exchange, and re-aeration would continue to
43 occur.

1 **SWP/CVP Export Service Areas**

2 The primary factor that would affect DO in the conveyance channels and ultimately the receiving
3 reservoirs in the SWP/CVP Export Service Areas would be changes in the levels of nutrients and
4 oxygen-demanding substances and DO levels in the exported water. For reasons provided above, the
5 Delta waters exported to the SWP/CVP Export Service Areas would not be expected to be
6 substantially lower in DO compared to Existing Conditions or the No Action Alternative. Because the
7 biochemical oxygen demand of the exported water would not be expected to substantially differ
8 from that under Existing Conditions or the No Action Alternative (due to ever increasing water
9 quality regulations), canal turbulence and exposure of the water to the atmosphere and the algal
10 communities that exist within the canals would establish an equilibrium for DO levels within the
11 canals. The same would occur in downstream reservoirs. Consequently, substantial adverse effects
12 on DO levels in the SWP/CVP Export Service Areas would not be expected to occur.

13 **NEPA Effects:** The effects on DO from implementing any operational scenario of Alternative 4 is
14 determined to not be adverse.

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
17 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
18 constituent. For additional details on the effects assessment findings that support this CEQA impact
19 determination, see the effects assessment discussion that immediately precedes this conclusion.

20 Reservoir storage reductions that would occur under any operational scenario of Alternative 4,
21 relative to Existing Conditions, would not be expected to result in a substantial adverse change in DO
22 levels in the reservoirs, because oxygen sources (surface water aeration, aerated inflows, vertical
23 mixing) would remain. Similarly, river flow rate reductions that would occur would not be expected
24 to result in a substantial adverse change in DO levels in the rivers upstream of the Delta, given that
25 mean monthly flows would remain within the ranges historically seen under Existing Conditions
26 and the affected river are large and turbulent. Any reduced DO saturation level that may be caused
27 by increased water temperature would not be expected to cause DO levels to be outside of the range
28 seen historically. Finally, amounts of oxygen demanding substances and salinity would not be
29 expected to change sufficiently to affect DO levels.

30 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
31 Delta source water percentages under this alternative or substantial degradation of these water
32 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
33 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
34 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
35 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
36 the reaeration of Delta waters would not be expected to change substantially.

37 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
38 Export Service Areas waters under any operational scenario of Alternative 4, relative to Existing
39 Conditions. Because the biochemical oxygen demand of the exported water would not be expected
40 to substantially differ from that under Existing Conditions (due to ever increasing water quality
41 regulations), canal turbulence and exposure of the water to the atmosphere and the algal
42 communities that exist within the canals would establish an equilibrium for DO levels within the
43 canals. The same would occur in downstream reservoirs.

1 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 2 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 3 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 4 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 5 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 6 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 7 related impairment of these areas would not be expected. This impact would be less than significant.
 8 No mitigation is required.

9 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

10 **NEPA Effects:** CM2–CM21 would not be expected to contribute to adverse DO levels in the Delta. The
 11 increased habitat provided by CM2–CM11 could contribute to an increased biochemical or sediment
 12 demand, through contribution of organic carbon and plants decaying. However, similar habitat
 13 exists currently in the Delta and is not identified as contributing to adverse DO conditions. Although
 14 additional DOC loading to the Delta may occur (see impact WQ-18), only a fraction of the DOC is
 15 available to microorganisms that would consume oxygen as part of the decay and mineralization
 16 process. Since decreases in dissolved organic carbon are not typically observed in Delta waterways
 17 due to these processes, any increase in DOC is unlikely to contribute to adverse DO levels in the
 18 Delta. CM13 proposes to use a variety of methods to control invasive aquatic plants, of which
 19 herbicide spraying is one option. The area of treatment that would be funded by the conservation
 20 measure would be 1,700–3,300 acres (see Section 3.6.3.2 of Chapter 3, *Description of Alternatives*), a
 21 limited area relative to the entire area of the Delta surface waters. Further, as described in Section
 22 3.6.3.2 of Chapter 3, avoidance and minimization measures would be adopted and would likely be
 23 similar to those conditions identified in the existing CDBW program (including the associated
 24 biological opinion and EIR), which restrict where and when herbicide treatment may be
 25 implemented, establish allowable chemical concentrations in treated areas and adjacent water, and
 26 require extensive water quality monitoring. Thus, based on the size of the area to be treated and the
 27 measures to be used, this conservation is not considered to have an adverse effect on DO in the Delta
 28 that would adversely affect beneficial uses. CM14, an oxygen aeration facility in the Stockton Deep
 29 Water Ship Channel to meet TMDL objectives established by the Central Valley Water Board, would
 30 maintain DO levels above those that impair fish species when covered species are present. CM19,
 31 which would fund projects to contribute to reducing pollutant discharges in stormwater, would be
 32 expected to reduce biochemical oxygen demand load and, thus, would not adversely affect DO levels.
 33 The remaining conservation measures would not be expected to affect DO levels because they are
 34 actions that do not affect the presence of oxygen-demanding substances.

35 The effects on DO from implementing CM2–CM21 is determined to not be adverse.

36 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
 37 or in the SWP/CVP Export Service Areas following implementation of CM2–CM21 under Alternative
 38 4 would not be substantially different from existing DO conditions. Therefore, this alternative is not
 39 expected to cause additional exceedance of applicable water quality objectives by frequency,
 40 magnitude, and geographic extent that would result in significant impacts on any beneficial uses
 41 within affected water bodies. Because no substantial changes in DO levels would be expected, long-
 42 term water quality degradation would not be expected, and, thus, beneficial uses would not be
 43 adversely affected. Various Delta waterways are 303(d)-listed for low DO, but because no
 44 substantial decreases in DO levels would be expected, greater degradation and impairment of these
 45 areas would not be expected. Implementation of CM14 would have a net beneficial effect on DO

1 conditions in the Stockton Deep Water Ship Channel. This impact would be less than significant. No
2 mitigation is required.

3 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 4 **Operations and Maintenance (CM1)**

5 ***Upstream of the Delta***

6 Alternative 4, Scenarios H1–H4, would alter the magnitude and timing of water releases from
7 reservoirs upstream of the Delta relative to Existing Conditions and the No Action Alternative. With
8 respect to EC, an increase or decrease in river flow alone is not of concern. Measureable changes in
9 the quality of the watershed runoff and reservoir inflows would not be expected to occur in the
10 future; therefore, the EC levels in these reservoirs would not be expected to change relative to
11 Existing Conditions or the No Action Alternative. There could be increased discharges of EC-
12 elevating parameters in the future in water bodies upstream of the Delta as a result of urban growth
13 and increased runoff and wastewater discharges. The state has begun to aggressively regulate point-
14 source discharge effects on Delta salinity-elevating parameters, capping dischargers at existing
15 levels, and is expected to further regulate EC and related parameters upstream of and within the
16 Delta in the future as salt management plans are developed. Based on these considerations, EC levels
17 (highs, lows, typical conditions) in the Sacramento River and its tributaries, the eastside tributaries,
18 or their associated reservoirs upstream of the Delta would not be expected to be outside the ranges
19 occurring under Existing Conditions or the No Action Alternative.

20 The effects on lower San Joaquin River EC would be somewhat different. Elevated EC in the San
21 Joaquin River can be sourced to agricultural use of irrigation water imported from the southern
22 Delta and applied on soils high in salts. This accumulation of salts is a primary contributor of
23 elevated EC on the lower San Joaquin River. Tributary flows generally provide dilution of the high
24 EC agricultural drainage waters. Depending on operational scenario, long-term average flows at
25 Vernalis would decrease about 6% (as a result of climate change and increased water demands)
26 relative to Existing Conditions, and would increase about 0.1% relative to the No Action Alternative
27 (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). These decreases
28 in flow, alone, would correspond to a possible increase in long-term average EC levels. The level of
29 EC increase cannot be readily quantified but, based on estimated increase in bromide and chloride
30 concentrations, to which EC is correlated, would be relatively small and on the order of about 3%
31 relative to Existing Conditions, and less than 0.1% relative to the No Action Alternative. However,
32 with the implementation of the adopted TMDL for the San Joaquin River at Vernalis and the ongoing
33 development of the TMDL for the San Joaquin River upstream of Vernalis and its implementation, it
34 is expected that long-term EC levels will improve. Based on these considerations, substantial
35 changes in EC levels in the San Joaquin River relative to Existing Conditions or the No Action
36 Alternative would not be expected of sufficient magnitude and geographic extent that would result
37 in adverse effects on any beneficial uses, or substantially degrade the quality of these water bodies,
38 with regard to EC.

39 ***Delta***

40 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
41 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
42 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
43 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of

1 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
2 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
3 more information.

4 Relative to Existing Conditions, modeling indicates that Alternative 4, Scenarios H1–H4, would result
5 in an increase in the number of days the Bay-Delta WQCP EC objectives would be exceeded in the
6 Sacramento River at Emmaton, San Joaquin River at San Andreas Landing, Jersey Point, and
7 Prisoners Point, and Old River near Middle River and at Tracy Bridge (Appendix 8H, Table EC-4).

8 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
9 (1976–1991) would increase from 6% under Existing Conditions to 27–29%, depending on the
10 operations scenario, and the percentage of days out of compliance would increase from 11% under
11 Existing Conditions to 40–43%, depending on the operations scenario. Although these results are for
12 modeling that was originally performed for Alternative 4 assuming the Emmaton compliance point
13 shifted to Threemile Slough, Alternative 4 now does not include a change in compliance point from
14 Emmaton to Threemile Slough. Sensitivity analyses were performed that modeled Alternative 4
15 Scenario H3 with Emmaton as the compliance point. Assuming the compliance location at Emmaton
16 instead of Threemile Slough in the CALSIM II modeling decreased exceedances at Emmaton from
17 28% to 15% under Alternative 4, Operational Scenario H3 (see Appendix 8H, Attachment 1 for more
18 discussion of these sensitivity analyses), which would still be greater than Existing Conditions. Table
19 2 of Appendix 8H, Attachment 1 indicates that most of these exceedances are a result of modeling
20 artifacts, but some exceedances are due to dead pool conditions that occurred in 1977, 1981, and
21 1990 under Alternative 4 and not under Existing Conditions. As discussed in Chapter 5, *Water*
22 *Supply*, Section 5.3.1, *Methods for Analysis*, under extreme hydrologic and operational conditions
23 where there is not enough water supply to meet all requirements, CALSIM II uses a series of
24 operating rules to reach a solution that is a simplified version of the very complex decision
25 processes that SWP and CVP operators would use in actual extreme conditions. Thus, it is unlikely
26 that the Emmaton objective would actually be violated due to dead pool conditions. However, these
27 results indicate that water supply could be either under greater stress or under stress earlier in the
28 year, and EC levels at Emmaton and in the western Delta may increase as a result, leading to EC
29 degradation and increased possibility of adverse effects to agricultural beneficial uses.

30 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
31 from 1% to 3–6%, depending on the operations scenario. The percentage of days out of compliance
32 with the EC objective for San Andreas Landing would increase from 1% to 5–9%, depending on the
33 operations scenario. Sensitivity analyses performed indicate that many of these exceedances are
34 modeling artifacts, and the small number of remaining exceedances were small in magnitude, lasted
35 only a few days, and could be addressed with real time operations of the SWP and CVP (see Section
36 8.3.1.1, *Models Used and Their Linkages*, for a description of real time operations of the SWP and
37 CVP).

38 The percentage of days the Prisoners Point EC objective would be exceeded for the entire period
39 modeled would increase from 6% to 21–31% and the percentage of days out of compliance with the
40 EC objective would increase from 10% to 25–33%, depending on the operations scenario. At Jersey
41 Point, the percentage of days the EC fish and wildlife objective would be exceeded for the entire
42 period modeled would increase from 0% to 0–2%, and the percentage of days out of compliance
43 with the EC objective would increase from 0% to 0–2%, depending on operations scenario.
44 Sensitivity analyses conducted indicate that removing all tidal restoration areas would reduce the
45 number of exceedances, but there would still be substantially more exceedances than under Existing

1 Conditions or the No Action Alternative. Results of the sensitivity analyses indicate that the
2 exceedances are partially a function of the operations of the alternative itself, perhaps due to Head
3 of Old River Barrier assumptions and south Delta export differences (see Appendix 8H, Attachment
4 1, for more discussion of these sensitivity analyses). Appendix X8H Attachment 2 contains a more
5 detailed assessment of the likelihood of these exceedances impacting aquatic life beneficial uses.
6 Specifically, Appendix 8H, Attachment 2, discusses whether these exceedances might have indirect
7 effects on striped bass spawning in the Delta, and concludes that the high level of uncertainty
8 precludes making a definitive determination.

9 The increase in percentage of days exceeding the EC objectives and days out of compliance at the
10 Old River locations would be 1–2% at Tracy Bridge and less than 1% at Middle River for all
11 operations scenarios. Sensitivity analyses performed indicated that many of these exceedances are
12 modeling artifacts, and modeling barrier installation assumptions consistent with historical dry year
13 practices of installing barriers earlier in the year could resolve these additional exceedances (see
14 Appendix 8H, Attachment 1, for a discussion of these sensitivity analyses). Furthermore, as noted in
15 Section 8.1.3.7, SWP and CVP operations have relatively little influence on salinity levels at these
16 locations, and the elevated salinity in south Delta channels is affected substantially by local salt
17 contributions discharged into the San Joaquin River downstream of Vernalis. Thus, the modeling has
18 limited ability to estimate salinity accurately in this region.

19 Average EC levels at the western and southern Delta compliance locations would decrease, except at
20 Emmaton, from 1–36% for the entire period modeled and 2–33% during the drought period
21 modeled (1987–1991) (Appendix 8H, Tables EC-15A through EC-15D). At Emmaton, there would be
22 an increase in average EC under all operational scenarios, though the increase would be less for
23 Scenarios H3 and H4 (0% for entire period; 8% for drought period) than for Scenarios H1 and H2
24 (13–14% for entire period; 12–13% for drought period). There would be increases in average EC at
25 two interior Delta locations under all operational scenarios: the S. Fork Mokelumne River at
26 Terminous average EC would increase 5% for the entire period modeled and 4% during the drought
27 period modeled; and San Joaquin River at San Andreas Landing average EC would increase 0–9% for
28 the entire period modeled and 7–13% during the drought period modeled. In addition, under
29 Scenarios H1 and H2, there would be slight increase (<1–2%) in drought period average EC in the
30 San Joaquin River at Prisoners Point. On average, EC would increase at San Andreas Landing from
31 March through September under all operations scenarios; Scenarios H1, H2, and H4 also would
32 increase EC at this location in February and Scenarios H1 and H2 would increase EC in October.
33 Average EC in the S. Fork Mokelumne River at Terminous would increase during all months. Average
34 EC at Jersey Point during the months of April–May, when the fish and wildlife objective applies in all
35 but critical water year types, would increase from 14–15% for the entire period modeled (Appendix
36 8H, Tables EC-15A through EC-15D). The comparison to Existing Conditions reflects changes in EC
37 due to both Alternative 4 operations (including north Delta intake capacity of 9,000 cfs and
38 numerous other operational components of Scenarios H1–H4) and climate change/sea level rise.

39 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
40 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
41 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
42 Tracy Bridge (Appendix 8H, Table EC-4). The increase in percentage of days exceeding the EC
43 objective would be 20–30% at Prisoners Point, depending on the operations scenario, and 15% or
44 less at the remaining locations. The increase in percentage of days out of compliance would be 24–
45 32% at Prisoners Point, depending on the operations scenario, and 17% or less at the remaining
46 locations. In general, the changes in frequency of exceedances of EC objectives relative to the No

1 Action Alternative would be similar to those discussed above relative to Existing Conditions, and
2 thus the conclusions of the sensitivity analyses discussed above extend to the comparison to the No
3 Action Alternative. The exception to this is for Emmaton. As discussed above, assuming the
4 compliance location at Emmaton instead of Threemile Slough in the CALSIM II modeling decreased
5 the frequency of objective exceedances at Emmaton from 28% to 15% under Alternative 4,
6 Operational Scenario H3 (see Appendix 8H, Attachment 1, for more discussion of these sensitivity
7 analyses). This frequency of objective exceedance is very similar to the frequency of exceedances
8 under the No Action Alternative, which would be 13%. Nevertheless, Table 2 of Appendix 8H,
9 Attachment 1, indicates that exceedances due to deadpool conditions in 1981 and 1990 occurred
10 under Alternative 4 and not under the No Action Alternative. As discussed above, it is unlikely that
11 the Emmaton objective would actually be exceeded due to dead pool conditions. However, these
12 results indicate that water supply conditions could be either under greater stress or under stress
13 earlier in the year, and EC levels at Emmaton and in the western Delta may increase as a result,
14 leading to EC degradation and increased possibility of adverse effects on agricultural beneficial uses.
15 The frequency and magnitude of increased EC levels relative to the No Action Alternative at
16 Emmaton is lower than relative to Existing Conditions, because climate change and sea level rise
17 present in both the No Action Alternative and Alternative 4 contribute to the extreme hydrologic
18 conditions in several years.

19 For the entire period modeled, average EC levels would increase at western (Scenarios H1 and H2
20 only), interior, and southern Delta locations; the average EC increase would be 12–13% at Emmaton
21 (western Delta; for Scenarios H1 and H2 only), 5–15% at interior Delta locations and 2% or less at
22 southern Delta locations, depending on the operations scenario (Appendix 8H, Tables EC-15A
23 through EC-15D). During the drought period modeled, average EC would increase at western
24 (Scenarios H1 and H2 only), interior, and southern Delta locations. The greatest average EC increase
25 during the drought period modeled would occur in the interior Delta in the San Joaquin River at San
26 Andreas Landing (7–13% depending on the operations scenario); the increase at the other locations
27 would be <1–9% (Appendix 8H, Tables EC-15A through EC-15D). The comparison to the No Action
28 Alternative reflects changes in EC due only to the different components of Operational Scenarios
29 H1–H4 of Alternative 4.

30 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
31 fish and wildlife apply. Modeling data indicate that average EC for the entire period modeled would
32 increase in the Sacramento River at Collinsville during the months of March through May under all
33 operations scenarios of Alternative 4, relative to Existing Conditions, by 0.3–0.9 mS/cm (Appendix
34 8H, Table EC-21). Long-term average EC would decrease under all operations scenarios, relative to
35 Existing Conditions, in Montezuma Slough at National Steel during October–May (Appendix 8H,
36 Table EC-22). The most substantial EC increase would occur near Beldon’s Landing, with long-term
37 average EC levels increasing by 1.3–6.0 mS/cm, depending on the month and operations scenario, at
38 least doubling during some months the long-term average EC relative to Existing Conditions
39 (Appendix 8H, Table EC-23). Sunrise Duck Club and Volanti Slough also would have long-term
40 average EC increases during all months ranging 0.5–3.9 mS/cm (Appendix 8H, Tables EC-24 and EC-
41 25). Modeling of Alternative 4 assumed no operation of the Montezuma Slough Salinity Control
42 Gates, but the project description assumes continued operation of the Salinity Control Gates,
43 consistent with assumptions included in the No Action Alternative. A sensitivity analysis modeling
44 run conducted for Alternative 4 Scenario H3 with the gates operational consistent with the No
45 Action Alternative resulted in substantially lower EC levels than indicated in the original Alternative
46 4 modeling results discussed above, but EC levels were still somewhat higher than EC levels under

1 Existing Conditions and the No Action Alternative for several locations and months. Another
 2 modeling run with the gates operational and restoration areas removed resulted in EC levels nearly
 3 equivalent to Existing Conditions and the No Action Alternative, indicating that design and siting of
 4 restoration areas has notable bearing on EC levels at different locations within Suisun Marsh (see
 5 Appendix 8H, Attachment 1, for more information on these sensitivity analyses). These analyses also
 6 indicate that increases are related primarily to the hydrodynamic effects of CM4, not operational
 7 components of CM1. Based on the sensitivity analyses, optimizing the design and siting of
 8 restoration areas may limit the magnitude of long-term EC increases to be on the order of 1 mS/cm
 9 or less.

10 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
 11 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
 12 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
 13 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
 14 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
 15 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
 16 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
 17 certain locations could be substantial, depending on siting and design of restoration areas, and it is
 18 uncertain the degree to which current management plans for the Suisun Marsh would be able to
 19 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
 20 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
 21 Long-term average EC increases in Suisun Marsh under Alternative 4, Scenarios H1–H4, relative to
 22 the No Action Alternative would be similar to the increases relative to Existing Conditions.

23 ***SWP/CVP Export Service Area***

24 At the Banks and Jones pumping plants, Alternative 4, Scenarios H1–H4, would result in no
 25 exceedances of the Bay-Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled
 26 (Appendix 8H, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
 27 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 4.

28 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 4,
 29 Scenarios H1–H4, would decrease 23–27% for the entire period modeled and 21–27% during the
 30 drought period modeled, depending on the operations scenario. Relative to the No Action
 31 Alternative, average EC levels would similarly decrease, by 17–22% for the entire period modeled
 32 and 16–22% during the drought period modeled. (Appendix 8H, Tables EC-15A through EC-15D)

33 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 4,
 34 Scenarios H1–H4, would decrease 21–26% for the entire period modeled and 17–23% during the
 35 drought period modeled, depending on the operations scenario. Relative to the No Action
 36 Alternative, average EC levels would similarly decrease by 17–22% for the entire period modeled
 37 and 14–20% during the drought period modeled. (Appendix 8H, Table EC-15A through EC-15D).

38 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 39 pumping plants, Alternative 4, Scenarios H1–H4, would not cause degradation of water quality with
 40 respect to EC in the SWP/CVP Export Service Areas; rather, Alternative 4, Scenarios H1–H4, would
 41 improve long-term average EC conditions in the SWP/CVP Export Service Areas.

42 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 43 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related

1 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
2 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
3 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
4 increase in EC at Vernalis related to decreased annual average San Joaquin River flows.

5 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
6 elevated EC. Alternative 4, Scenarios H1-H4, would result in lower average EC levels relative to
7 Existing Conditions and the No Action Alternative and, thus, would not contribute to additional
8 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

9 **NEPA Effects:** In summary, based on the results of the modeling and sensitivity analyses conducted,
10 it is unlikely that there would be increased frequency of exceedance of agricultural EC objectives in
11 the western, interior, or southern Delta. However, modeling results indicate that there could be
12 increased long-term and drought period average EC levels that would occur in the western Delta
13 under Alternative 4, Scenarios H1-H4, relative to the No Action Alternative, that would contribute to
14 adverse effects on the agricultural beneficial uses. The increased frequency of exceedance of the San
15 Joaquin River at Prisoners Point EC objective and long-term and drought period average EC could
16 contribute to adverse effects on fish and wildlife beneficial uses (specifically, indirect adverse effects
17 on striped bass spawning), though there is a high degree of uncertainty associated with this impact.
18 The western and southern Delta are CWA Section 303(d) listed as impaired due to elevated EC, and
19 increases in long-term average and drought period average EC in the western portion of the Delta
20 have the potential to contribute to additional beneficial use impairment. The increases in long-term
21 average EC levels that could occur in Suisun Marsh would further degrade existing EC levels and
22 could contribute to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is CWA
23 Section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
24 average EC levels could contribute to additional beneficial use impairment. The effects on EC in the
25 western Delta, San Joaquin River at Prisoners Point, and in Suisun Marsh constitute an adverse effect
26 on water quality. Mitigation Measure WQ-11 would be available to reduce these effects.
27 Implementation of this measure along with a separate, other commitment as set forth in EIR/EIS
28 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-related
29 changes would reduce these effects. Specifically, Mitigation Measure WQ-11d would be expected to
30 reduce effects in Suisun Marsh to a level that would not be adverse.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
33 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
34 constituent. For additional details on the effects assessment findings that support this CEQA impact
35 determination, see the effects assessment discussion that immediately precedes this conclusion.

36 River flow rate and reservoir storage reductions that would occur under Alternative 4, Scenarios
37 H1-H4, relative to Existing Conditions, would not be expected to result in a substantial adverse
38 change in EC levels in the reservoirs and rivers upstream of the Delta, given that: changes in the
39 quality of watershed runoff and reservoir inflows would not be expected to occur in the future; the
40 state's aggressive regulation of point-source discharge effects on Delta salinity-elevating parameters
41 and the expected further regulation as salt management plans are developed; the salt-related
42 TMDLs adopted and being developed for the San Joaquin River; and the expected improvement in
43 lower San Joaquin River average EC levels commensurate with the lower EC of the irrigation water
44 deliveries from the Delta.

1 Relative to Existing Conditions, Alternative 4, Scenarios H1–H4, would not result in any substantial
2 increases in long-term average EC levels in the SWP/CVP Export Service Areas. There would be no
3 exceedance of the EC objective at the Jones and Banks pumping plants. Average EC levels for the
4 entire period modeled would decrease at both plants and, thus, this alternative would not contribute
5 to additional beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas
6 waters. Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service
7 Areas, relative to Existing Conditions.

8 In the Plan Area, Alternative 4, Scenarios H1–H4, would result in an increase in the frequency with
9 which Bay-Delta WQCP EC objectives are exceeded for the entire period modeled (1976–1991) in
10 the San Joaquin River at Jersey Point, and the San Joaquin River at Prisoners Point. Though objective
11 exceedance would likely not occur in the Sacramento River at Emmaton, average EC levels at
12 Emmaton would increase by <1–14% for the entire period modeled and 8–13% during the drought
13 period modeled. These increases in long-term and drought period average EC levels would
14 potentially contribute to adverse effects on the agricultural beneficial uses in the western Delta. The
15 comparison to Existing Conditions reflects changes in EC due to both Alternative 4 operations and
16 climate change/sea level rise. The adverse effects expected to occur at Emmaton would be due in
17 part to the effects of climate change/sea level rise, and in part due to Alternative 4 operations. This
18 is evidenced by the significant effects expected in the No Action Alternative at Emmaton relative to
19 Existing Conditions (see Section 8.3.3.1, Impact WQ-11), as well as the fact that a lesser level of
20 adverse effects is expected at Emmaton under Alternative 4 relative to the No Action Alternative
21 (see “NEPA Effects” section above). Based on the results of the modeling and sensitivity analyses
22 conducted, it is unlikely that there would be increased frequency of exceedance of agricultural EC
23 objectives in the interior or southern Delta, or that increased long-term and drought period average
24 EC levels that would occur in these areas, relative to Existing Conditions, would contribute to
25 adverse effects on the agricultural beneficial uses. The increased frequency of exceedance of the fish
26 and wildlife objective at Jersey Point and Prisoners Point could contribute to adverse effects on
27 aquatic life (specifically, indirect adverse effects on striped bass spawning), though there is a high
28 degree of uncertainty associated with this impact. Because EC is not bioaccumulative, the increases
29 in long-term average EC levels would not directly cause bioaccumulative problems in aquatic life or
30 humans. The western and southern Delta are CWA Section 303(d) listed for elevated EC and the
31 increased EC degradation that could occur in the western Delta could make beneficial use
32 impairment measurably worse. Since there would be very little change in EC levels in the southern
33 Delta and there is not expected to be an increase in frequency of exceedances of objectives, this
34 alternative is not expected to make beneficial use impairment measurably worse in the southern
35 Delta. This impact is considered to be significant.

36 Further, relative to Existing Conditions, Alternative 4, Scenarios H1–H4, could result in substantial
37 increases in long-term average EC during the months of October through May in Suisun Marsh. The
38 increases in long-term average EC levels that would occur in Suisun Marsh could further degrade
39 existing EC levels and thus contribute additionally to adverse effects on the fish and wildlife
40 beneficial uses. Because EC is not bioaccumulative, the increases in long-term average EC levels
41 would not directly cause bioaccumulative problems in fish and wildlife. Suisun Marsh is CWA
42 Section 303(d) listed for elevated EC and the increases in long-term average EC that would occur in
43 the marsh could make beneficial use impairment measurably worse. This impact is considered to be
44 significant. However, based on sensitivity analyses conducted to date (see Appendix 8H, Attachment
45 1), it is expected that implementation of Mitigation Measure WQ-11d would reduce impacts on EC in
46 Suisun Marsh to a less-than-significant level.

1 Implementation of Mitigation Measure WQ-11 along with a separate, other commitment relating to
 2 the potential increased costs associated with EC-related changes would reduce these effects.
 3 Although it is not known whether implementation of WQ-11 will be able to feasibly reduce water
 4 quality degradation in the western Delta, implementation of Mitigation Measure WQ-11 is
 5 recommended to attempt to reduce the effect that increased EC may have on Delta beneficial uses.
 6 However, because the effectiveness of this mitigation measure to result in feasible measures for
 7 reducing these water quality effects is uncertain, this impact is considered to remain significant and
 8 unavoidable. As mentioned above, it is expected that implementation of Mitigation Measure WQ-11d
 9 would reduce impacts on EC in Suisun Marsh to a less-than-significant level.

10 In addition to and to supplement Mitigation Measure WQ-11, the project proponents have
 11 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 12 *AMMs*, and *CMs*, a separate, other commitment to address the potential increased water treatment
 13 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 14 purveyor operations. Potential options for making use of this financial commitment include funding
 15 or providing other assistance towards acquiring alternative water supplies or towards modifying
 16 existing operations when EC concentrations at a particular location reduce opportunities to operate
 17 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
 18 actions that could be taken pursuant to this commitment in order to reduce the water quality
 19 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
 20 bromide.

21 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 22 **Quality Conditions**

23 In order to reduce the effects of increased EC levels, and potential adverse effects on beneficial
 24 uses associated with CM1 operations (and hydrodynamic effects of tidal restoration under CM4),
 25 the proposed mitigation requires a series of phased actions to identify and evaluate feasible
 26 actions, followed by development and implementation of the actions, if determined to be
 27 necessary. The emphasis and mitigation actions would be limited to those identified as
 28 necessary to avoid, reduce, or offset adverse EC effects at Delta compliance locations and the
 29 Suisun Marsh. The development and implementation of any mitigation actions shall be focused
 30 on those incremental effects attributable to implementation of Alternative 4 operations only.
 31 Development of mitigation actions for the incremental EC effects attributable to climate
 32 change/sea level rise are not required because these changed conditions would occur with or
 33 without implementation of Alternative 4. The goal of specific actions would be to reduce/avoid
 34 additional exceedances of Delta EC objectives and reduce long-term average concentration
 35 increases to levels that would not adversely affect beneficial uses within the Delta and Suisun
 36 Marsh.

37 **Mitigation Measure WQ-11a: Conduct Additional Evaluation of Operational Ability to**
 38 **Reduce or Eliminate Water Quality Degradation in Western Delta Incorporating Site-**
 39 **Specific Restoration Areas and Updated Climate Change/Sea Level Rise Projections, if**
 40 **Available**

41 The project proponents will conduct additional evaluations and develop additional modeling (as
 42 necessary) to define the extent to which modified operations of the SWP and CVP could reduce
 43 or eliminate water quality degradation in the western Delta currently modeled to occur under
 44 Alternative 4. The additional evaluations will be conducted to consider specifically the changes

1 in Delta hydrodynamic conditions associated with tidal habitat restoration under CM4 once the
2 specific restoration locations and timing of their construction are identified and designed. The
3 evaluations will also consider up-to-date estimates of climate change and sea level rise, if and
4 when such information is available. These evaluations will be conducted concurrently with
5 Mitigation Measure WQ-11b. Together, findings from WQ-11a and WQ-11b will indicate
6 whether sufficient flexibility to prevent or offset EC increases is feasible under Alternative 4.
7 These actions are identical to the actions discussed in Mitigation Measure WQ-7a regarding
8 levels of chloride in the western Delta.

9 **Mitigation Measure WQ-11b: Site and Design Restoration Sites to Reduce or Eliminate**
10 **Water Quality Degradation in the Western Delta**

11 The project proponents shall consider effects of site-specific restoration areas proposed under
12 CM4 on EC levels in the western Delta. Design and siting of restoration areas shall attempt to
13 reduce water quality degradation in the western Delta to the extent possible without
14 compromising proposed benefits of the restoration areas. These evaluations will be conducted
15 concurrently with Mitigation Measure WQ-11a. Together, findings from WQ-11a and WQ-11b
16 will indicate whether sufficient flexibility to prevent or offset EC increases is feasible under
17 Alternative 4. These actions are identical to the actions discussed in Mitigation Measure WQ-7b
18 regarding levels of chloride in the western Delta.

19 **Mitigation Measure WQ-11c: Design Restoration Sites to Reduce Effects on Compliance**
20 **with the Fish and Wildlife EC Objective between Prisoners Point and Jersey Point,**
21 **Evaluate Striped Bass Monitoring Data, and Consult with CDFW/USFWS/NMFS to**
22 **Determine Whether Additional Actions are Warranted**

23 The project proponents shall consider effects of site-specific restoration areas proposed under
24 CM4 on compliance with the fish and wildlife EC objective between Jersey Point and Prisoners
25 point on the San Joaquin River. Design of restoration areas shall attempt to reduce potential
26 effects to the extent possible without compromising proposed benefits of the restoration areas.
27 Additionally, following commencement of initial operations of CM1, the project proponents will
28 evaluate ongoing monitoring of striped bass populations, and, specifically spawning in the San
29 Joaquin River between Jersey Point and Prisoners Point, and will conduct such monitoring if it is
30 not already being conducted by CDFW at that time. The project proponents will consult with
31 CDFW, USFWS, and NMFS to determine whether adaptive changes to Head of Old River Barrier
32 operations and/or changes in North Delta vs. South Delta exports are warranted to avoid
33 adverse impacts of salinity on striped bass spawning in the San Joaquin River. Because these
34 actions may have adverse effects on other species, consultation is required, and the changes may
35 not be warranted depending on conditions of striped bass populations and populations of other
36 species at that time.

37 **Mitigation Measure WQ-11d: Site and Design Restoration Sites and consult with**
38 **CDFW/USFWS, and Suisun Marsh Stakeholders to Identify Potential Actions to Avoid or**
39 **Reduce EC Level Increases in the Marsh**

40 The project proponents shall consider effects of site-specific restoration areas proposed under
41 CM4 on EC levels and compliance with the fish and wildlife EC objectives for Suisun Marsh.
42 Design and siting of restoration areas shall attempt to reduce potential effects to the extent
43 possible without compromising proposed benefits of the restoration areas. The project

1 proponents will also consult with CDFW/USFWS, and Suisun Marsh stakeholders, to identify
 2 potential actions to avoid or minimize the EC increases in the marsh, with the goal of
 3 maintaining EC at levels that would not further impair fish and wildlife beneficial uses in Suisun
 4 Marsh. Potential actions may include modifications of the existing Suisun Marsh Salinity Control
 5 Gates for effective salinity control and evaluation of the efficacy of additional physical salinity
 6 control facilities or operations for the marsh to reduce the effects of increased EC levels. These
 7 actions are identical to the actions discussed in Mitigation Measure WQ-7d regarding levels of
 8 chloride in Suisun Marsh.

9 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 10 **CM21**

11 **NEPA Effects:** The implementation of the other conservation measures (i.e., CM2–CM21) present no
 12 new direct sources of EC to the affected environment, including areas upstream of the Delta, within
 13 the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC, implementation of
 14 these conservation measures would not be expected to adversely affect any of the beneficial uses of
 15 the affected environment. Moreover, some habitat restoration conservation measures would occur
 16 on lands within the Delta currently used for irrigated agriculture. Such replacement or substitution
 17 of land use activity is not expected to result in new or increased sources of EC to the Delta and, in
 18 fact, could decrease EC through elimination of high EC agricultural runoff.

19 CM4 would result in substantial tidal habitat restoration that would increase the magnitude of daily
 20 tidal water exchange at the restoration areas, and alter other hydrodynamic conditions in adjacent
 21 Delta channels. The DSM2 modeling included assumptions regarding possible locations of tidal
 22 habitat restoration areas, and how restoration would affect Delta hydrodynamic conditions, and
 23 thus the effects of this restoration measure on Delta EC were included in the assessment of CM1
 24 facilities operations and maintenance.

25 Implementation of CM2–CM21 would not be expected to adversely affect EC levels in the affected
 26 environment and thus would not adversely affect beneficial uses or substantially degrade water
 27 quality with regard to EC within the affected environment.

28 The effects on EC from implementing CM2–CM21 is determined to not be adverse.

29 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 4 would not present new or
 30 substantially changed sources of EC to the affected environment. Some conservation measures may
 31 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 32 is not expected to substantially increase or present new sources of EC, and could actually decrease
 33 EC loads to Delta waters. Thus, implementation of CM2–CM21 would have negligible, if any, adverse
 34 effects on EC levels throughout the affected environment and would not cause exceedance of
 35 applicable state or federal numeric or narrative water quality objectives/criteria that would result
 36 in adverse effects on any beneficial uses within affected water bodies. Further, implementation of
 37 CM2–CM21 would not cause significant long-term water quality degradation such that there would
 38 be greater risk of adverse effects on beneficial uses. Based on these findings, this impact is
 39 considered to be less than significant. No mitigation is required.

1 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under the various Alternative 4 scenarios (H1–H4), greater water demands and climate change
 5 would alter the magnitude and timing of reservoir releases and river flows upstream of the Delta in
 6 the Sacramento River watershed and eastside tributaries, relative to Existing Conditions.

7 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 8 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 9 relationships for mercury and methylmercury. No significant, predictive regression relationships
 10 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 11 (monthly or annual) (Appendix 8I, Figure I-10 through I-13). Such a positive relationship between
 12 total mercury and flow is to be expected based on the association of mercury with suspended
 13 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 14 Sacramento River under the operational scenarios of Alternative 4 relative to Existing Conditions
 15 and No Action Alternative are not of the magnitude of storm flows, in which substantial sediment-
 16 associated mercury is mobilized. Therefore mercury loading should not be substantially different
 17 due to changes in flow. In addition, even though it may be flow-affected, total mercury
 18 concentrations remain well below criteria at upstream locations. Any negligible changes in mercury
 19 concentrations that may occur in the water bodies of the affected environment located upstream of
 20 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
 21 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
 22 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
 23 are expected to remain above guidance levels at upstream of Delta locations, but will not change
 24 substantially relative to Existing Conditions or No Action Alternative due to changes in flows under
 25 the operational scenarios of Alternative 4.

26 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 27 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 28 Mercury Control Program. These projects will target specific sources of mercury and methylation
 29 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 30 The implementation of these projects could help to ensure that upstream of Delta environments will
 31 not be substantially degraded for water quality with respect to mercury or methylmercury.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 37 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 38 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 39 more information.

40 The water quality impacts of waterborne concentrations of mercury (Appendix 8I, Table I-5) and
 41 methylmercury (Appendix 8I, Table I-6) and fish tissue mercury concentrations (Appendix 8I,
 42 Tables I-11A through I-11D) were evaluated for nine Delta locations.

1 The analysis of percentage change in assimilative capacity of waterborne total mercury of
2 Alternative 4 scenarios as compared to Existing Conditions showed the greatest decrease to be of -
3 2.4% in the Old River at Rock Slough and the Contra Costa Pumping Plant for scenario. These are
4 bounded by Alternative 4 H1 estimates of -1.4% and -1.5% at these two locations, respectively. In
5 contrast the greatest increase in assimilative capacity relative to Existing Conditions was 4.4% for
6 H4 at the Jones Pumping Plant (Figures 8-53a through 8-54b). Scenarios H2 and H3 range in
7 changes in assimilative capacity in relation to Existing Conditions from -2.1% (H3 at Contra Costa
8 Pumping Plant to 4.1) (H2 at Banks). These small changes in assimilative capacity are not expected
9 to result in adverse (or positive) effects to beneficial uses.

10 As compared to the No Action Alternative, Alternative 4 H4 showed the greatest range in changes in
11 assimilative capacity for total mercury; ranging from 5.0% at the Jones Pumping Plant to -2.3% at
12 the Old River site. These same sites show the smallest range of effects for Alternative 4 H1; with
13 4.3% and -1.4% for these same two stations, respectively. Scenarios H2 and H3 fall between these
14 extremes. However, these small ranges of changes are not expected to result in adverse effects to
15 beneficial uses.

16 All methylmercury concentrations in water were estimated to exceed TMDL guidelines and no
17 assimilative capacity exists. Changes in methylmercury concentration are expected to be very small.
18 The greatest annual average methylmercury concentration for drought conditions was 0.163 ng/L
19 for the San Joaquin River at Buckley Cove (all scenarios) which was slightly higher than Existing
20 Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L) (Appendix
21 8I, Table I-6). In general, the Alternative 4 H4 conditions were highest in concentration and
22 Alternative 4 H1 was lowest, as compared among scenarios for modeled methylmercury
23 concentrations in water. All modeled concentrations exceeded the methylmercury TMDL guidance
24 objective of 0.06 ng/L; therefore, percentage change in assimilative capacity was not evaluated for
25 methylmercury.

26 Similar to waterborne methylmercury, fish tissue mercury concentration estimates all exceed TMDL
27 guidelines. Percentage changes were somewhat larger than for waterborne concentrations, but not
28 expected to result in changes to beneficial use. Fish tissue estimates show only small or no increases
29 in EQs based on long-term annual average concentrations for mercury at the Delta locations
30 (Appendix 8I, Tables I-11Aa through I-11Db). The greatest increase over Existing Conditions was for
31 Scenario H4 and was 15% at Old River at Rock Slough and 13% for Franks Tract as compared to H1
32 estimates for both of those locations of 9% (Tables 1-11Ab through I-11Db). In comparison to the
33 No Action Alternative, the greatest increases in concentrations mirrored the Existing Condition
34 comparisons and were estimated to be 12% for Old River at Rock Slough, and 12% for Franks Tract.
35 Scenario H1 provided the lowest set of percentage changes in bass mercury for those locations
36 (Figures 8-55a and 8-55b; Appendix 8I, Tables I-11Aa through I-11Db). Because these increases are
37 relatively small, and it is not evident that substantive increases are expected at numerous locations
38 throughout the Delta, these changes are expected to be within the uncertainty inherent in the
39 modeling approach, and would likely not be measurable in the environment. See Appendix 8I for a
40 discussion of the uncertainty associated with the fish tissue estimates.

41 ***SWP/CVP Export Service Areas***

42 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
43 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
44 methylmercury concentrations for Alternative 4, all scenarios, at the Jones and Banks pumping

1 plants, were lower than Existing Conditions and the No Action Alternative (Appendix 8I, Figures I-4
2 and I-5). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-
3 53a through 8-54b). The greatest increase was 5% for Scenario H4 for Jones Plant (compared to No
4 Action); the least was H2 at Banks of 2.9% (compared to Existing Conditions).

5 The largest improvements in bass tissue mercury concentrations and EQs for Alternative 4, relative
6 to Existing Conditions and the No Action Alternative at any location within the Delta are expected
7 for the export pump locations. The greatest improvement in bass tissue mercury concentration are
8 expected for Scenario H4 at the Banks and Jones pumping plants (-14% and -16%, respectively)
9 (Figures 8-55a, and 8-55b; Appendix 8I, Tables I-11Aa through I-11Db).

10 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
11 comparison of Scenarios H1–H4 of Alternative 4 to the No Action Alternative (as waterborne and
12 bioaccumulated forms) are not considered to be adverse.

13 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
14 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
15 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
16 constituent. For additional details on the effects assessment findings that support this CEQA impact
17 determination, see the effects assessment discussion that immediately precedes this conclusion.

18 Under Alternative 4, greater water demands and climate change would alter the magnitude and
19 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
20 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
21 methylmercury upstream of the Delta will not be substantially different relative to Existing
22 Conditions due to the lack of important relationships between mercury/methylmercury
23 concentrations and flow for the major rivers.

24 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
25 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
26 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
27 mercury concentrations show almost no differences would occur among sites for Alternative 4
28 scenarios as compared to Existing Conditions for Delta sites. The greatest changes in assimilative
29 capacity and tissue mercury estimates were for Scenario H4; these least for Scenario H1.

30 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
31 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
32 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
33 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 4, all
34 scenarios, as compared to Existing Conditions.

35 As such, none of the H1–H4 scenarios for this alternative are expected to cause additional
36 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
37 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
38 Because mercury concentrations are not expected to increase substantially, no long-term water
39 quality degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
40 Because any increases in mercury or methylmercury concentrations are not likely to be measurable,
41 changes in mercury concentrations or fish tissue mercury concentrations would not make any
42 existing mercury-related impairment measurably worse. In comparison to Existing Conditions,
43 Alternative 4 would not increase levels of mercury by frequency, magnitude, and geographic extent

1 such that the affected environment would be expected to have measurably higher body burdens of
 2 mercury in aquatic organisms, thereby substantially increasing the health risks to wildlife (including
 3 fish) or humans consuming those organisms. This impact is considered to be less than significant. No
 4 mitigation is required.

5 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-**
 6 **CM21**

7 **NEPA Effects:** Some habitat restoration activities under Alternative 4 would occur on lands in the
 8 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 9 Alternative 4 have the potential to increase water residence times and increase accumulation of
 10 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 11 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 12 possible but uncertain depending on the specific restoration design implemented at a particular
 13 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 14 not currently available. However, DSM2 modeling for Alternative 4 operations does incorporate
 15 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 16 8.3.1.3, *Plan Area*) that result in changes to Delta hydrodynamics compared to the No Action
 17 Alternative. These modeled restoration assumptions provide some insight into potential
 18 hydrodynamic changes that could be expected related to implementing CM2 and CM4 and are
 19 considered in the evaluation of the potential for increased mercury and methylmercury
 20 concentrations under Alternative 4.

21 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 22 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 23 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 24 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 25 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 26 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 27 ● Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 28 better inform restoration design,
- 29 ● Sequestering methylmercury at restoration sites using low intensity chemical dosing
 30 techniques,
- 31 ● Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 32 organic material at a restoration site (this approach could limit the benefit of restoration areas
 33 by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some cases,
 34 this would run directly counter to the goals and objectives of the BDCP. This approach should
 35 not be implemented in such a way that it reduces the benefits to the Delta ecosystem provided
 36 by restoration areas),
- 37 ● Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 38 biologically unavailable, inorganic form of mercury,
- 39 ● Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 40 ● Considering capping mercury laden sediments, where feasible, to reduce methylation potential
 41 at a site.

1 Because of the uncertainties associated with site-specific estimates of methylmercury
 2 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 3 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 4 need to be evaluated separately for each restoration effort, as part of design and implementation.
 5 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 6 potential effect of implementing CM2–CM21 is considered adverse.

7 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 8 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 9 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 10 However, in the Delta, uptake of mercury from water and/or methylation of inorganic mercury may
 11 increase to an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich
 12 restoration areas. Methylmercury is 303(d)-listed within the affected environment, and therefore
 13 any potential measurable increase in methylmercury concentrations would make existing mercury-
 14 related impairment measurably worse. Because mercury is bioaccumulative, increases in
 15 waterborne mercury or methylmercury that could occur in some areas could bioaccumulate to
 16 somewhat greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife,
 17 or humans. Design of restoration sites under Alternative 4 would be guided by CM12 which requires
 18 development of site-specific mercury management plans as restoration actions are implemented.
 19 The effectiveness of minimization and mitigation actions implemented according to the mercury
 20 management plans is not known at this time, although the potential to reduce methylmercury
 21 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 22 goal to reduce this potential effect, the uncertainties related to site specific restoration conditions
 23 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 24 impact being considered significant. No mitigation measures would be available until specific
 25 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 26 unavoidable.

27 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 Although point sources of nitrate do exist upstream of the Delta in the Sacramento River watershed,
 31 nitrate levels in the major rivers (Sacramento, Feather, American) are low, generally due to ample
 32 dilution available in the rivers relative to the magnitude of the discharges. Furthermore, while many
 33 dischargers have already improved facilities to remove more nitrate, many others are likely to do so
 34 over the next few decades. Non-point sources of nitrate within the Sacramento watersheds are also
 35 relatively low, thus resulting in generally low nitrate-N concentrations in the reservoirs and rivers
 36 of the watershed. Furthermore, there is no correlation between historical water year average nitrate
 37 concentrations and water year average flow in the Sacramento River at Freeport (Appendix 8),
 38 *Nitrate*, Figure 1). Consequently, any modified reservoir operations and subsequent changes in river
 39 flows under various operational scenarios of Alternative 4, relative to Existing Conditions or the No
 40 Action Alternative, are expected to have negligible, if any, effects on average reservoir and river
 41 nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

42 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento
 43 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
 44 between historical water year average nitrate concentrations and water year average flow in the San

1 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
 2 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
 3 regression $r^2=0.49$; see Appendix 8J, *Nitrate*, Figure 2). Under Alternative 4, Scenarios H1–H4,
 4 modeling indicates that long-term annual average flows on the San Joaquin River would decrease by
 5 an estimated 6% relative to Existing Conditions, and would remain virtually the same relative to the
 6 No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical*
 7 *Appendix*). Given these relatively small decreases in flows and the weak correlation between nitrate
 8 and flows in the San Joaquin River (see Appendix 8J, Figure 2), it is expected that nitrate
 9 concentrations in the San Joaquin River would be minimally affected, if at all, by changes in flow
 10 rates under any operational scenario of Alternative 4.

11 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 12 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 13 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 14 water bodies, with regards to nitrate.

15 **Delta**

16 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 17 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 18 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 19 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 20 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 21 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 22 more information.

23 Mixing calculations indicate that under Alternative 4 (including the different components of
 24 Operational Scenarios H1–H4), relative to Existing Conditions and the No Action Alternative, nitrate
 25 concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to
 26 adopted objectives (Appendix 8J, *Nitrate*, Table 16, 17A through 17D). Although changes at specific
 27 Delta locations and for specific months may be substantial on a relative basis, the absolute
 28 concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking
 29 water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term average
 30 nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment locations
 31 except the San Joaquin River at Buckley Cove, where long-term average concentrations would be
 32 somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate concentration
 33 would be somewhat reduced under Alternative 4 relative to Existing Conditions, and slightly
 34 increased relative to the No Action Alternative. Regardless of operational scenario, no additional
 35 exceedances of the MCL are anticipated at any location under Alternative 4 (Appendix 8J, *Nitrate*,
 36 Table 16).

37 Use of assimilative capacity relative to the drinking water MCL of 10 mg/L-N under the four
 38 operational scenarios of Alternative 4 is low or negligible (i.e., <5%) in comparison to both Existing
 39 Conditions and the No Action Alternative, for all locations and months, for all modeled years, and for
 40 the drought period (Appendix 8J, *Nitrate*, Table 18A through 18D). One exception is for Buckley
 41 Cove on the San Joaquin River in August, where use of assimilative capacity available during the
 42 drought period (1987–1991) relative to the No Action Alternative for the four operational scenarios
 43 of Alternative 4 ranged from 6.3% to 6.5%.

1 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 2 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 3 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 4 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 5 the modeling.

- 6 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 7 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 8 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 9 the increase becoming greater with increasing distance downstream. However, the increase in
 10 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 11 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 12 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Regional
 13 Water Quality Control Board 2010a:32).
- 14 • Under the four operational scenarios of Alternative 4, the planned upgrades to the SRWTP,
 15 which include nitrification/partial denitrification, would substantially decrease ammonia
 16 concentrations in the discharge, but would increase nitrate concentrations in the discharge up to
 17 10 mg/L-N, which is substantially higher than under Existing Conditions.
- 18 • Overall, under the four operational scenarios of Alternative 4, the nitrogen load from the SRWTP
 19 discharge is expected to decrease (by up to 50%), relative to Existing Conditions, due to
 20 nitrification/partial denitrification upgrades at the SRWTP facility. Thus, while concentrations of
 21 nitrate downstream of the facility are expected to be higher than modeling results indicate for
 22 both Existing Conditions and the four operational scenarios of Alternative 4, the increase is
 23 expected to be greater under Existing Conditions than for the four operational scenarios of
 24 Alternative 4 due to the upgrades that are assumed under the four operational scenarios of
 25 Alternative 4.

26 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 27 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 28 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 29 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 30 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 31 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 32 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 33 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 34 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 35 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 36 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 37 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 38 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

39 In summary, any increases in nitrate-N concentrations that may occur at certain locations within the
 40 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 41 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

42 ***SWP/CVP Export Service Areas***

43 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 44 nitrate-N at the Banks and Jones pumping plants.

1 Results of the mixing calculations indicate that the change in nitrate concentrations and use of
2 assimilative capacity are similar for the four operational scenarios of Alternative 4 (Appendix 8J,
3 *Nitrate*, Tables 16, 17A through 17D, 18A through 18D). Relative to Existing Conditions and the No
4 Action Alternative, nitrate concentrations at Banks and Jones pumping plants under Alternative 4
5 are anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Tables 17A
6 through 17D). During the late summer, particularly in the drought period assessed, concentrations
7 are expected to increase, but the absolute value of these changes (i.e., in mg/L-N) is small.
8 Additionally, given the many factors that contribute to potential algal blooms in the SWP and CVP
9 canals within the Export Service Area, and the lack of studies that have shown a direct relationship
10 between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these
11 water bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal
12 increases in nitrate concentrations would increase the potential for problem algal blooms in the
13 SWP and CVP Export Service Area. No additional exceedances of the MCL are anticipated (Appendix
14 8J, *Nitrate*, Table 16). On a monthly average basis and on a long term annual average basis, for all
15 modeled years and for the drought period (1987–1991) only, use of assimilative capacity available
16 under Existing Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was
17 negligible (<5%) for both Banks and Jones pumping plants (Appendix 8J, *Nitrate*, Table 18A through
18 18D).

19 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
20 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
21 degrade the quality of exported water, with regards to nitrate.

22 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
23 CM1 are considered to be not adverse.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
26 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
27 constituent. For additional details on the effects assessment findings that support this CEQA impact
28 determination, see the effects assessment discussion that immediately precedes this conclusion.

29 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
30 substantial dilution available for point sources and the lack of substantial nonpoint sources of
31 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
32 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
33 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
34 Consequently, any modified reservoir operations and subsequent changes in river flows under
35 Alternative 4, relative to Existing Conditions, are expected to have negligible, if any, effects on
36 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
37 watershed and upstream of the Delta in the San Joaquin River watershed.

38 In the Delta, results of the mixing calculations indicate that under the four operational scenarios of
39 Alternative 4 (H1 through H4), relative to Existing Conditions, nitrate concentrations throughout the
40 Delta are anticipated to remain low (<1.4 mg/L-N) relative to adopted objectives. No additional
41 exceedances of the MCL are anticipated at any location, and use of assimilative capacity available
42 under Existing Conditions, relative to the drinking water MCL of 10 mg/L-N, was low or negligible
43 (i.e., <5%) for all operational scenarios for virtually all locations and months.

1 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 2 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
 3 indicate that under Alternative 4 (including the different components of Operational Scenarios H1-
 4 H4), relative to Existing Conditions, long-term average nitrate concentrations at Banks and Jones
 5 pumping plants are anticipated to change negligibly. No additional exceedances of the MCL are
 6 anticipated, and use of assimilative capacity available under Existing Conditions, relative to the MCL
 7 was negligible (i.e., <5%) for both Banks and Jones pumping plants for all months.

8 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
 9 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 10 CVP and SWP service areas under Alternative 4 relative to Existing Conditions. As such, this
 11 alternative is not expected to cause additional exceedance of applicable water quality
 12 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 13 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
 14 expected to increase substantially, no long-term water quality degradation is expected to occur and,
 15 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
 16 affected environment and thus any increases that may occur in some areas and months would not
 17 make any existing nitrate-related impairment measurably worse because no such impairments
 18 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 19 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 20 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 21 significant. No mitigation is required.

22 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 23 CM21**

24 **NEPA Effects:** Some habitat restoration activities included in CM2-CM11 would occur on lands
 25 within the Delta formerly used for agriculture. It is expected that this will decrease nitrate
 26 concentrations in the Delta, due to less use of nitrate-based fertilizers, relative to the No Action
 27 Alternative. Modeling scenarios included assumptions regarding how certain habitat restoration
 28 activities (i.e., CM2 and CM4) would affect Delta hydrodynamics, and thus such effects of these
 29 restoration measures were included in the assessment of CM1 facilities operations and maintenance
 30 (see Impact WQ-1). In general, aside from changes in Delta hydrodynamics resulting from habitat
 31 restoration discussed in Impact WQ-1, CM2-CM11 proposed for Alternative 4 are not expected to
 32 increase nitrate concentrations in water bodies of the affected environment, relative to the No
 33 Action Alternative.

34 Because urban stormwater is a source of nitrate in the affected environment, CM19, Urban
 35 Stormwater Treatment, is expected to slightly reduce nitrate loading to the Delta, thus slightly
 36 decreasing nitrate-N concentrations relative to the No Action Alternative. Implementation of CM12-
 37 CM18 and CM20-CM21 is not expected to substantially alter nitrate concentrations in any of the
 38 water bodies of the affected environment.

39 The effects on nitrate from implementing CM2-CM21 are considered to be not adverse.

40 **CEQA Conclusion:** There would be no substantial, long-term increase in nitrate-N concentrations in
 41 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 42 CVP and SWP service areas due to implementation of CM2-CM21 under Alternative 4, Scenarios H1-
 43 H4, relative to Existing Conditions. Because urban stormwater is a source of nitrate in the affected
 44 environment, *CM19, Urban Stormwater Treatment*, is expected to slightly reduce nitrate loading to

1 the Delta. As such, implementation of these conservation measures is not expected to cause
 2 additional exceedance of applicable water quality objectives/criteria by frequency, magnitude, and
 3 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 4 environment. Because nitrate concentrations are not expected to increase substantially due to these
 5 conservation measures, no long-term water quality degradation is expected to occur and, thus, no
 6 adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the affected
 7 environment and thus any minor increases that may occur in some areas would not make any
 8 existing nitrate-related impairment measurably worse because no such impairments currently exist.
 9 Because nitrate is not bioaccumulative, minor increases that may occur in some areas would not
 10 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
 11 risks to fish, wildlife, or humans. This impact is considered to be less than significant. No mitigation
 12 is required.

13 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 14 **Operations and Maintenance (CM1)**

15 ***Upstream of the Delta***

16 Under Alternative 4, Scenarios H1–H4, there would be no substantial change to the sources of DOC
 17 within the watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in
 18 the Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes
 19 in system operations and resulting reservoir storage levels and river flows under the various
 20 operational scenarios of Alternative 4 would not be expected to cause a substantial long-term
 21 change in DOC concentrations in the water bodies upstream of the Delta. Any negligible changes in
 22 DOC levels in water bodies upstream of the Delta under Scenarios H1–H4 of Alternative 4, relative to
 23 Existing Conditions and the No Action Alternative, would not be of sufficient frequency, magnitude
 24 and geographic extent that would adversely affect any beneficial uses or substantially degrade the
 25 quality of these water bodies, with regards to DOC.

26 ***Delta***

27 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 28 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 29 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 30 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 31 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 32 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
 33 more information.

34 Under the four operational scenarios of Alternative 4, the geographic extent of effects pertaining to
 35 long-term average DOC concentrations in the Delta would be similar to those previously described
 36 for Alternative 1A, although the magnitude of predicted long-term change and relative frequency of
 37 concentration threshold exceedances would be slightly greater. For all the operational scenarios
 38 relative to Existing Conditions, the modeled effects would be greatest at Franks Tract, Rock Slough,
 39 and Contra Costa PP No. 1. Increased long-term average DOC concentrations at these locations
 40 would be greatest under Scenario H4 and would be least under Scenario H1, although differences
 41 would be generally small between operational scenarios (i.e., ≤ 0.2 mg/L). Under Scenario H4, long-
 42 term average DOC concentrations for the modeled 16-year hydrologic period and the modeled
 43 drought period would be predicted to increase between 0.4–0.5 mg/L at Franks Tract, Rock Slough,

1 and Contra Costa PP No. 1 ($\leq 14\%$ net increase) (Appendix 8K, *Organic Carbon*, DOC Table 5). Under
2 Scenario H4, increases in long-term average concentrations of between 0.4–0.5 mg/L at Franks
3 Tract, Rock Slough, and Contra Costa PP No. 1 would correspond to more frequent concentration
4 threshold exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1
5 locations. For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase
6 from 52% under Existing Conditions to 76% under Scenario H4 of Alternative 4 (an increase from
7 47% to 67% for the drought period), and concentrations exceeding 4 mg/L would increase from
8 30% to 38% (32% to 38% for the drought period). For Contra Costa PP No. 1, long-term average
9 DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 81%
10 under Scenario H4 of Alternative 4 (45% to 78% for the drought period), and concentrations
11 exceeding 4 mg/L would increase from 32% to 45% (35% to 47% for the drought period). Relative
12 change in frequency of threshold exceedance for the other operational scenarios and at other
13 assessment locations would be similar or less. While all of the operational scenarios of Alternative 4
14 would generally lead to slightly higher long-term average DOC concentrations (≤ 0.5 mg/L) at some
15 municipal water intakes and Delta interior locations, the predicted change would not be expected to
16 adversely affect MUN beneficial uses, or any other beneficial use. This comparison to Existing
17 Conditions reflects changes in DOC due to both Alternative 4 operations (including north Delta
18 intake capacity of 9,000 cfs and the different components of Operational Scenarios H1–H4) and
19 climate change/sea level rise.

20 In comparison, relative to the No Action Alternative, the operational scenarios of Alternative 4
21 would generally result in a magnitude of change similar to that discussed for the Alternative 4
22 operational scenario comparison to Existing Conditions. Scenario H4 would generally lead to the
23 largest model predicted long-term average DOC concentration increases, and Scenario H1 would
24 generally lead to the smallest model predicted increases, although the relative difference between
25 operational scenarios would be small (i.e., ≤ 0.2 mg/L). Under Scenario H4, maximum increases of
26 0.3–0.4 mg/L DOC (i.e., $\leq 12\%$) would be predicted at Franks Tract, Rock Slough, and Contra Costa
27 PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table 5). For the
28 operational scenarios, threshold concentration exceedance frequency trends would also be similar
29 to those discussed for the Existing Condition comparison, with exception to the drought period
30 predicted 4 mg/L exceedance frequency at Buckley Cove. In comparison to the No Action
31 Alternative, and regardless of operational scenario, the frequency which long-term average DOC
32 concentrations exceeded 4 mg/L during the modeled drought period at Buckley Cove would
33 increase from 42% to 50%. While the operational scenarios of Alternative 4 would generally lead to
34 slightly higher long-term average DOC concentrations at some Delta assessment locations when
35 compared to No Action Alternative conditions, the predicted change would not be expected to
36 adversely affect MUN beneficial uses, or any other beneficial use, particularly when considering the
37 relatively small change in long-term annual average concentration. Unlike the comparison to
38 Existing Conditions, this comparison to the No Action Alternative reflects changes in DOC due only
39 to the different components of Operational Scenarios H1–H4 of Alternative 4.

40 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
41 occur before significant changes in drinking water treatment plant design or operations are
42 triggered. The increases in long-term average DOC concentrations estimated to occur at various
43 Delta locations under the four alternative operational scenarios of Alternative 4 are of sufficiently
44 small magnitude that they would not require existing drinking water treatment plants to
45 substantially upgrade treatment for DOC removal above levels currently employed.

1 Relative to existing and No Action Alternative conditions, Alternative 4 would lead to predicted
 2 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 3 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
 4 would be predicted to decrease by as much as 0.1–0.2 mg/L, depending on operational scenario,
 5 baseline conditions comparison and modeling period.

6 ***SWP/CVP Export Service Areas***

7 Under all operational scenarios of Alternative 4, relative to Existing Conditions and the No Action
 8 Alternative, modeled long-term average DOC concentrations would decrease at Banks and Jones
 9 pumping plants. Modeled decreases would be greatest under Scenarios H2 and H4. Relative to
 10 Existing Conditions, long-term average DOC concentrations at Banks under Scenarios H2 and H4
 11 would be predicted to decrease by 0.4 mg/L (0.4 mg/L during drought period) (Appendix 8K,
 12 *Organic Carbon*, DOC Table 5). At Jones, long-term average DOC concentrations would be predicted
 13 to decrease by 0.4 mg/L (<0.1 mg/L during drought period). Under all the operational scenarios,
 14 decreases in long-term average DOC would result in generally lower exceedance frequencies for
 15 concentration thresholds, although the frequency of exceedance during the modeled drought period
 16 (i.e., 1987–1991) in particular would be predicted to increase. For the Banks pumping plant during
 17 the drought period, exceedance of the 3 mg/L threshold would increase from 57% under Existing
 18 Conditions to as much as 83% under Scenario H3, and exceedance of the 4 mg/L concentration
 19 threshold would increase slightly for only Scenarios H1 and H3 from 42% to as much as 45%. At the
 20 Jones pumping plant, exceedance of the 3 mg/L concentration threshold during the drought period
 21 would increase from 72% under Existing Conditions to as much as 93% under Scenario H1, and
 22 exceedance of the 4 mg/L threshold would increase slightly for all operational scenarios, from 35%
 23 to as much as 41% for Scenario H4. Comparisons to the No Action Alternative yield similar trends,
 24 but with slightly smaller magnitude drought period changes. Overall, modeling results for the
 25 SWP/CVP Export Service Areas predict an overall improvement in Export Service Areas water
 26 quality, although more frequent exports of >3mg/L DOC water would likely occur for drought
 27 periods.

28 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 29 facilities under Scenarios H1–H4 of Alternative 4 would not be expected to create new sources of
 30 DOC or contribute towards a substantial change in existing sources of DOC in the affected area.
 31 Maintenance activities would not be expected to cause any substantial change in long-term average
 32 DOC concentrations such that MUN beneficial uses, or any other beneficial use, would be adversely
 33 affected.

34 ***NEPA Effects:*** In summary, the operations and maintenance activities under Scenarios H1–H4 of
 35 Alternative 4, relative to the No Action Alternative, would not cause a substantial long-term change
 36 in DOC concentrations in the water bodies upstream of the Delta. Depending on operational
 37 scenario, long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
 38 decrease by as much as 0.5 mg/L, while long-term average DOC concentrations for some Delta
 39 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.4 mg/L.
 40 Regardless of operational scenario, the increase in long-term average DOC concentration that could
 41 occur within the Delta interior would not be of sufficient magnitude to adversely affect the MUN
 42 beneficial use, or any other beneficial uses, of Delta waters. The effect of operations and
 43 maintenance activities on DOC under Scenarios H1–H4 of Alternative 4 is determined not to be
 44 adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
3 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
4 constituent. For additional details on the effects assessment findings that support this CEQA impact
5 determination, see the effects assessment discussion that immediately precedes this conclusion.

6 While greater water demands under the operational scenarios of Alternative 4 would alter the
7 magnitude and timing of reservoir releases north, south and east of the Delta, these activities would
8 have no substantial effect on the various watershed sources of DOC. Moreover, long-term average
9 flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
10 therefore, changes in river flows would not be expected to cause a substantial long-term change in
11 DOC concentrations upstream of the Delta.

12 Relative to Existing Conditions, the operational scenarios of Alternative 4 would result in relatively
13 small increases (i.e., $\leq 14\%$) in long-term average DOC concentrations at some Delta interior
14 locations, including Franks Tract, Rock Slough, and Contra Costa PP No. 1. These increases would be
15 greatest for Scenario H4, and least for Scenarios H1, although the difference in change would be
16 relatively small. The predicted increases under the operational scenarios modeled would not
17 substantially increase the frequency with which long-term average DOC concentrations exceeds 2, 3,
18 or 4 mg/L. While Scenarios H1–H4 would generally lead to slightly higher long-term average DOC
19 concentrations (≤ 0.2 – 0.5 mg/L) within the Delta interior and some municipal water intakes, the
20 predicted change would not be expected to adversely affect MUN beneficial uses, or any other
21 beneficial use.

22 The assessment of Alternative 4 Scenarios H1–H4 effects on DOC in the SWP/CVP Export Service
23 Areas is based on assessment of changes in DOC concentrations at Banks and Jones pumping plants.
24 Relative decreases in long-term average DOC concentrations would be greatest under Scenarios H2
25 and H4, where long-predicted concentrations would decrease as much as 0.4 mg/L at Banks and
26 Jones pumping plants. Regardless of operational scenario, however, slightly more frequent export of
27 >3 mg/L DOC water is predicted during the drought period. Nevertheless, under any operational
28 scenario, an overall improvement in DOC-related water quality would be predicted in the SWP/CVP
29 Export Service Areas.

30 Based on the above, the operations and maintenance activities of Scenarios H1–H4 of Alternative 4
31 would not result in any substantial change in long-term average DOC concentration upstream of the
32 Delta or result in substantial increase in the frequency with which long-term average DOC
33 concentrations exceeds 2, 3, or 4 mg/L levels at the 11 assessment locations analyzed for the Delta.
34 Increases in long-term average DOC concentrations at some Delta interior locations, including
35 Franks Tract, Rock Slough, and Contra Costa PP No. 1 would be predicted, with the greatest
36 increases occurring under Scenario H4 and the smallest increase occurring under Scenario H1.
37 Under Scenario H4, modeled long-term average DOC concentrations would increase by no more
38 than 0.5 mg/L at any single Delta assessment location (i.e., $\leq 14\%$ relative increase) while under
39 Scenario H1, modeled long-term DOC concentrations would increase by no more than 0.3 mg/L at
40 any single Delta assessment location (i.e., $\leq 9\%$ relative increase). For all operational scenarios
41 considered, the increases in long-term average DOC concentration that could occur within the Delta
42 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
43 beneficial uses, of Delta waters or waters of the SWP/CVP Service Area. Because DOC is not
44 bioaccumulative, the increases in long-term average DOC concentrations would not directly cause
45 bioaccumulative problems in aquatic life or humans. Finally, DOC is not causing beneficial use

1 impairments and thus is not 303(d) listed for any water body within the affected environment. Thus,
 2 the increases in long-term average DOC that could occur at various locations would not make any
 3 beneficial use impairment measurably worse. Because long-term average DOC concentrations are
 4 not expected to increase substantially, no long-term water quality degradation with respect to DOC
 5 is expected to occur and, thus, no adverse effects on beneficial uses would occur. This impact is
 6 considered to be less than significant. No mitigation is required.

7 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 8 **Implementation of CM2–CM21**

9 **NEPA Effects:** The mostly non-land disturbing CM12–CM21 present no new sources of DOC to the
 10 affected environment, including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP
 11 Export Service Area. Implementation of methylmercury control measures (CM12) and urban
 12 stormwater treatment measures (CM19) may result in beneficial effects, to the extent that control
 13 measures treat or reduce organic carbon loading from tidal wetlands and urban land uses. Control of
 14 nonnative aquatic vegetation (CM13) may include killing mature aquatic vegetation in place, leading
 15 to their decay and contribution to DOC in Delta channels. However, this measure is not expected to
 16 be a significant source of long-term DOC loading as vegetation control would be sporadic and on an
 17 as needed basis, with decreasing need for treatments in the long-term as nonnative vegetation is
 18 eventually controlled and managed. Implementation of CM12–CM21 would not be expected to have
 19 substantial, if even measurable, effect on DOC concentrations upstream of the Delta, within the
 20 Delta, and in the SWP/CVP service areas. Consequently, any negligible increases in DOC levels in
 21 these areas of the affected environment are not expected to be of sufficient frequency, magnitude
 22 and geographic extent that they would adversely affect the MUN beneficial use, or any other
 23 beneficial uses, of the affected environment, nor would potential increases substantially degrade
 24 water quality with regards to DOC.

25 For CM2–CM11, effects on DOC concentrations can generally be considered in terms of: (1)
 26 alternative-caused change in Delta hydrodynamics, and (2) alternative-caused change in Delta DOC
 27 sources. Change in Delta hydrodynamics involves a two part process, including the conveyance
 28 facilities and operational scenarios of CM1, as well as the change in Delta channel geometry and
 29 open water areas that would occur as a consequence of implementing tidal wetland restoration
 30 measures such as that described for CM4. Modeling scenarios included assumptions regarding how
 31 these habitat restoration activities would affect Delta hydrodynamics, and thus the effects of these
 32 restoration measures, via their effects on delta hydrodynamics, were included in the assessment of
 33 CM1 facilities operations and maintenance (see Impact WQ-17). The potential for these same
 34 conservation measures to change Delta DOC sources are addressed below.

35 CM2, CM3, CM8, CM9, and CM11 could include activities that would target increasing primary
 36 production (i.e., algae growth) within the Delta. Algae currently are not estimated to be a major
 37 source of DOC in the Delta (CALFED Bay-Delta Program 2008a: 4, 6), and comprise mostly the
 38 particulate fraction of TOC. Conventional drinking water treatment removes much of the POC from
 39 raw source water; therefore, conservation measure activities targeted at increased algae production
 40 are not expected to contribute substantial amounts of new DOC, or adversely affect MUN beneficial
 41 use, or any other beneficial uses, of the affected environment.

42 CM4–CM7 and CM10 include land disturbing restoration activities known to be sources of DOC.
 43 Research within the Delta has focused primarily on non-tidal wetlands and flooding of Delta island
 44 peat soils. The dynamics of DOC production and export from wetlands and seasonally flooded soils is

1 complex, as well as highly site and circumstance specific. Age and configuration of a wetland
2 significantly affects the amount of DOC that may be generated in a wetland. In a study of a
3 permanently flooded non-tidal constructed wetland on Twitchell Island, initial DOC loading was
4 determined to be much greater (i.e., approximately 10 times greater) than equivalent area of
5 agricultural land, but trends in annual loading led researchers to estimate that loading from the
6 wetland would be equivalent to that of agriculture within about 15 years (Fleck et. al. 2007: 18). It
7 was observed that the majority of the wetland load originated from seepage through peat soils.
8 Trends in declining load were principally associated with flushing of mobile DOC from submerged
9 soils, the origins of which were related to previous agricultural activity prior to restoration to
10 wetland. Peaks in annual loading, however, would be different, where peaks in agricultural drainage
11 occur in winter months while peaks in wetland loading occur in spring and summer months. As
12 such, age, configuration, location, operation, and season all factor into DOC loading, and long-term
13 average DOC concentrations in the Delta.

14 Available evidence suggests that restoration activities establishing new tidal and non-tidal wetlands,
15 new riparian and new seasonal floodplain habitat could potentially lead to new substantial sources
16 of localized DOC loading within the Delta. If established in areas presently used for agriculture, these
17 restoration activities could result in a substitution and temporary increase in localized DOC loading
18 for years. Presently, the specific design, operational criteria, and location of these activities are not
19 well established. Depending on localized hydrodynamics, such restoration activities could
20 contribute substantial amounts of DOC to municipal raw water if established near municipal intakes.
21 Substantially increased DOC concentrations in municipal source water may create a need for
22 existing drinking water treatment plants to upgrade treatment systems in order to achieve EPA
23 Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While treatment
24 technologies sufficient to achieve the necessary DOC removals exist, implementation of such
25 technologies would likely require substantial investment in new or modified infrastructure.

26 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 4 would
27 present new localized sources of DOC to the study area, and in some circumstances would substitute
28 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
29 proximity to municipal drinking water intakes, such restoration activities could contribute
30 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
31 DOC could necessitate changes in water treatment plant operations or require treatment plant
32 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
33 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

34 **CEQA Conclusion:** Implementation of CM2, CM3, CM8, CM9, and CM11–CM21 would not present
35 new or substantially changed sources of organic carbon to the affected environment of the Delta,
36 and thus would not contribute substantially to changes in long-term average DOC concentrations in
37 the Delta. Therefore, related long-term water quality degradation would not be expected to occur
38 and, thus, no adverse effects on beneficial uses would occur through implementation of CM2, CM3,
39 CM8, CM9, and CM11–CM21. Furthermore, DOC is not bioaccumulative, therefore changes in DOC
40 concentrations would not cause bioaccumulative problems in aquatic life or humans. Nevertheless,
41 implementation of CM4–CM7 and 10 would present new localized sources of DOC to the study area,
42 and in some circumstances would substitute for existing sources related to replaced agriculture.
43 Depending on localized hydrodynamics and proximity to municipal drinking water intakes, such
44 restoration activities could contribute substantial amounts of DOC to municipal raw water. The
45 potential for substantial increases in long-term average DOC concentrations related to the habitat
46 restoration elements of CM4–CM7 and 10 could contribute to long-term water quality degradation

1 with respect to DOC and, thus, adversely affect MUN beneficial uses. The impact is considered to be
 2 significant and mitigation is required. It is uncertain whether implementation of Mitigation Measure
 3 WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact remains
 4 significant and unavoidable.

5 In addition to and to supplement Mitigation Measure WQ-18, the project proponents have
 6 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 7 *AMMs*, and *CMs*, a separate, other commitment to address the potential increased water treatment
 8 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 9 operations. Potential options for making use of this financial commitment include funding or
 10 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 11 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 12 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 13 water quality effects relating to DOC.

14 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 15 **Effects on Municipal Intakes**

16 The project proponents will design wetland and riparian habitat features taking into
 17 consideration effects on Delta hydrodynamics and impacts on municipal intakes. Locate
 18 restoration features such that impacts on municipal intakes are minimized and habitat benefits
 19 are maximized. Incorporate design features to control the load and/or timing of DOC exports
 20 from habitat restoration features. This could include design elements to control seepage from
 21 non-tidal wetlands (e.g., incorporation of slurry walls into levees), and features to increase
 22 retention time and decrease tidal exchange in tidal wetlands and riparian and channel margin
 23 habitat designs. For restoration features directly connected to open channel waters, design
 24 wetlands with only channel margin exchanges to decrease DOC loading. Stagger construction of
 25 wetlands and channel margin/riparian sites both spatially and temporally so as to allow aging of
 26 the restoration features and associated decreased creation of localized “hot spots” and net Delta
 27 loading.

28 The project proponents will also establish measures to help guide the design and creation of the
 29 target wetland habitats. At a minimum, the measures should limit potential increases in long-
 30 term average DOC concentrations, and thus guide efforts to site, design, and maintain wetland
 31 and riparian habitat features, consistent with the biological goals and objectives of the BDCP.
 32 For example, restoration activities could be designed and located with the goal of preventing,
 33 consistent with the biological goals and objectives of the BDCP, net long-term average DOC
 34 concentration increases of greater than 0.5 mg/L at any municipal intake location within the
 35 Delta.

36 However, it must be noted that some of these measures could limit the benefit of restoration
 37 areas by limiting the amount of carbon supplied by these areas to the Delta as a whole. In some
 38 cases, these measures would run directly counter to the goals and objectives of the BDCP. This
 39 mitigation measure should not be implemented in such a way that it reduces the benefits to the
 40 Delta ecosystem provided by restoration areas. As mentioned above, the project proponents
 41 have incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental*
 42 *Commitments*, *AMMs*, and *CMs*, a separate, other commitment to address the potential increased
 43 water treatment costs that could result from DOC concentration effects on municipal and
 44 industrial water purveyor operations.

1 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
2 **(CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 4, Scenarios H1–H4, the only pathogen sources expected to change in the
5 watersheds upstream of the Delta relative to Existing Conditions or the No Action Alternative would
6 be associated with population growth, i.e., increased municipal wastewater discharges and
7 development contributing to increased urban runoff.

8 Increased municipal wastewater discharges resulting from future population growth would not be
9 expected to measurably increase pathogen concentrations in receiving waters due to state and
10 federal water quality regulations requiring disinfection of effluent discharges and the state’s
11 implementation of Title 22 filtration requirements for many wastewater dischargers in the
12 Sacramento River and San Joaquin River watersheds.

13 Pathogen loading from urban areas would generally occur in association with both dry and wet
14 weather runoff from urban landscapes. Municipal stormwater regulations and permits have become
15 increasingly stringent in recent years, and such further regulation of urban stormwater runoff is
16 expected to continue in the future. Municipalities may implement BMPs for reducing pollutant
17 loadings from urban runoff, particularly in response to NPDES stormwater-related regulations
18 requiring reduction of pollutant loading in urban runoff. The ability of these BMPs to consistently
19 reduce pathogen loadings and the extent of future implementation is uncertain, but would be
20 expected to improve as new technologies are continually tested and implemented. Also, some of the
21 urbanization may occur on lands used by other pathogens sources, such as grazing lands, resulting
22 in a change in pathogen source, but not necessarily an increase (and possibly a decrease) in
23 pathogen loading.

24 Pathogen concentrations in the Sacramento and San Joaquin Rivers have a minimal relationship to
25 flow rate in these rivers, although most of the high concentrations observed have been during the
26 wet months (Tetra Tech 2007). Further, urban runoff contributions during the dry season would be
27 expected to be a relatively small fraction of the rivers’ total flow rates. During wet weather events,
28 when urban runoff contributions would be higher, the flows in the rivers also would be higher.
29 Given the small magnitude of urban runoff contributions relative to the magnitude of river flows,
30 that pathogen concentrations in the rivers have a minimal relationship to river flow rate, and the
31 expected reduced pollutant loadings in response to NPDES stormwater-related regulations, river
32 flow rate and reservoir storage reductions that would occur under Alternative 4, Scenarios H1–H4,
33 relative to Existing Conditions and the No Action Alternative, would not be expected to result in a
34 substantial adverse change in pathogen concentrations in the reservoirs and rivers upstream of the
35 Delta. As such, none of the operational scenarios of Alternative 4 would be expected to substantially
36 increase the frequency with which applicable Basin Plan objectives or U.S. EPA-recommended
37 pathogen criteria would be exceeded in water bodies of the affected environment located upstream
38 of the Delta or substantially degrade the quality of these water bodies, with regard to pathogens.

39 ***Delta***

40 *The Conceptual Model for Pathogens and Pathogen Indicators in the Central Valley and Sacramento-*
41 *San Joaquin Delta* (Pathogens Conceptual Model; Tetra Tech 2007) provides a comprehensive
42 evaluation of factors affecting pathogen levels in the Delta. The Pathogens Conceptual Model
43 characterizes relative pathogen contributions to the Delta from the Sacramento and San Joaquin

1 Rivers and various pathogen sources, including wastewater discharges and urban runoff.
 2 Contributions from the San Francisco Bay to the Delta are not addressed. The Pathogens Conceptual
 3 Model is based on a database compiled by the Central Valley Drinking Water Policy Group in 2004–
 4 2005, supplemented with data from Natomas East Main Drainage Canal Studies, North Bay Aqueduct
 5 sampling, and the USGS. Data for multiple sites in the Sacramento River and San Joaquin River
 6 watersheds, and in the Delta were compiled. Indicator species evaluated include fecal coliforms,
 7 total coliforms, and *E. coli*. Because of its availability, *Cryptosporidium* and *Giardia* data for the
 8 Sacramento River also were evaluated. Key results of the data evaluation are:

9 **Total Coliform**

- 10 • In the Sacramento Valley, the highest total coliform concentrations (>10,000 MPN/100 ml) were
 11 located near urban areas.
- 12 • Similarly high total coliform concentrations were not observed in the San Joaquin Valley,
 13 because reported results were capped at about 2,400 MPN/100 ml, though a large number of
 14 results were reported as being greater than this value.
- 15 • The data should not to be interpreted to conclude that Sacramento River has higher total
 16 coliform concentrations; rather, the “appearance” of the lower total coliform concentrations in
 17 the San Joaquin Valley is attributed to a lower upper limit of reporting (2,400 MPN/100 ml
 18 versus 10,000 MPN/100 ml).

19 ***E. coli***

- 20 • Comparably high concentrations observed in the Sacramento River and San Joaquin River
 21 watersheds for waters affected by urban environments and intensive agriculture.
- 22 • The highest concentrations in the San Joaquin River were not at the most downstream location
 23 monitored, but rather at an intermediate location near Hills Ferry.
- 24 • *E. coli* concentrations in the Delta were somewhat higher than in the San Joaquin River and
 25 Sacramento River, indicating the importance of in-Delta sources and influence of distance of
 26 pathogen source on concentrations at a particular location in the receiving waters.
- 27 • Temporal (seasonal) trends were weak, however, the highest concentrations in the Sacramento
 28 River were observed during the wet months and the lowest concentrations were observed in
 29 July and August.

30 **Fecal Coliform**

- 31 • There was limited data from which to make comparisons/observations.

32 **Cryptosporidium and Giardia**

- 33 • Data were available only for the Sacramento River, limiting the ability to make comparisons
 34 between sources.
- 35 • Often not detected and when detected, concentrations typically less than 1 organism per liter.
- 36 • There may be natural/artificial barriers/processes that limit *Cryptosporidium* transport to
 37 water. Significant die off of those that reach the water may contribute to the low frequency of
 38 detection.

1 The Pathogens Conceptual Model found that coliform indicators vary by orders of magnitudes over
 2 small distances and short time-scales. Concentrations appear to be more closely related to what
 3 happens in the proximity of a sampling station, rather than what happens in the larger watershed
 4 where significant travel time and concomitant pathogen die-off can occur. Sites in the Delta close to
 5 urban discharges had elevated concentrations of coliform organisms. The highest total coliform and
 6 *E. coli* concentrations were observed in the discharge from the Natomas East Main Drainage Canal
 7 and several stations near sloughs, indicating the relative influence of urban and wildlife pathogen
 8 sources on receiving water concentrations.

9 The effects of the operational scenarios of Alternative 4 relative to Existing Conditions and the No
 10 Action Alternative would be changes in the relative percentage of water throughout the Delta being
 11 comprised of various source waters (i.e., water from the Sacramento River, San Joaquin River, Bay
 12 water, eastside tributaries, and agricultural return flow), due to potential changes in inflows
 13 particularly from the Sacramento River watershed due to increased water demands and somewhat
 14 modified SWP and CVP operations. However, it is expected there would be no substantial change in
 15 Delta pathogen concentrations in response to a shift in the Delta source water percentages under
 16 this alternative or substantial degradation of these water bodies, with regard to pathogens. This
 17 conclusion is based on the Pathogens Conceptual Model, which found that pathogen sources in close
 18 proximity to a Delta site appear to have the greatest influence on pathogen levels at the site, rather
 19 than the primary source(s) of water to the site. In-Delta potential pathogen sources, including
 20 water-based recreation, tidal habitat, wildlife, and livestock-related uses, would continue under this
 21 alternative.

22 ***SWP/CVP Export Service Areas***

23 None of the operational scenarios of Alternative 4 are expected to result in substantial changes in
 24 pathogen levels in Delta waters, relative to Existing Conditions or the No Action Alternative. As such,
 25 there is not expected to be substantial, if even measurable, changes in pathogen concentrations in
 26 the SWP/CVP Export Service Area waters.

27 ***NEPA Effects:*** The effects on pathogens from implementing Alternative 4, Scenarios H1–H4, is
 28 determined to not be adverse.

29 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 30 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
 31 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
 32 constituent. For additional details on the effects assessment findings that support this CEQA impact
 33 determination, see the effects assessment discussion that immediately precedes this conclusion.

34 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 35 (water facilities and operations) under Alternative 4, relative to Existing Conditions, would not be
 36 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 37 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
 38 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 39 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 40 related regulations.

41 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 42 a shift in the Delta source water percentages under this alternative or substantial degradation of
 43 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual

1 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 2 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 3 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 4 and livestock-related uses, would continue under this alternative.

5 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
 6 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
 7 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
 8 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
 9 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
 10 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
 11 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

12 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 14 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 15 expected to increase substantially, no long-term water quality degradation for pathogens is
 16 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 17 River in the Stockton Deep Water Ship Channel is Clean Water Act Section 303(d) listed for
 18 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 19 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 20 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 21 considered to be less than significant. No mitigation is required.

22 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

23 **NEPA Effects:** CM2–CM11 would involve habitat restoration actions, and CM21 involves waterfowl
 24 and shorebird areas. Tidal wetlands are known to be sources of coliforms originating from aquatic,
 25 terrestrial, and avian wildlife that inhabit these areas (Desmarais et al. 2001, Grant et al. 2001,
 26 Evanson and Ambrose 2006, Tetra Tech 2007). Specific locations of restoration areas for this
 27 alternative have not yet been established. However, most low-lying land suitable for restoration is
 28 unsuitable for livestock. Therefore, it is likely that the majority of land to be converted to wetlands
 29 would be crop-based agriculture or fallow/idle land. Because of a great deal of scientific uncertainty
 30 in the loading of coliforms from these various sources, the resulting change in coliform loading is
 31 uncertain, but it is anticipated that coliform loading to Delta waters would increase. Based on
 32 findings from the Pathogens Conceptual Model that pathogen concentrations are greatly influenced
 33 by the proximity to the source, this could result in localized increases in wildlife-related coliforms
 34 relative to the No Action Alternative. The Delta currently supports similar habitat types and, with
 35 the exception of the Clean Water Act Section 303(d) listing for the Stockton Deep Water Ship
 36 Channel, is not recognized as exhibiting pathogen concentrations that rise to the level of adversely
 37 affecting beneficial uses. As such, the potential increase in wildlife-related coliform concentrations
 38 due to tidal habitat creation is not expected to adversely affect beneficial uses.

39 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
 40 would be expected to reduce pathogen load relative to the No Action Alternative. The remaining
 41 conservation measures would not be expected to affect pathogen levels, because they are actions
 42 that do not affect the presence of pathogen sources.

43 The effects on pathogens from implementing CM2–CM21 is determined to not be adverse.

1 **CEQA Conclusion:** Based on findings from the Pathogens Conceptual Model that pathogen
 2 concentrations are greatly influenced by the proximity to the source, implementation of CM2–CM11
 3 and CM21 could result in localized increases in wildlife-related coliforms relative to Existing
 4 Conditions. The Delta currently supports similar habitat types and, with the exception of the Clean
 5 Water Act Section 303(d) listing for the Stockton Deep Water Ship Channel, is not recognized as
 6 exhibiting pathogen concentrations that rise to the level of adversely affecting beneficial uses. As
 7 such, the potential increase in wildlife-related coliform concentrations due to tidal habitat creation
 8 is not expected to adversely affect beneficial uses. Therefore, this alternative is not expected to cause
 9 additional exceedance of applicable water quality objectives by frequency, magnitude, and
 10 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 11 environment. Because pathogen concentrations are not expected to increase substantially, no long-
 12 term water quality degradation for pathogens is expected to occur and, thus, no adverse effects on
 13 beneficial uses would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is Clean
 14 Water Act Section 303(d) listed for pathogens. Because no measurable increase in Deep Water Ship
 15 Channel pathogen concentrations are expected to occur on a long-term basis, further degradation
 16 and impairment of this area is not expected to occur. Finally, pathogens are not bioaccumulative
 17 constituents. This impact is considered to be less than significant. No mitigation is required.

18 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 19 **Maintenance (CM1)**

20 Residues of “legacy” OC pesticides enter rivers primarily through surface runoff and erosion of
 21 terrestrial soils during storm events, and through resuspension of riverine bottom sediments, the
 22 combination of which to this day may contribute to excursions above water quality objectives
 23 (Central Valley Regional Water Quality Control Board 2010c). Operation of the CVP/SWP does not
 24 affect terrestrial sources, but may result in geomorphic changes to the affected environment that
 25 ultimately could result in changes to sediment suspension and deposition. However, as discussed in
 26 greater detail for Turbidity/TSS, operations under any alternative would not be expected to change
 27 TSS or turbidity levels (highs, lows, typical conditions) to any substantial degree. Changes in the
 28 magnitude, frequency, and geographic distribution of legacy pesticides in water bodies of the
 29 affected environment that would result in new or more severe adverse effects on aquatic life or
 30 other beneficial uses, relative to Existing Conditions or the No Action Alternative, would not be
 31 expected to occur. Therefore, the pesticide assessment focuses on the present use pesticides for
 32 which substantial information is available, namely diazinon, chlorpyrifos, pyrethroids, and diuron.

33 ***Upstream of the Delta***

34 Pyrethroid and OP insecticides are applied to agricultural fields, orchards, row crops, and confined
 35 animal facilities on an annual basis, with peaks in agricultural application during the winter
 36 dormant season (January–February) and during field cropping in the spring and summer.
 37 Applications of diuron occur year-round, but the majority of diuron is applied to road rights-of-way
 38 as a pre-emergent and early post emergent weed treatment during the late fall and early winter
 39 (Green and Young 2006). Pyrethroid insecticides and urban use herbicides are additionally applied
 40 around urban and residential structures and landscapes on an annual basis. These applications
 41 throughout the upstream watershed represent the source and potential pool of these pesticides that
 42 may enter the rivers upstream of the Delta by way of surface runoff and/or drift. Principal factors
 43 contributing to pesticide loading in the Sacramento River watershed include the amount of pesticide
 44 used and amount of precipitation (Guo et al. 2004). Although urban dry weather runoff occurs, this
 45 is generally believed to be less significant source of pesticides to main stem receiving waters, but for

1 pyrethroids a recent study concluded that municipal wastewater treatment plants in Sacramento
2 and Stockton represent a continuous year-round source of pyrethroids to the lower Sacramento and
3 San Joaquin River's (Weston and Lydy 2010).

4 Pesticide-related toxicity has historically been observed throughout the affected environment
5 regardless of season or water year type; however, toxicity is generally observed with increased
6 incidence during spring and summer months of April to June, coincident with the peak in irrigated
7 agriculture in the Sacramento and San Joaquin Valleys, as well as the winter rainy season,
8 particularly December through February, coincident with urban and agricultural storm-water runoff
9 and the orchard dormant spraying season (Fox and Archibald 1997). Although OP insecticide
10 incidence and related toxicity can be observed throughout the year, diazinon is most frequently
11 observed during the winter months and chlorpyrifos is most frequently observed in the summer
12 irrigation months (Central Valley Regional Water Quality Control Board 2007). These seasonal
13 trends coincide with their use, where diazinon is principally used as an orchard dormant season
14 spray, and chlorpyrifos is primarily used on crops during the summer.

15 Application of diuron peaks in the late fall and early winter. Coincidentally, diuron is found most
16 frequently in surface waters during the winter precipitation and runoff months of January through
17 March (Green and Young 2006), although diuron can be found much less frequently in surface
18 waters throughout the year (Johnson et al. 2010).

19 Monitoring for pyrethroid insecticides in main-stem rivers is limited and detections are rather few.
20 With the replacement of many traditionally OP related uses, however, it is conservatively assumed
21 that pyrethroid incidence and associated toxicity could ultimately take a pattern of seasonality
22 similar to that of the chlorpyrifos or diazinon.

23 In comparison to the Valley floor, relatively small amounts of pesticides are used in watersheds
24 upstream of project reservoirs. Water released from reservoirs flow through urban and agricultural
25 areas at which point these waters may acquire a burden of pesticide from agricultural or urban
26 sourced discharges. These discharges with their potential burden of pesticides are effectively
27 diluted by reservoir water. Under the operational scenarios of Alternative 4, no activity of the SWP
28 or CVP would substantially drive a change in pesticide use, and thus pesticide sources would remain
29 unaffected. Nevertheless, changes in the timing and magnitude of reservoir releases could have an
30 effect on available dilution capacity along river segments such as the Sacramento, Feather,
31 American, and San Joaquin Rivers.

32 Under the operational scenarios of Alternative 4, winter (November–March) and summer (April–
33 October) season average flow rates on the Sacramento River at Freeport, American River at Nimbus,
34 Feather River at Thermalito, and the San Joaquin River at Vernalis would change. Relative to
35 Existing Conditions and the No Action Alternative, seasonal average flow rates on the Sacramento
36 for Scenarios H1–H4 would decrease no more than 7% during the summer and 4% during the
37 winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River, average flow rates for Scenarios
38 H1–H4 would decrease no more than 9% during the summer and 2% during the winter, while on
39 the American River average flow rates would decrease by as much as 19% in the summer but would
40 increase by as much as 8% in the winter. Seasonal average flow rates for Scenarios H1–H4 on the
41 San Joaquin River would decrease by as much as 12% in the summer, but increase by as much as 1%
42 in the winter.

43 As previously stated, historically chlorpyrifos is used in greater amounts in agriculture in the
44 summer, and consequently observed in surface waters with greater frequency in the summer, while

1 diazinon and diuron are used and observed in surface water with greater frequency in the winter.
 2 While flow reductions in the summer on the American River would not coincide with urban
 3 stormwater discharges, summer flow reductions on the San Joaquin River would correspond to the
 4 agricultural irrigation season. However, summer average flow reductions of up to 19% are not
 5 considered of sufficient magnitude to substantially increase in-river concentrations or alter the
 6 long-term risk of pesticide-related effects on aquatic life beneficial uses. Greater long-term average
 7 flow reductions, and corresponding reductions in dilution/assimilative capacity, would be necessary
 8 before long-term risk of pesticide related effects on aquatic life beneficial uses would be adversely
 9 altered.

10 **Delta**

11 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 12 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 13 the Delta. Similar to Upstream of the Delta, CVP/SWP operations under Scenarios H1-H4 of
 14 Alternative 4 would not affect these sources.

15 Under Scenarios H1-H4, the distribution and mixing of Delta source waters would change.
 16 Percentage change in monthly average source water fraction were evaluated for the modeled 16-
 17 year (1976-1991) hydrologic period and a representative drought period (1987-1991), with special
 18 attention given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources
 19 water fractions. Changes in source water fractions at the modeled Delta assessment locations would
 20 vary depending on operational scenario, but relative differences between the operational scenarios
 21 would be small. Relative to Existing Conditions, under Scenarios H1-H4 of Alternative 4 modeled
 22 San Joaquin River fractions would increase greater than 10% at Buckley Cove (drought period only),
 23 Franks Tract, Rock Slough, and Contra Costa PP No. 1, with the largest changes occurring under
 24 Scenario H4 (Appendix 8D, *Source Water Fingerprinting Results*). At Buckley Cove under Scenario
 25 H4, change in drought period San Joaquin River source water fractions would increase 11% in July
 26 and 16% in August. At Franks Tract under Scenario H4, change in San Joaquin River source water
 27 fractions when modeled for the 16-year hydrologic period, would increase 11-16% during October
 28 through November and February through June. At Rock Slough, modeled San Joaquin River source
 29 water fractions under Scenario H4 would increase 15-22% during September through March (11-
 30 15% during October and November of the modeled drought period). Similarly, under Scenario H4
 31 modeled San Joaquin River fractions at Contra Costa Pumping Plant No. 1 would increase 15-23%
 32 during October through April (12% during October and November of the modeled drought period).
 33 While the modeled 22-23% increases of San Joaquin River Fraction at Rock Slough and Contra Costa
 34 PP No. 1 in November are considerable, the resultant net fraction would be $\leq 29\%$. For all
 35 operational scenarios, relative to Existing Conditions, there would be no modeled increases in
 36 Sacramento River fractions greater than 14% (with exception to Banks and Jones, discussed below)
 37 and Delta agricultural fractions greater than 8%. These modeled changes in the source water
 38 fractions of Sacramento, San Joaquin and Delta agriculture water are not of sufficient magnitude to
 39 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
 40 other beneficial uses of the Delta.

41 When compared to the No Action Alternative, changes in source water fractions resulting from
 42 Scenarios H1-H4 would be similar in season, geographic extent, and magnitude to those discussed
 43 for Existing Conditions, with exception to Buckley Cove. Relative to the No Action Alternative, on a
 44 source water basis Buckley Cove is comprised predominantly of water of San Joaquin River origin
 45 (i.e., typically >80% San Joaquin River) for all months of the year but July and August. In July and

1 August, the combined operational effects on Delta hydrodynamics of the Delta Cross Channel being
2 open, the absence of a barrier at Head of Old River, and seasonally high exports from south Delta
3 pumps results in substantially lower San Joaquin River source water fraction at Buckley Cove
4 relative to all other months of the year. Under the operational scenarios of Alternative 4, however,
5 modeled July and August San Joaquin River fractions at Buckley Cove would increase relative to the
6 No Action Alternative, with increases between 16–17% in July (31–34% for the modeled drought
7 period) and 24–25% in August (47–49% for the modeled drought period) (Appendix 8D, *Source*
8 *Water Fingerprinting Results*). Despite these San Joaquin River increases, the resulting net San
9 Joaquin River source water fraction for July and August would remain less than all other months. As
10 a result, these modeled changes in the source water fractions are not of sufficient magnitude to
11 substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect
12 other beneficial uses of the Delta.

13 **SWP/CVP Export Service Areas**

14 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
15 the Banks and Jones pumping plants. Under all operational scenarios of Alternative 4, Sacramento
16 River source water fractions would increase substantially at both Banks and Jones pumping plants
17 relative to Existing Conditions and the No Action Alternative (Appendix 8D, *Source Water*
18 *Fingerprinting Results*). Sacramento River source water fractions would increase similarly by both
19 season and magnitude extent under all operational scenarios at both Banks and Jones pumping
20 plant. At Banks pumping plant, Sacramento source water fractions would generally increase from
21 16–48% for the period of January through June (12–35% for March through April of the modeled
22 drought period) and at Jones pumping plant Sacramento source water fractions would generally
23 increase from 21–56% for the period of January through June (15–48% for February through May of
24 the modeled drought period). These increases in Sacramento source water fraction would primarily
25 balance through equivalent decreases in San Joaquin River water. Based on the general observation
26 that San Joaquin River, in comparison to the Sacramento River, is a greater contributor of OP
27 insecticides in terms of greater frequency of incidence and presence at concentrations exceeding
28 water quality benchmarks, modeled increases in Sacramento River fraction at Banks and Jones
29 would generally represent an improvement in export water quality respective to pesticides.

30 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
31 American, and San Joaquin Rivers, under Scenarios H1–H4 of Alternative 4 relative to the No Action
32 Alternative, are of insufficient magnitude to substantially increase the long-term risk of pesticide-
33 related water quality degradation and related toxicity to aquatic life in these water bodies upstream
34 of the Delta. Similarly, modeled changes in source water fractions to the Delta are of insufficient
35 magnitude to substantially alter the long-term risk of pesticide-related water quality degradation
36 and related toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on
37 pesticides from operations and maintenance (CM1) are determined not to be adverse.

38 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions
39 provided above are summarized here, and are then compared to the CEQA thresholds of significance
40 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
41 determination for this constituent. For additional details on the effects assessment findings that
42 support this CEQA impact determination, see the effects assessment discussion that immediately
43 precedes this conclusion.

1 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
2 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
3 pesticide inputs. For all operational scenarios relative to Existing Conditions, however, modeled
4 changes in long-term average flows on the Sacramento, Feather, American, and San Joaquin Rivers
5 are of insufficient magnitude to substantially increase the long-term risk of pesticide-related water
6 quality degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.

7 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
8 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
9 and maintenance activities under Scenarios H1–H4 would not affect these sources, changes in Delta
10 source water fraction could change the relative risk associated with pesticide related toxicity to
11 aquatic life. Under Scenarios H1–H4 of Alternative 4, however, modeled changes in source water
12 fractions relative to Existing Conditions are of insufficient magnitude to substantially alter the long-
13 term risk of pesticide-related toxicity to aquatic life within the Delta, nor would such changes result
14 in adverse pesticide-related effects on any other beneficial uses of Delta waters.

15 The assessment of Alternative 4 effects on pesticides in the SWP/CVP Export Service Areas is based
16 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
17 Scenario H1–H4 effects to pesticides in the Delta, modeled changes in source water fractions at the
18 Banks and Jones pumping plants are of insufficient magnitude to substantially alter the long-term
19 risk of pesticide-related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water
20 bodies of the SWP and CVP export service area.

21 Based on the above, the considered operational scenarios of Alternative 4 would not result in any
22 substantial change in long-term average pesticide concentration or result in substantial increase in
23 the anticipated frequency with which long-term average pesticide concentrations would exceed
24 aquatic life toxicity thresholds or other beneficial use effect thresholds upstream of the Delta, at the
25 11 assessment locations analyzed for the Delta, or the SWP/CVP service area. Numerous pesticides
26 are currently used throughout the affected environment, and while some of these pesticides may be
27 bioaccumulative, those present-use pesticides for which there is sufficient evidence for their
28 presence in waters affected by SWP and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and
29 pyrethroids) are not considered bioaccumulative, and thus changes in their concentrations would
30 not directly cause bioaccumulative problems in aquatic life or humans. Furthermore, while there are
31 numerous 303(d) listings throughout the affected environment that name pesticides as the cause for
32 beneficial use impairment, the modeled changes in upstream river flows and Delta source water
33 fractions under Scenarios H1–H4 would not be expected to make any of these beneficial use
34 impairments measurably worse. Because long-term average pesticide concentrations are not
35 expected to increase substantially, no long-term water quality degradation with respect to
36 pesticides is expected to occur and, thus, no adverse effects on beneficial uses would occur. This
37 impact is considered to be less than significant. No mitigation is required.

38 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 39 **CM21**

40 **NEPA Effects:** With the exception of CM13, the mostly non-land disturbing CM12–CM21 present no
41 new sources of pesticides to the affected environment, including areas Upstream of the Delta, within
42 the Plan Area, and the SWP/CVP Export Service Area. Implementation of urban stormwater
43 treatment measures (CM19) may result in beneficial effects, to the extent that control measures
44 treat or reduce pesticide loading from urban land uses. However, control of nonnative aquatic

1 vegetation (CM13) associated with tidal habitat restoration efforts would include killing invasive
2 and nuisance aquatic vegetation through direct application of herbicides or through alternative
3 mechanical means. Use and selection of type of herbicides would largely be circumstance specific,
4 but would follow existing control methods used by the CDBW. The CDBW's use of herbicides is
5 regulated by permits and regulatory agreements with the Central Valley Water Board, USFWS, and
6 NMFS and is guided by research conducted on the efficacy of vegetation control in the Delta through
7 herbicide use. Through a program of adaptive management and assessment, the CDBW has
8 employed a program of herbicide use that reduces potential environmental impacts, nevertheless,
9 the CDBW found that impacts on water quality and associated aquatic beneficial uses would
10 continue to occur and could not be avoided, including non-target impacts on aquatic invertebrates
11 and beneficial aquatic plants (California Department of Boating and Waterways 2006).

12 In addition to the potential beneficial and adverse effects of CM19 and CM13, respectively, the
13 various restoration efforts of CM2–CM11 could involve the conversion of active or fallow
14 agricultural lands to natural landscapes, such as wetlands, grasslands, floodplains, and vernal pools.
15 In the long-term, conversion of agricultural land to natural landscapes could possibly result in a
16 limited reduction in pesticide use throughout the Delta. In the short-term, tidal and non-tidal
17 wetland restoration, as well as seasonal floodplain restoration (i.e., CM4, CM5, and CM10) over
18 former agricultural lands may include the contamination of water with pesticide residues contained
19 in the soils. Present use pesticides typically degrade fairly rapidly, and in such cases where pesticide
20 containing soils are flooded, dissipation of those pesticides would be expected to occur rapidly.
21 Moreover, seasonal floodplain restoration (CM5) and Yolo Bypass enhancements (CM2) may be
22 managed alongside continuing agriculture, where pesticides may be used on a seasonal basis and
23 where water during flood events may come in contact with residues of these pesticides. Similarly,
24 however, rapid dissipation would be expected, particularly in the large volumes of water involved in
25 flooding. During these flooding events, pesticides potentially suspended in water would not be
26 expected to cause toxicity to aquatic life or cause substantial adverse effects on any other beneficial
27 uses of these water bodies.

28 In summary, CM13 of Alternative 4 proposes the use of herbicides to control invasive aquatic
29 vegetation around habitat restoration sites. Herbicides directly applied to water could adversely
30 affect non-target aquatic life, such as aquatic invertebrates and beneficial aquatic plants. Use of
31 herbicides could potentially exceed aquatic life toxicity objectives with sufficient frequency and
32 magnitude such that beneficial uses would be adversely affected, thus constituting an adverse effect
33 on water quality. Mitigation Measure WQ-22 would be available to reduce this effect.

34 **CEQA Conclusion:** With the exception of CM13, implementation of CM2–CM21 would not present
35 new or substantially increased sources of pesticides in the Plan Area. In the long-term,
36 implementation of conservation measures could possibly result in a limited reduction in pesticide
37 use throughout the Delta through the potential repurposing of active or fallow agricultural land for
38 natural habitat purposes. In the short-term, the repurposing of agricultural land associated with
39 CM4, CM5, and CM10 may expose water used for habitat restoration to pesticide residues. Moreover,
40 CM2 and CM5 may be managed alongside continuing agriculture, where pesticides may be used on a
41 seasonal basis and where water during flood events may come in contact with residues of these
42 pesticides. However, rapid dissipation would be expected, particularly in the large volumes of water
43 involved in flooding, such that aquatic life toxicity objectives would not be exceeded by frequency,
44 magnitude, and geographic extent whereby adverse effects on beneficial uses would be expected.
45 CM2–CM21 do not include the use of pesticides known to be bioaccumulative in animals or humans,
46 nor do the conservation measures propose the use of any pesticide currently named in a Section

1 303(d) listing of the affected environment. CM13 proposes the use of herbicides to control invasive
 2 aquatic vegetation around habitat restoration sites. Herbicides directly applied to water could
 3 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
 4 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency
 5 and magnitude such that beneficial uses would be impacted. Potential environmental effects related
 6 only to CM13 are considered significant. Mitigation Measure WQ-22 is available to partially reduce
 7 this impact of pesticides on water quality; however, because of the uncertainty about successful
 8 implementation of this measure at specific restoration sites programmatic impact is considered
 9 significant and unavoidable.

10 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
 11 **Strategies**

12 Implement the principals of IPM in the management of invasive aquatic vegetation under CM13,
 13 including the selective use of pesticides applied in a manner that minimizes risks to human
 14 health, nontarget organisms and the aquatic ecosystem. In doing so, the project proponents will
 15 consult with the Central Valley Water Board, USFWS, NMFS, and CDBW to obtain effective IPM
 16 strategies such as selective application of pesticides, timing of applications in order to minimize
 17 tidal dispersion, and timing to target the invasive plant species at the most vulnerable times
 18 such that less herbicide can be used or the need for repeat applications can be reduced.

19 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 20 **and Maintenance (CM1)**

21 As described under Impact WQ-29, facilities operations and maintenance is not expected to result in
 22 substantial changes in TSS and Turbidity under the project alternative relative to Existing
 23 Conditions in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service
 24 Areas. Thus in these areas, long-term changes in the levels of suspended sediment-bound
 25 phosphorus are not expected. Additional factors that may affect phosphorus levels are discussed
 26 below.

27 ***Upstream of the Delta***

28 A conceptual model of nutrients in the Delta stated that: “previous attempts to relate concentration
 29 data to flow data in the Central Valley and Delta showed little correlation between the two variables
 30 (Tetra Tech 2006b, Conceptual Model for Organic Carbon in the Central Valley). One possible reason
 31 is that the Central Valley and Delta system is a highly managed system with flows controlled by
 32 major reservoirs on most rivers” (Tetra Tech 2006b:4-1 to 4-2). Attempts discussed under Impact
 33 WQ-15 also showed weak correlation between nitrate and flows for major source waters to the
 34 Delta. The linear regressions between average dissolved ortho-phosphate concentrations and
 35 average flows in the San Joaquin and Sacramento Rivers were derived for this analysis (Figure 8-57
 36 and Figure 8-58). As expected, neither relationship is very strong, although over the large range in
 37 flows for the Sacramento River, the relationship is stronger than for the San Joaquin River. However,
 38 over smaller changes in flows, neither relationship can function as a predictor of phosphorus
 39 concentrations because the variability in the data over small to medium ranges of flows (i.e.,
 40 <10,000 cfs) is large.

41 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 42 because changes in flows do not necessarily result in changes in concentrations or loading of
 43 phosphorus to these water bodies, substantial changes in phosphorus concentration are not

1 anticipated under the operational scenarios of Alternative 4, relative to Existing Conditions or the
2 No Action Alternative. Any negligible changes in phosphorus concentrations that may occur in the
3 water bodies of the affected environment located upstream of the Delta would not be of frequency,
4 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
5 degrade the quality of these water bodies, with regards to phosphorus.

6 ***Delta***

7 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
8 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
9 long term-average basis. Phosphorus concentrations may increase during January through March at
10 locations where the source fraction of San Joaquin River water increases, due to the higher
11 concentration of phosphorus in the San Joaquin River during these months compared to Sacramento
12 River water or San Francisco Bay water. Based on the DSM2 fingerprinting results (see Appendix 8D,
13 *Source Water Fingerprinting Results*), together with source water concentrations shown in Figure 8-
14 56, the magnitude of increases during these months may range from negligible up to approximately
15 0.05 mg/L. However, there are no state or federal objectives/criteria for phosphorus and thus any
16 increases would not cause exceedances of objectives/criteria. Because algal growth rates are limited
17 by availability of light in the Delta, increases in phosphorus levels that may occur at some locations
18 and times within the Delta under Alternative 4, Scenarios H1–H4, would be expected to have little
19 effect on primary productivity in the Delta. Moreover, such increases in concentrations would not be
20 anticipated to be of frequency, magnitude and geographic extent that would adversely affect any
21 beneficial uses or substantially degrade the water quality at these locations, with regards to
22 phosphorus.

23 ***SWP/CVP Export Service Areas***

24 The assessment of effects of phosphorus under Alternative 4, Scenarios H1–H4, in the SWP and CVP
25 Export Service Areas is based on effects on phosphorus at the Banks and Jones pumping plants.

26 As noted in the Delta Region section above, phosphorus concentrations in the Delta (including Banks
27 and Jones pumping plants) are not anticipated to change substantially on a long term-average basis.
28 During January through March, phosphorus concentrations may increase as a result of more San
29 Joaquin River water reaching Banks and Jones pumping plants and the higher concentration of
30 phosphorus in the San Joaquin River. However, based on the DSM2 fingerprinting results (see
31 Appendix 8D, *Source Water Fingerprinting Results*), together with source water concentrations show
32 in Figure 8-56, the magnitude of this increase is expected to be negligible (<0.01 mg/L-P).

33 Additionally, there are no state or federal objectives for phosphorus. Moreover, given the many
34 factors that contribute to potential algal blooms in the SWP and CVP canals within the Export
35 Service Area, and the lack of studies that have shown a direct relationship between nutrient
36 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
37 there is no basis to conclude that any seasonal increases in phosphorus concentrations at the levels
38 expected under this alternative, should they occur, would increase the potential for problem algal
39 blooms in the SWP and CVP Export Service Area.

40 Any increases in phosphorus concentrations that may occur in water exported via Banks and Jones
41 pumping plants are not expected to result in adverse effects to beneficial uses of exported water or
42 substantially degrade the quality of exported water, with regards to phosphorus.

1 **NEPA Effects:** In summary, based on the discussion above, effects on phosphorus of CM1 are
2 considered to be not adverse.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
4 provided above are summarized here, and are then compared to the CEQA thresholds of significance
5 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
6 determination for this constituent. For additional details on the effects assessment findings that
7 support this CEQA impact determination, see the effects assessment discussion that immediately
8 precedes this conclusion.

9 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
10 because changes in flows do not necessarily result in changes in concentrations or loading of
11 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
12 Delta are not anticipated for any operational scenario of Alternative 4, relative to Existing
13 Conditions.

14 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
15 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
16 long term-average basis under the operational scenarios of Alternative 4, relative to Existing
17 Conditions. Algal growth rates are limited by availability of light in the Delta, and therefore any
18 minor increases in phosphorus levels that may occur at some locations and times within the Delta
19 would be expected to have little effect on primary productivity in the Delta.

20 The assessment of effects of phosphorus under the various operational scenarios of Alternative 4 in
21 the SWP and CVP Export Service Areas is based on effects on phosphorus at the Banks and Jones
22 pumping plants. As noted above, phosphorus concentrations in the Delta (including Banks and Jones
23 pumping plants) are not anticipated to change substantially on a long term-average basis.

24 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
25 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
26 CVP and SWP service areas under any operational scenario of Alternative 4 relative to Existing
27 Conditions. As such, this alternative is not expected to cause additional exceedance of applicable
28 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
29 adverse effects on any beneficial uses of waters in the affected environment. Because phosphorus
30 concentrations are not expected to increase substantially, no long-term water quality degradation is
31 expected to occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not
32 303(d) listed within the affected environment and thus any minor increases that may occur in some
33 areas would not make any existing phosphorus-related impairment measurably worse because no
34 such impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that
35 may occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would,
36 in turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
37 than significant. No mitigation is required.

38 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 39 **CM2–CM21**

40 **NEPA Effects:** CM2–CM11 include activities that create additional aquatic habitat within the affected
41 environment, and therefore may increase the total amount of algae and plant-life within the Delta.
42 These activities would not affect phosphorus loading to the affected environment, but may affect
43 phosphorus dynamics and speciation. For example, water column concentrations of total

1 phosphorus may increase or decrease in localized areas as a result of increased or decreased
 2 suspended solids, while ortho-phosphate concentrations may be locally altered as a result of
 3 changing planktonic and macroinvertebrate species contributing to the cycling of phosphorus
 4 within the affected environment. Additionally, depending on age, configuration, location, operation,
 5 and season, some of the restoration measures included under these conservation measures may
 6 function to remove or sequester phosphorus, but since presently, the specific design, operational
 7 criteria, and location of these activities are not well established, the degree to which this would
 8 occur is unknown. Overall, phosphorus concentrations are not expected to change substantially in
 9 the affected environment as a result of CM2–CM21. Because increases or decreases in phosphorus
 10 levels are, in general, expected to have little effect on productivity, any changes in phosphorus
 11 concentrations that may occur at certain locations within the affected environment are not
 12 anticipated to be of frequency, magnitude and geographic extent that would adversely affect any
 13 beneficial uses or substantially degrade the water quality at these locations, with regards to
 14 phosphorus.

15 Because urban stormwater is a source of phosphorus in the affected environment, CM19, Urban
 16 Stormwater Treatment, is expected to slightly reduce phosphorus loading to the Delta, thus slightly
 17 decreasing phosphorus concentrations relative to the No Action Alternative. Implementation of
 18 CM12–CM18 and CM20–CM21 is not expected to substantially alter phosphorus concentrations in
 19 the affected environment.

20 The effects on phosphorus from implementing CM2–CM21 are considered to be not adverse.

21 **CEQA Conclusion:** There would be no substantial, long-term increase in phosphorus concentrations
 22 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 23 CVP and SWP service areas due to implementation of CM2–CM21 under Alternative 4 relative to
 24 Existing Conditions. Because urban stormwater is a source of phosphorus in the affected
 25 environment, *CM19 Urban Stormwater Treatment*, is expected to slightly reduce phosphorus loading
 26 to the Delta. As such, implementation of these conservation measures is not expected to cause
 27 adverse effects on any beneficial uses of waters in the affected environment. Because phosphorus
 28 concentrations are not expected to increase substantially due to these conservation measures, no
 29 long-term water quality degradation is expected to occur and, thus, no adverse effects to beneficial
 30 uses would occur. Phosphorus is not 303(d) listed within the affected environment and thus any
 31 minor increases that may occur in some areas would not make any existing phosphorus-related
 32 impairment measurably worse because no such impairments currently exist. Because phosphorus is
 33 not bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to
 34 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
 35 or humans. This impact is considered to be less than significant. No mitigation is required.

36 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 37 **Maintenance (CM1)**

38 ***Upstream of the Delta***

39 Substantial point sources of selenium do not exist upstream in the Sacramento River watershed, in
 40 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
 41 upstream of the Delta in the San Joaquin River watershed. Nonpoint sources of selenium within the
 42 watersheds of the Sacramento River and the eastern tributaries also are relatively low, resulting in
 43 generally low selenium concentrations in the reservoirs and rivers of those watersheds.

1 Consequently, any modified reservoir operations and subsequent changes in river flows under
2 Alternative 4, Scenarios H1–H4, relative to Existing Conditions or the No Action Alternative, are
3 expected to have negligible, if any, effects on reservoir and river selenium concentrations upstream
4 of Freeport in the Sacramento River watershed or in the eastern tributaries upstream of the Delta.

5 Non-point sources of selenium in the San Joaquin River watershed are associated with discharges of
6 subsurface agricultural drainage to the river and its tributaries. Selenium concentrations in the San
7 Joaquin River upstream of the Delta comply with NTR criteria and Basin Plan objectives at Vernalis
8 under Existing Conditions, and they are expected to do so under the No Action Alternative. This is
9 because a TMDL has been developed by the Central Valley Water Board (2001), the Grassland
10 Bypass Project has established limits that will result in reduced inputs of selenium to the Delta, and
11 the Central Valley Water Board (2010d) and State Water Board (2010b, 2010c) have established
12 Basin Plan objectives that are expected to result in decreasing discharges of selenium from the San
13 Joaquin River to the Delta, as previously discussed in 8.1.3.15.

14 Selenium concentrations at Vernalis are generally higher during lower San Joaquin River flows, with
15 considerable variability in concentrations below about 3,000 cfs, as shown in Appendix 8M,
16 *Selenium*, Table M-33 and Figures M-7 through M-20. Under the four operational scenarios of
17 Alternative 4, modeling indicates that long-term annual average flows on the San Joaquin River
18 would decrease by 6% relative to Existing Conditions and would remain virtually the same relative
19 to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical*
20 *Appendix*). Given these relatively small decreases in flows and the considerable variability in the
21 relationship between selenium concentrations and flows in the San Joaquin River, it is expected that
22 selenium concentrations in the San Joaquin River would be minimally affected, if at all, by
23 anticipated changes in flow rates under the operational scenarios of Alternative 4.

24 Thus, available information indicates selenium concentrations are well below the Basin Plan
25 objective and are likely to remain so. Any negligible changes in selenium concentrations that may
26 occur in the water bodies of the affected environment located upstream of the Delta would not be of
27 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
28 substantially degrade the quality of these water bodies as related to selenium.

29 **Delta**

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
31 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
34 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
35 the Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3, *Plan Area*, for
36 more information.

37 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
38 locations under Alternative 4, relative to Existing Conditions and the No Action Alternative, are
39 presented in Appendix 8M, *Selenium*, Table M-9b for water, Tables M-14a, through M-14d, and
40 Tables M-24a through M-24d for most biota (whole-body fish (excluding sturgeon)), bird eggs
41 [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout the Delta, and Tables M-30
42 through M-32 for sturgeon at the two western Delta locations. Figures 8-59b and 8-60b present
43 graphical distributions of predicted selenium concentration changes (shown as changes in available
44 assimilative capacity based on 1.3 µg/L) in water at each modeled assessment location for all years.

1 Appendix 8M, Figure M-22 provides more detail in the form of monthly patterns of selenium
2 concentrations in water during the modeling period.

3 All scenarios (H1, H2, H3, and H4) under Alternative 4 would result in small changes in average
4 selenium concentrations in water relative to Existing Conditions and No Action Alternative at all
5 modeled Delta assessment locations (Appendix 8M, *Selenium*, Table M-9b). Long-term average
6 concentrations at some interior and western Delta locations would increase by 0.01–0.05 µg/L for
7 the entire period modeled (1976–1991), depending on operational scenario. These small increases
8 in selenium concentrations in water would result in small reductions (4% or less) in available
9 assimilative capacity for selenium, relative to the 1.3 µg/L USEPA draft water quality criterion
10 (Figures 8-59b and 8-60b). The long-term average selenium concentrations in water under
11 Alternative 4 Scenarios H1–H4 (range 0.09–0.40 µg/L) would be similar to Existing Conditions
12 (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and would all be
13 below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, *Selenium*, Table M-9b).

14 Relative to Existing Conditions and the No Action Alternative, all scenarios under Alternative 4
15 would result in small changes (approximately 1%) in estimated selenium concentrations in most
16 biota (whole-body fish, bird eggs [invertebrate diet or fish diet], and fish fillets) throughout the
17 Delta, with little difference among locations (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*,
18 Tables M-24a through M-24d). Level of Concern Exceedance Quotients (i.e., modeled tissue divided
19 by Level of Concern benchmarks) for selenium concentrations in those biota for all years and for
20 drought years are less than 1.0 (indicating low probability of adverse effects). Similarly, Advisory
21 Tissue Level Exceedance Quotients for selenium concentrations in fish fillets for all years and
22 drought years also are less than 1.0. Estimated selenium concentrations in sturgeon for the San
23 Joaquin River at Antioch are predicted to increase by 14–19% relative to Existing Conditions and to
24 the No Action Alternative in all years (from about 4.7 to 5.6 mg/kg dry weight), and those for
25 sturgeon in the Sacramento River at Mallard Island are predicted to increase by 9–11% in all years
26 (from about 4.4 to 4.9 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31), with the highest
27 percent increase for Scenario H4. Selenium concentrations in sturgeon during drought years are
28 expected to increase by about 3–9% at those locations, with the highest increase in San Joaquin
29 River Antioch in drought years for Scenario H4 (Appendix 8M, Tables M-30 and M-31). Detection of
30 small changes in whole-body sturgeon such as those estimated for the western Delta would require
31 very large sample sizes because of the inherent variability in fish tissue selenium concentrations.
32 Low Toxicity Threshold Exceedance Quotients for selenium concentrations in sturgeon in the
33 western Delta would exceed 1.0 (indicating a higher probability for adverse effects) for drought
34 years at both locations (as they do for Existing Conditions and the No Action Alternative) and would
35 increase slightly, from 0.94 to 1.1, for all years in the San Joaquin River at Antioch (Appendix 8M,
36 Table M-32).

37 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
38 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
39 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
40 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
41 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
42 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
43 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
44 the two western Delta locations and used literature-derived uptake factors and trophic transfer
45 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
46 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected

1 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
2 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
3 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
4 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
5 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
6 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
7 waterborne selenium concentration at the two locations in different time periods.

8 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
9 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
10 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
11 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
12 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
13 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
14 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
15 most areas of the Delta.

16 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
17 Alternative 4 would be greater in the East Delta and South Delta than in other sub-regions. Relative
18 to Existing Conditions, annual average residence times for Alternative 4 in the South Delta are
19 expected to increase by more than 10 days (Table 8-60a). Relative to the No Action Alternative,
20 annual average residence times for Alternative 4 in the South Delta are expected to increase by less
21 than 10 days. Increases in residence times for other sub-regions would be smaller, especially as
22 compared to Existing Conditions and the No Action Alternative (which are longer than those
23 modeled for the South Delta). As mentioned above, these results incorporate hydrodynamic effects
24 of both CM1 and CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of
25 CM2 and CM4. However, it is expected that CM2 and CM4 are substantial drivers of the increased
26 residence time.

27 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
28 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
29 concentrations in particulates, as the lowest level of the food chain, relative to the waterborne
30 concentration], and associated tissue concentrations [especially in clams and their consumers, such
31 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
32 (73,732 cfs in June 1998 to 12, 251 cfs in October 1998), residence time doubled (from 11 to 22
33 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
34 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
35 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

36 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
37 as related to residence time, but the effects of residence time are incorporated in the
38 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
39 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
40 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
41 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
42 concentrations are currently low and not approaching thresholds of concern (which, as discussed
43 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
44 residence time alone would not be expected to cause them to then approach or exceed thresholds of
45 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed

1 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
 2 sparse, the most likely area in which biota tissues would be at levels high enough that additional
 3 bioaccumulation due to increased residence time from restoration areas would be a concern is the
 4 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
 5 increase in residence time estimated in the western Delta is 4 days relative to Existing Conditions,
 6 and 2 days relative to the No Action Alternative. Given the available information, these increases are
 7 small enough that they are not expected to substantially affect selenium bioaccumulation in the
 8 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
 9 residence times, further discussion is included in Impact WQ-26 below.

10 In summary, relative to Existing Conditions and the No Action Alternative, all scenarios under
 11 Alternative 4 would result in essentially no change in selenium concentrations throughout the Delta
 12 for most biota (approximately 1% or less), although increases in selenium concentrations are
 13 predicted for sturgeon in the western Delta. The Low Toxicity Threshold Exceedance Quotient for
 14 selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch would increase
 15 from 0.94 for Existing Conditions and the No Action Alternative to 1.1 for Alternative 4.
 16 Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a low
 17 potential for effects. The modeling of bioaccumulation for sturgeon is less calibrated to site-specific
 18 conditions than that for other biota, which was calibrated on a robust dataset for modeling of
 19 bioaccumulation in largemouth bass as a representative species for the Delta. Overall, all scenarios
 20 under Alternative 4 would not be expected to substantially increase the frequency with which
 21 applicable benchmarks would be exceeded in the Delta (there being only a small increase for
 22 sturgeon relative to the low benchmark and no exceedance of the high benchmark) or substantially
 23 degrade the quality of water in the Delta, with regard to selenium.

24 ***SWP/CVP Export Service Areas***

25 Alternative 4 scenarios would result in small (0.05–0.08 µg/L) decreases in long-term average
 26 selenium concentrations in water at the Banks and Jones pumping plants, relative to Existing
 27 Conditions and the No Action Alternative, for the entire period modeled (Appendix 8M, Table M-9b).
 28 These decreases in long-term average selenium concentrations in water would result in increases in
 29 available assimilative capacity for selenium at these pumping plants, relative to the 1.3 µg/L USEPA
 30 draft water quality criterion (Figures 8-59b and 8-60b). The long-term average selenium
 31 concentrations in water for Alternative 4, Scenarios H1–H4 (range 0.16–0.21 µg/L) would be well
 32 below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9b).

33 Relative to Existing Conditions and the No Action Alternative, all scenarios under Alternative 4
 34 would result in small changes (approximately 1%) in estimated selenium concentrations in biota
 35 (whole-body fish, bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Figures 8-61a
 36 through 8-64b; Appendix 8M, *Selenium*, Tables M-24a through M-24d) at Banks and Jones pumping
 37 plants. Concentrations in biota would not exceed any selenium benchmarks for Alternative 4
 38 (Figures 8-61a through 8-64b).

39 ***NEPA Effects:*** Selenium concentrations in water and biota very slightly increase progressively from
 40 Scenario H1 (smallest) to Scenario H4 (largest). However, based on the discussion above, the effects
 41 on selenium (both as waterborne and as bioaccumulated in biota) from all scenarios under
 42 Alternative 4 are not considered to be adverse.

43 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 44 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,

1 *Determination of Effects*) for the purpose of making the CEQA impact determination for selenium.
2 For additional details on the effects assessment findings that support this CEQA impact
3 determination, see the effects assessment discussion that immediately precedes this conclusion.

4 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
5 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
6 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
7 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
8 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
9 Valley Regional Water Quality Control Board 2010d; State Water Resources Control Board 2010b,
10 2010c) that are expected to result in decreasing discharges of selenium from the San Joaquin River
11 to the Delta. Consequently, any modified reservoir operations and subsequent changes in river flows
12 under Alternative 4 scenarios, relative to Existing Conditions, are expected to cause negligible
13 changes in selenium concentrations in water. Any negligible changes in selenium concentrations
14 that may occur in the water bodies of the affected environment located upstream of the Delta would
15 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
16 uses or substantially degrade the quality of these water bodies as related to selenium.

17 Relative to Existing Conditions, modeling estimates indicate that all scenarios under Alternative 4
18 would result in essentially no change in selenium concentrations in water or most biota throughout
19 the Delta, with no exceedances of benchmarks for biological effects. The Low Toxicity Threshold
20 Exceedance Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River
21 at Antioch would increase slightly, from 0.94 for Existing Conditions to 1.1 for Alternative 4.
22 Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a low
23 potential for effects. Overall, Alternative 4 would not be expected to substantially increase the
24 frequency with which applicable benchmarks would be exceeded in the Delta (there being only a
25 small increase for sturgeon exceedance relative to the low benchmark for sturgeon and no
26 exceedance of the high benchmark) or substantially degrade the quality of water in the Delta, with
27 regard to selenium.

28 Assessment of effects of selenium in the SWP. CVP Export Service Areas is based on effects on
29 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions, all
30 scenarios under Alternative 4 would cause no increase in the frequency with which applicable
31 benchmarks would be exceeded, and would slightly improve the quality of water in selenium
32 concentrations at the Banks and Jones pumping plants.

33 Based on the above, selenium concentrations that would occur in water under all Alternative 4
34 scenarios would not cause additional exceedances of applicable state or federal numeric or narrative
35 water quality objectives/criteria, or other relevant water quality effects thresholds identified for
36 this assessment (Table 8-54), by frequency, magnitude, and geographic extent that would result in
37 adverse effects to one or more beneficial uses within affected water bodies. In comparison to
38 Existing Conditions, water quality conditions under all scenarios for Alternative 4 would not
39 increase levels of selenium by frequency, magnitude, and geographic extent such that the affected
40 environment would be expected to have measurably higher body burdens of selenium in aquatic
41 organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans
42 consuming those organisms. Water quality conditions under these alternative scenarios with
43 respect to selenium would not cause long-term degradation of water quality in the affected
44 environment, and therefore would not result in use of available assimilative capacity such that
45 exceedances of water quality objectives/criteria would be likely and would result in substantially

1 increased risk for adverse effects to one or more beneficial uses. All scenarios under this alternative
 2 would not further degrade water quality by measurable levels, on a long-term basis, for selenium
 3 and, thus, cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly
 4 worse. This impact is considered to be less than significant. No mitigation is required.

5 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
 6 **CM21**

7 **NEPA Effects:** In general, with the possible exception of changes in Delta hydrodynamics resulting
 8 from habitat restoration, CM2–CM21 would not substantially increase selenium concentrations in
 9 the water bodies of the affected environment. Modeling scenarios included assumptions regarding
 10 how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics, and
 11 thus such effects of these restoration measures were included in the assessment of CM1 facilities
 12 operations and maintenance (see Impact WQ-25).

13 As discussed in Impact WQ-25, implementation of these conservation measures may increase water
 14 residence time within the restoration areas. Increased restoration area water residence times could
 15 increase the bioaccumulation of selenium in biota, thereby potentially increasing fish tissue and bird
 16 egg concentrations of selenium (see residence time discussion in Appendix 8M, *Selenium*, and
 17 Presser and Luoma [2010b]). Models are not available to quantitatively estimate the level of changes
 18 in selenium bioaccumulation as related to residence time, but the effects of residence time are
 19 incorporated in the bioaccumulation modeling for selenium that was based on higher K_d values for
 20 drought years in comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in
 21 fish tissue or bird egg selenium were to occur, the increases would likely be of concern only where
 22 fish tissues or bird eggs are already elevated in selenium to near or above thresholds of concern.
 23 That is, where biota concentrations are currently low and not approaching thresholds of concern
 24 (which, as discussed above, is the case throughout the Delta, except for sturgeon in the western
 25 Delta), changes in residence time alone would not be expected to cause them to then approach or
 26 exceed thresholds of concern. In consideration of this factor, although the Delta as a whole is a CWA
 27 Section 303(d)-listed water body for selenium, and although monitoring data of fish tissue or bird
 28 eggs in the Delta are sparse, the most likely area in which biota tissues would be at levels high
 29 enough that additional bioaccumulation due to increased residence time from restoration areas
 30 would be a concern is the western Delta and Suisun Bay for sturgeon, as discussed above. As shown
 31 in Table 8-60a, the overall increase in residence time estimated in the western Delta is 4 days
 32 relative to Existing Conditions, and 2 days relative to the No Action Alternative. Given the available
 33 information, these increases are small enough that they are not expected to substantially affect
 34 selenium bioaccumulation in the western Delta.

35 The western Delta and Suisun Bay receive elevated selenium loads from North San Francisco Bay
 36 (including San Pablo Bay, Carquinez Strait, and Suisun Bay) and from the San Joaquin River. The San
 37 Francisco Bay Water Board is conducting a TMDL project to address selenium toxicity in the North
 38 San Francisco Bay (North Bay), defined to include a portion of the Delta, Suisun Bay, Carquinez
 39 Strait, San Pablo Bay, and the Central Bay (State Water Resources Control Board 2011). The North
 40 Bay selenium TMDL will identify and characterize selenium sources to the North Bay and the
 41 processes that control the uptake of selenium by wildlife. The TMDL will quantify selenium loads,
 42 develop and assign waste load and load allocations among sources, and include an implementation
 43 plan designed to achieve the TMDL and protect beneficial uses. Nonpoint sources of selenium in the
 44 San Joaquin Valley that contribute selenium to the San Joaquin River, and thus the Delta and Suisun
 45 Bay, will be controlled through a TMDL developed by the Central Valley Water Board (2001) for the

1 lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
2 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources
3 Control Board 2010b and 2010c) that are expected to result in decreasing discharges of selenium
4 from the San Joaquin River to the Delta.

5 The South Delta receives elevated selenium loads from the San Joaquin River, and as Table 8-60a
6 shows, residence times in this area are expected to increase on an annual average by 11 days
7 relative to Existing Conditions, and 9 days relative to the No Action Alternative. However, as
8 discussed in Impact WQ-25, biota concentrations in the South Delta are not approaching levels of
9 concern. Furthermore, in contrast to Suisun Bay and possibly the western Delta in the future, the
10 South Delta lacks the overbite clam (*Corbula [Potamocorbula] amurensis*), which is considered a key
11 driver of selenium bioaccumulation in Suisun Bay, due to its high bioaccumulation of selenium and
12 its role in the benthic foodweb that includes long-lived sturgeon. The south Delta does have
13 *Corbicula fluminea*, another bivalve that bioaccumulates selenium, but to a lesser degree than the
14 overbite clam (Lee et al. 2006). Also, as mentioned above, nonpoint sources of selenium in the San
15 Joaquin Valley that contribute selenium to the Delta will be controlled through a TMDL developed by
16 the Central Valley Water Board (2001) for the lower San Joaquin River, established limits for the
17 Grassland Bypass Project, and Basin Plan objectives (Central Valley Regional Water Quality Control
18 Board 2010d; State Water Resources Control Board 2010b and 2010c) that are expected to result in
19 decreasing discharges of selenium from the San Joaquin River to the Delta. Further, if selenium
20 levels in the San Joaquin River are not sufficiently reduced via these efforts, it is expected that the
21 State Water Board and Central Valley Water Board would initiate additional TMDLs to further
22 control nonpoint sources of selenium. Given the available information, these increases are small
23 enough that they are not expected to cause selenium concentrations in biota in the south Delta to
24 approach or exceed thresholds of concern.

25 Wetland restoration areas will not be designed such that water flows in and does not flow out.
26 Exchange of water between the restoration areas and existing Delta channels is an important design
27 factor, since one goal of the restoration areas is to export food produced in these areas to the rest of
28 the Delta (see BDCP Chapter 3, *Conservation Strategy*, Section 3.3, *Biological Goals and Objectives*).
29 Thus, these areas can be thought of as “flow-through” systems. Consequently, although water
30 residence times associated with BDCP restoration could increase, they are not expected to increase
31 without bound, and selenium concentrations in the water column would not continue to build up
32 and be recycled in sediments and organisms as may be the case within a closed system.

33 However, because increases in bioavailable selenium in the habitat restoration areas are uncertain,
34 proposed avoidance and minimization measures would require evaluating risks of selenium
35 exposure at a project level for each restoration area, minimizing to the extent feasible potential risk
36 of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife to establish
37 whether, or to what extent, additional bioaccumulation is occurring. See Appendix 3B,
38 *Environmental Commitments, AMMs, and CMs*, for a description of the environmental commitment
39 the project proponents are making with respect to Selenium Management; and Appendix 3.C of the
40 BDCP for additional detail on this avoidance and minimization measure (AMM27). Data generated as
41 part of the avoidance and minimization measures will assist the State and Regional Water Boards in
42 determining whether beneficial uses are being impacted by selenium, and thus will provide the data
43 necessary to support regulatory actions (including additional TMDL development), should such
44 actions be warranted.

1 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
 2 waterborne selenium that could occur in some areas as a result of increased water residence time
 3 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
 4 expected to have measurably higher body burdens of selenium in aquatic organisms and, therefore,
 5 would not substantially increase risk for adverse effects to beneficial uses. Furthermore, although
 6 the Delta is a 303(d)-listed water body for selenium, given the discussion in the assessment above, it
 7 is unlikely that restoration areas would result in measurable increases in selenium in fish tissues or
 8 bird eggs such that the beneficial use impairment would be made discernibly worse.

9 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 10 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 11 and minimization measures that are designed to further minimize and evaluate the risk of such
 12 increases, the effects of WQ-26 are considered not adverse.

13 **CEQA Conclusion:** There would be no substantial, long-term increase in selenium concentrations in
 14 water in the rivers and reservoirs upstream of the Delta, water in the Delta, or the waters exported
 15 to the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing
 16 Conditions. Waterborne selenium concentrations under this alternative would not exceed applicable
 17 water quality objectives/criteria.

18 Given the factors discussed in the assessment above, any increases in bioaccumulation rates from
 19 waterborne selenium that could occur in some areas as a result of increased water residence times
 20 would not be of sufficient magnitude and geographic extent that any portion of the Delta would be
 21 expected to have measurably higher body burdens of selenium in aquatic organisms, and therefore
 22 would not substantially increase risk for adverse effects to beneficial uses. CM2–CM21 would not
 23 cause long-term degradation of water quality resulting in sufficient use of available assimilative
 24 capacity such that occasionally exceeding water quality objectives/criteria would be likely. Also,
 25 CM2–CM21 would not result in substantially increased risk for adverse effects to any beneficial uses.
 26 Furthermore, although the Delta is a 303(d)-listed water body for selenium, given the discussion in
 27 the assessment above, it is unlikely that restoration areas would result in measurable increases in
 28 selenium in fish tissues or bird eggs such that the beneficial use impairment would be made
 29 discernibly worse.

30 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 31 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 32 and minimization measures that are designed to further minimize and evaluate the risk of such
 33 increases (see Appendix 3.C of the BDCP for more detail on AMM27) also described as the Selenium
 34 Management environmental commitment (see Appendix 3B, *Environmental Commitments, AMMs,*
 35 *and CMs*), this impact is considered less than significant. No mitigation is required.

36 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 37 **and Maintenance (CM1)**

38 ***Upstream of the Delta***

39 Relative to Existing Conditions and the No Action Alternative, under Alternative 4, Scenarios H1–H4,
 40 sources of trace metals would not be expected to change substantially with exception to sources
 41 related to population growth, such as increased municipal wastewater discharges and development
 42 contributing to increased urban dry and wet weather runoff. Facility operations could have an effect
 43 on these sources if concentrations of dissolved metals were closely correlated to river flow,

1 suggesting that changes in river flow, and the related capacity to dilute these sources, could
2 ultimately have a substantial effect on long-term metals concentrations.

3 On the Sacramento River, available dissolved trace metals data and river flow at Freeport are poorly
4 associated (Appendix 8N, *Trace Metals*, Figure 1). Similarly, dissolved copper, iron, and manganese
5 concentrations on the San Joaquin River at Vernalis are poorly associated (Appendix 8N, Figure 2).
6 While there is an insufficient number of data for the other trace metals to observe trends at Vernalis,
7 it is reasonable to assume that these metals similarly show poor association to San Joaquin River
8 flow, as shown for the corresponding dissolved metals on the Sacramento River.

9 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
10 reservoir storage reductions that would occur under Alternative 4, Scenarios H1–H4, relative to
11 Existing Conditions and the No Action Alternative, would not be expected to result in a substantial
12 adverse change in trace metal concentrations in the reservoirs and rivers upstream of the Delta. As
13 such, the Alternative 4, Scenarios H1–H4, would not be expected to substantially increase the
14 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in water
15 bodies of the affected environment located upstream of the Delta or substantially degrade the
16 quality of these water bodies, with regard to trace metals.

17 **Delta**

18 For metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel, silver, and
19 zinc), average and 95th percentile trace metal concentrations of the primary source waters to the
20 Delta are very similar, with difference typically not greater than a factor of 2 to 5 (Appendix 8N,
21 Tables 1–7). For example, average dissolved copper concentrations on the Sacramento River, San
22 Joaquin River, and Bay (Martinez) are 1.7 µg/L, 2.4 µg/L, and 1.7 µg/L, respectively. The 95th
23 percentile dissolved copper concentrations on the Sacramento River, San Joaquin River, and Bay
24 (Martinez) are 3.4 µg/L, 4.5 µg/L, and 2.4 µg/L, respectively. Given this similarity, very large
25 changes in source water fraction would be necessary to effect a relatively small change in trace
26 metal concentration at a particular Delta location. Moreover, average and 95th percentile trace metal
27 concentrations for these primary source waters are all below their respective water quality criteria,
28 including those that are hardness-based without a WER adjustment (Tables 8-51 and 8-52). No
29 mixing of these three source waters could result in a metal concentration greater than the highest
30 source water concentration, and given that the average and 95th percentile source water
31 concentrations for copper, cadmium, chromium, lead, nickel, silver, and zinc do not exceed their
32 respective criteria, more frequent exceedances of criteria in the Delta would not occur under the
33 operational scenario for this alternative.

34 For metals of primarily human health and drinking water concern (arsenic, iron, manganese),
35 average and 95th percentile concentrations are also very similar (Appendix 8N, *Trace Metals*, Tables
36 8–10). The arsenic criterion was established to protect human health from the effects of long-term
37 chronic exposure, while secondary maximum contaminant levels for iron and manganese were
38 established as reasonable goals for drinking water quality. The primary source water average
39 concentrations for arsenic, iron, and manganese are below these criteria. No mixing of these three
40 source waters could result in a metal concentration greater than the highest source water
41 concentration, and given that the average water concentrations for arsenic, iron, and manganese do
42 not exceed water quality criteria, more frequent exceedances of drinking water criteria in the Delta
43 would not be expected to occur under this alternative.

1 Relative to Existing Conditions and the No Action Alternative, facilities operation under Alternative
 2 4, Scenarios H1–H4, would result in negligible change in trace metal concentrations throughout the
 3 Delta. The operational scenarios of Alternative 4 would not be expected to substantially increase the
 4 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in the
 5 Delta or substantially degrade the quality of water in the Delta, with regard to trace metals.

6 ***SWP/CVP Export Service Areas***

7 Alternative 4, Scenarios H1–H4, would not result in substantial increases in trace metal
 8 concentrations in the water exported from the Delta or diverted from the Sacramento River through
 9 the proposed conveyance facilities. As such, there is not expected to be substantial changes in trace
 10 metal concentrations in the SWP/CVP export service area waters under any operational scenario of
 11 Alternative 4, relative to Existing Conditions or the No Action Alternative. As such, Alternative 4,
 12 Scenarios H1–H4, would not be expected to substantially increase the frequency with which
 13 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
 14 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
 15 water bodies, with regard to trace metals.

16 ***NEPA Effects:*** In summary, relative to the No Action Alternative, Alternative 4, Scenarios H1–H4,
 17 would not cause a substantial increase in long-term average trace metals concentrations within the
 18 affected environment, nor would it cause an increased frequency of water quality objective/criteria
 19 exceedances within the affected environment. The effect on trace metals is determined not to be
 20 adverse.

21 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
 22 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 23 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
 24 determination for this constituent. For additional details on the effects assessment findings that
 25 support this CEQA impact determination, see the effects assessment discussion that immediately
 26 precedes this conclusion.

27 While greater water demands under the operational scenarios of Alternative 4 would alter the
 28 magnitude and timing of reservoir releases north, south and east of the Delta, these activities would
 29 have no substantial effect on the various watershed sources of trace metals. Moreover, long-term
 30 average flow and trace metals at Sacramento River at Hood and San Joaquin River at Vernalis are
 31 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
 32 long-term change in trace metal concentrations upstream of the Delta.

33 Average and 95th percentile trace metal concentrations are very similar across the primary source
 34 waters to the Delta. Given this similarity, very large changes in source water fraction would be
 35 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 36 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 37 waters are all below their respective water quality criteria, including those that are hardness-based
 38 without a WER adjustment. No mixing of these three source waters could result in a metal
 39 concentration greater than the highest source water concentration, and given that trace metals do
 40 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
 41 not be expected to occur under any operational scenario of Alternative 4.

42 The assessment of Alternative 4, Scenarios H1–H4, effects on trace metals in the SWP/CVP Export
 43 Service Areas is based on assessment of changes in trace metal concentrations at Banks and Jones

1 pumping plants. As just discussed regarding similarities in Delta source water trace metal
2 concentrations, no operational scenario of Alternative 4 is expected to result in substantial changes
3 in trace metal concentrations in Delta waters, including Banks and Jones pumping plants, therefore
4 effects on trace metal concentrations in the SWP/CVP Export Service Area are expected to be
5 negligible.

6 Based on the above, there would be no substantial long-term increase in trace metal concentrations
7 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
8 service area waters under any operational scenario of Alternative 4 relative to Existing Conditions.
9 As such, this alternative is not expected to cause additional exceedance of applicable water quality
10 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
11 beneficial uses of waters in the affected environment. Because trace metal concentrations are not
12 expected to increase substantially, no long-term water quality degradation for trace metals is
13 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore, any
14 negligible changes in long-term trace metal concentrations that may occur in water bodies of the
15 affected environment would not be expected to make any existing beneficial use impairments
16 measurably worse. The trace metals discussed in this assessment are not considered
17 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
18 humans. This impact is considered to be less than significant. No mitigation is required.

19 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 20 **CM2–CM21**

21 **NEPA Effects:** Implementation of CM2–CM21 present no new sources of trace metals to the affected
22 environment, including areas upstream of the Delta, within the Delta, or in the SWP and CVP service
23 areas. However, CM19, which would fund projects to contribute to reducing pollutant discharges in
24 urban stormwater, would be expected to reduce trace metal loading to surface waters of the affected
25 environment. The remaining conservation measures would not be expected to affect trace metal
26 levels, because they are actions that do not affect the presence of trace metal sources. As they
27 pertain to trace metals, implementation of these conservation measures would not be expected to
28 adversely affect beneficial uses of the affected environment or substantially degrade water quality
29 with respect to trace metals.

30 In summary, implementation of CM2–CM21 under Alternative 4 relative to Existing Conditions and
31 the No Action Alternative, would have negligible, if any, effect on trace metals concentrations. The
32 effect on trace metals from implementing CM2–CM21 is determined not to be adverse.

33 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 4 would not cause substantial
34 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
35 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
36 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
37 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
38 environment. Because trace metal concentrations are not expected to increase substantially, no
39 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
40 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
41 concentrations that may occur throughout the affected environment would not be expected to make
42 any existing beneficial use impairments measurably worse. The trace metals discussed in this
43 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative

1 problems in aquatic life or humans. This impact is considered to be less than significant. No
2 mitigation is required.

3 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 4 **Maintenance (CM1)**

5 *Upstream of the Delta*

6 TSS concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1)
7 TSS concentrations and turbidity levels of the water released from the upstream reservoirs, 2)
8 erosion occurring within the river channel beds, which is affected by river flow velocity and bank
9 protection, 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and
10 nonpoint runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and
11 other biological material in the water.

12 Alternative 4, Scenarios H1–H4, would alter the magnitude and timing of water releases from
13 reservoirs upstream of the Delta relative to Existing Conditions and the No Action Alternative, which
14 in turn would alter downstream river flows. With respect to TSS and turbidity, an increase in river
15 flow is generally the concern, as this increases shear stress on the channel, suspending particles
16 resulting in higher TSS concentrations and turbidity levels. Schoellhamer et al. (2007b) noted that
17 suspended sediment concentration was more affected by season than flow, with the higher
18 concentrations for a given flow rate occurring during “first flush events” and lower concentrations
19 occurring during spring snowmelt events. Because of such a relationship, the changes in mean
20 monthly average river flows under the operational scenarios of Alternative 4 are not expected to
21 cause river TSS concentrations or turbidity levels (highs, lows, typical conditions) to be outside the
22 ranges occurring under Existing Conditions or the No Action Alternative. Consequently, this
23 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the
24 reservoirs and rivers upstream of the Delta.

25 Changes in land use that would occur relative to Existing Conditions and the No Action Alternative
26 could have minor effects on TSS concentrations and turbidity levels throughout this portion of the
27 affected environment. Site-specific and temporal exceptions may occur due to localized temporary
28 construction activities, dredging activities, development, or other land use changes. These localized
29 actions would generally require agency permits that would regulate and limit both their short-term
30 and long-term effects on TSS concentrations and turbidity levels to less-than-substantial levels.

31 *Delta*

32 TSS concentrations and turbidity levels in Delta waters are affected by TSS concentrations and
33 turbidity levels of the Delta inflows (and associated sediment load). TSS concentrations and
34 turbidity levels within Delta waters also are affected by fluctuation in flows within the channels due
35 to the tides, with sediments depositing as flow velocities and turbulence are low at periods of slack
36 tide, and sediments becoming suspended when flow velocities and turbulence increase when tides
37 are near the maximum. TSS and turbidity variations can also be attributed to phytoplankton,
38 zooplankton and other biological material in the water.

39 Under Alternative 4, Scenarios H1–H4, any land use changes that may occur under this alternative
40 would not be expected to have permanent, substantial effects on TSS concentrations and turbidity
41 levels of Delta waters, relative to Existing Conditions or the No Action Alternative. Furthermore, this
42 alternative would not cause the TSS concentrations or turbidity levels in the rivers contributing

1 inflows to the Delta to be outside the ranges occurring under Existing Conditions or the No Action
2 Alternative. Consequently, this alternative is expected to have minimal effect on TSS concentrations
3 and turbidity levels in the Delta region. As such, any minor TSS and turbidity changes that may occur
4 under Alternative 4, Scenarios H1–H4, would not be of sufficient frequency, magnitude, and
5 geographic extent that would result in adverse effects on beneficial uses in the Delta region, or
6 substantially degrade the quality of these water bodies, with regard to TSS and turbidity.

7 ***SWP/CVP Export Service Areas***

8 The operational scenarios of Alternative 4 are expected to have minimal effect on TSS
9 concentrations and turbidity levels in Delta waters, including water exported at the south Delta
10 pumps, relative to Existing Conditions or the No Action Alternative. As such, Alternative 4 is
11 expected to have minimal effect on TSS concentrations and turbidity levels in the SWP/CVP Export
12 Service Areas waters.

13 ***NEPA Effects:*** The effects on TSS and turbidity from implementing any operational scenario of
14 Alternative 4 is determined to not be adverse.

15 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
16 provided above are summarized here, and are then compared to the CEQA thresholds of significance
17 (defined in Section 8.3.2, *Determination of Effects*) for the purpose of making the CEQA impact
18 determination for this constituent. For additional details on the effects assessment findings that
19 support this CEQA impact determination, see the effects assessment discussion that immediately
20 precedes this conclusion.

21 Changes in river flow rate and reservoir storage that would occur under the operational scenarios of
22 Alternative 4, relative to Existing Conditions, would not be expected to result in a substantial
23 adverse change in TSS concentrations and turbidity levels in the reservoirs and rivers upstream of
24 the Delta, given that suspended sediment concentrations are more affected by season than flow.
25 Site-specific and temporal exceptions may occur due to localized temporary construction activities,
26 dredging activities, development, or other land use changes would be site-specific and temporal,
27 which would be regulated to limit both their short-term and long-term effects on TSS and turbidity
28 levels to less than substantial levels.

29 Within the Delta, geomorphic changes associated with sediment transport and deposition are
30 usually gradual, occurring over years, and high storm event inflows would not be substantially
31 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
32 would not be substantially different from the levels under Existing Conditions. Consequently, this
33 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
34 region, relative to Existing Conditions.

35 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
36 turbidity levels in the SWP/CVP Export Service Areas waters under any operational scenario of
37 Alternative 4, relative to Existing Conditions, because as stated above, this alternative is not
38 expected to result in substantial changes in TSS concentrations and turbidity levels at the south
39 Delta export pumps, relative to Existing Conditions.

40 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
41 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
42 concentrations and turbidity levels are not expected to be substantially different, long-term water
43 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely

1 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act Section 303(d)
2 listed constituents. This impact is considered to be less than significant. No mitigation is required.

3 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

4 **NEPA Effects:** Creation of habitat and open water through implementation of CM2–CM11 could
5 affect Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels.
6 The magnitude of increases in TSS concentrations and turbidity levels in the affected channels due
7 to higher potential of erosion cannot be readily quantified. The increases in TSS concentrations and
8 turbidity levels in the affected channels could be substantial in localized areas, depending on how
9 rapidly the Delta hydrodynamics are altered and the channels equilibrate with the new tidal flux
10 regime, after implementation of this alternative. However, geomorphic changes associated with
11 sediment transport and deposition are usually gradual, occurring over years. Within the
12 reconfigured channels there could be localized increases in TSS concentrations and turbidity levels,
13 but within the greater Plan Area it is expected that the TSS concentrations and turbidity levels
14 would not be substantially different from the levels under the No Action Alternative.

15 CM19, which would fund projects to contribute to reducing pollutant discharges in stormwater,
16 would be expected to reduce TSS and turbidity in urban discharges relative to the No Action
17 Alternative. The remaining conservation measures would not be expected to affect TSS
18 concentrations and turbidity levels, because they are actions that do not affect the presence of TSS
19 and turbidity sources.

20 The effects on TSS and turbidity from implementing CM2–CM21 is determined to not be adverse.

21 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
22 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of CM2–CM21
23 under Alternative 4 would not be substantially different relative to Existing Conditions, except
24 within localized areas of the Delta modified through creation of habitat and open water. Therefore,
25 this alternative is not expected to cause additional exceedance of applicable water quality objectives
26 where such objectives are not exceeded under Existing Conditions. Because TSS concentrations and
27 turbidity levels Upstream of the Delta, in the greater Plan Area, and in the SWP/CVP Export Service
28 Areas are not expected to be substantially different, long-term water quality degradation is not
29 expected relative to TSS and turbidity, and, thus, beneficial uses are not expected to be adversely
30 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act Section 303(d)
31 listed constituents. This impact is considered to be less than significant. No mitigation is required.

32 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 33 **(CM1–CM21)**

34 This section addresses construction-related water quality effects to constituents of concern other
35 than effects caused by changes in the operations and maintenance of CM1–CM21, which are
36 addressed in terms of constituent-specific impact assessments elsewhere in this chapter. The
37 conveyance features for CM1 under Alternative 4 would be very similar to those discussed for
38 Alternative 1A and most of the construction activity would occur in the Delta. The primary
39 difference between Alternative 4 and Alternative 1A is that under Alternative 4, there would be two
40 fewer intakes and two fewer pumping plant locations, which would result in a reduced level of
41 construction activity. However, construction techniques and locations of major features of the
42 conveyance system within the Delta would be similar. Alternative 4 additionally would include
43 construction of an operable barrier at the head of Old River. The remainder of the facilities

1 constructed under Alternative 4, including CM2–CM21, would be very similar to, or the same as,
2 those to be constructed for Alternative 1A. Few, if any, of the CM1–CM21 actions involve
3 construction work in the SWP and CVP Service Area or areas upstream of the Delta. The
4 conservation measures, or components of measures, that are anticipated to be constructed in areas
5 upstream of the Delta would be limited to: 1) *CM2 Yolo Bypass Fisheries Enhancement* (i.e., the
6 Fremont Weir component of the action), 2) *CM18 Conservation Hatcheries* (i.e., the new hatchery
7 facility), and 3) *CM19 Urban Stormwater Treatment*. Anticipated construction activities that may
8 occur under CM11–CM21, if any, would involve relatively minor disturbances, and thus would not be
9 anticipated to result in substantial discharges of any constituents of concern.

10 Within the Delta, the construction-related activities for Alternative 4 would be most extensive for
11 CM1 involving the new water conveyance facilities. Construction of water conveyance facilities
12 would involve vegetation removal, material storage and handling, excavation, overexcavation for
13 facility foundations, surface grading, trenching, road construction, levee construction, construction
14 site dewatering, soil stockpiling, RTM dewatering basin construction and storage operations, and
15 other general facility construction activities (i.e., concrete, steel, carpentry, and other building
16 trades) over approximately 7,500 acres during the course of constructing the facilities. Vegetation
17 would be removed (via grubbing and clearing) and grading and other earthwork would be
18 conducted at the intakes, pumping plants, the intermediate forebay, the expanded Clifton Court
19 Forebay, culvert siphon between the northern cell of the expanded Clifton Court Forebay to a new
20 canal to the Jones Pumping Plant and a siphon under the Byron Highway into a short segment of
21 canal leading to the Banks Pumping Plant, borrow areas, RTM and spoil storage areas, setback and
22 transition levees, sedimentation basins, solids handling facilities, transition structures, surge shafts
23 and towers, substations, transmission line footings, access roads, concrete batch plants, fuel stations,
24 bridge abutments, barge unloading facilities, and laydown areas. Construction of each intake would
25 take nearly 4 years to complete.

26 Construction activities necessary to develop the new habitat restoration areas for CM2 and CM4–
27 CM10 including restored tidal wetlands, floodplain, and related channel margin and off-channel
28 habitats, would likely involve a variety of extensive conventional clearing and grading activities on
29 relatively dry sites of the Delta that are currently separated from the Delta channels by levees.
30 Construction would involve new setback levees, excavation and soil placement for new wetland and
31 other habitat feature development, and a variety of potential in-water construction activities such as
32 excavation, sediment dredging, levee breaching, and hauling and placement or disposal of excavated
33 sediment or dredge material. Construction activities for the proposed restoration sites, due to the
34 direct connectivity with Delta channels, have the potential to result in direct discharge of eroded soil
35 and construction-related contaminants, or indirectly through erosion and site inundation during the
36 weeks or months following construction prior to stabilization of newly contoured and restored
37 landforms and colonization by vegetation.

38 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
39 associated with implementation of CM1–CM21 under Alternative 4 would be very similar to the
40 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM21
41 would be essentially identical. Potential construction-related water quality effects may include
42 discharges of turbidity/TSS due to the erosion of disturbed soils and associated sedimentation
43 entering surface water bodies or other construction-related wastes (e.g., concrete, asphalt, cleaning
44 agents, paint, and trash). Construction activities also may result in temporary or permanent changes
45 in stormwater generation or drainage and runoff patterns (i.e., velocity, volume, and direction) that
46 may cause or contribute to soil erosion and offsite sedimentation, such as creation of additional

1 impervious surfaces (e.g., pavement, buildings, compacted soils), blockage or restriction of existing
2 drainage channels, or general surface drainage changes from grading and excavation activity.
3 Additionally, the use of heavy earthmoving equipment may result in spills and leakage of oils,
4 gasoline, diesel fuel, and related petroleum contaminants used in the fueling and operation of such
5 construction equipment.

6 Land surface grading and excavation activities, or exposure of disturbed sites immediately following
7 construction and prior to stabilization, could result in rainfall- and stormwater-related soil erosion,
8 runoff, and offsite sedimentation in surface water bodies. The initial runoff following construction,
9 or return of seasonal rains to previously disturbed sites, can result in runoff with peak pollutant
10 levels and is referred to as “first flush” storm events. Soil erosion and runoff can also result in
11 increased concentrations and loading of organic matter, nutrients (nitrogen and phosphorus), and
12 other contaminants contained in the soil such as trace metals, pesticides, or animal-related
13 pathogens. Graded and exposed soils also can be compacted by heavy machinery, resulting in
14 reduced infiltration of rainfall and runoff, thus increasing the rate of runoff (and hence
15 contaminants) to downstream water bodies.

16 Construction activities also would be anticipated to involve the transport, handling, and use of a
17 variety of hazardous substances and non-hazardous materials that may adversely affect water
18 quality if discharged inadvertently to construction sites or directly to water bodies. Typical
19 construction-related contaminants include petroleum products for refueling and maintenance of
20 machinery (e.g., fuel, oils, solvents), concrete, paints and other coatings, cleaning agents, debris and
21 trash, and human wastes. Construction activities also would involve large material storage and
22 laydown areas, and occasional accidental spills of hazardous materials stored and used for
23 construction may occur. Contaminants released or spilled on bare soil also may result in
24 groundwater contamination. Dewatering operations may contain elevated levels of suspended
25 sediment or other constituents that may cause water quality degradation.

26 The intensity of construction activity along with the fate and transport characteristics of the
27 chemicals used, would largely determine the magnitude, duration, and frequency of construction-
28 related discharges and resulting concentrations and degradation associated with the specific
29 constituents of concern. The potential water quality concerns associated with the major categories
30 of contaminants that might be discharged as a result of construction activity include the following.

- 31 ● Suspended sediment: May increase turbidity (i.e., reduce water clarity) that can affect aquatic
32 organisms and increase the costs and effort of removal in municipal/industrial water supplies.
33 Downstream sedimentation can affect aquatic habitat, or cause a nuisance if it affects functions
34 of agricultural or municipal intakes, or boat navigation.
- 35 ● Organic matter: May contribute turbidity and oxygen demanding substances (i.e., reduce DO
36 levels) that can affect aquatic organisms. Organic carbon may increase the potential for
37 disinfection byproduct formation in municipal drinking water supplies.
- 38 ● Nutrients: May contribute nitrogen, phosphorus, and other key nutrients that can contribute to
39 nuisance biostimulation of algae and vascular aquatic plants, which may affect municipal water
40 supplies, recreation, aquatic life, and aesthetics.
- 41 ● Petroleum hydrocarbons: May contribute toxic compounds to aquatic life, and oily sheens may
42 reduce oxygen/gas transfer in water, foul aquatic habitats, and reduce water quality for
43 municipal supplies, recreation, and aesthetics.

- 1 • Trace constituents (metals, pesticides, synthetic organic compounds): Compounds in eroded soil
2 or construction-related materials (e.g., paints, coatings, cleaning agents) may be toxic to aquatic
3 life.
- 4 • Pathogens: Bacteria, viruses, and protozoans may affect aquatic life and increase human health
5 risks via municipal water supplies, reduced recreational water quality, or contaminated shellfish
6 beds.
- 7 • Other inorganic compounds: Construction-related materials can contain inorganic compounds
8 such as acidic/basic materials which can change pH and may adversely affect aquatic life and
9 habitats. Concrete contains lime which can increase pH levels, and drilling fluids may alter pH.

10 Some construction-related contaminants, such as PAHs that may be in some fuel and oil petroleum
11 byproducts, may be bioaccumulative in aquatic and terrestrial organisms. Construction activities
12 also may disturb areas where bioaccumulative constituents are present in the soil (e.g., mercury,
13 selenium, organochlorine pesticides, PCBs, and dioxin/furan compounds), or may disturb soils that
14 contain constituents included on the Section 303(d) lists of impaired water bodies in the affected
15 environment. While the 303(d)-listed Delta channels impaired by mercury are widespread,
16 impairment by selenium, pesticides, PCBs, and dioxin/furan compounds is more limited, and there
17 are no 303(d) listings for PAH impairment. Bioaccumulation of constituents in the aquatic
18 foodchain, and 303(d)-related impaired water bodies, arise as a result of long-term loading of a
19 constituent or a pervasive and widespread source of constituent discharge (e.g., mercury). However,
20 as a result of the generally localized disturbances, and intermittent and temporary nature of
21 construction-related activities, construction would not be anticipated to result in contaminant
22 discharges of substantial magnitude or duration to contribute to long-term bioaccumulation
23 processes, or cause measureable long-term degradation such that existing 303(d) impairments
24 would be made discernibly worse or TMDL actions to reduce loading would be adversely affected.

25 The environmental commitments for construction-related water quality protection would be
26 specifically designed as a part of the final design, included in construction contracts as a required
27 element, and would be implemented for Alternative 4 to avoid, prevent, and minimize the potential
28 discharges of constituents of concern to water bodies and associated adverse water quality effects
29 and comply with state water quality regulations. Additionally, temporary and permanent changes in
30 stormwater drainage and runoff would be minimized and avoided through construction of new or
31 modified drainage facilities, as described in the Chapter 3, *Description of Alternatives*. Alternative 4
32 would include installation of temporary drainage bypass facilities, long-term cross drainage, and
33 replacement of existing drainage facilities that would be disrupted due to construction of new
34 facilities.

35 Construction-related activities under Alternative 4 would be conducted in accordance with the
36 environmental commitment to develop and implement BMPs for all activities that may result in
37 discharge of soil, sediment, or other construction-related contaminants to surface water bodies, and
38 obtain authorization for the construction activities under the State Water Board's NPDES
39 Stormwater General Permit for Stormwater Discharges Associated with Construction and Land
40 Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002). The General
41 Construction NPDES Permit requires the preparation and implementation of SWPPPs, which are the
42 principal plans within the required PRDs that identify the proposed erosion control and pollution
43 prevention BMPs that would be used to avoid and minimize construction-related erosion and
44 contaminant discharges. The development of the SWPPPs, and applicability of other provisions of
45 this General Construction Permit depends on the "risk" classification for the construction which is

1 determined based on the potential for erosion to occur as well as the susceptibility of the receiving
2 water to potential adverse effects of construction. While the determination of project risk level, and
3 planning and development of the SWPPPs and BMPs to be implemented, would be completed as a
4 part of final design and contracting for the work, the responsibility for compliance with the
5 provisions of the General Construction Permit necessitates that BMPs are applied to all disturbance
6 activities. In addition to the BMPs, the SWPPPs would include BMP inspection and monitoring
7 activities, and identify responsibilities of all parties, contingency measures, agency contacts, and
8 training requirements and documentation for those personnel responsible for installation,
9 inspection, maintenance, and repair of BMPs. The General Construction Permit contains NALs and
10 for pH and turbidity, and specifies storm event water quality monitoring to determine if
11 construction is resulting in elevated discharges of these constituents, and monitoring for any non-
12 visible contaminants determined to have been potentially released. If an NAL is determined to have
13 been exceeded, the General Construction Permit requires the discharger to conduct a construction
14 site and run-on evaluation to determine whether contaminant sources associated with the site's
15 construction activity may have caused or contributed to the exceedance and immediately implement
16 corrective actions if they are needed.

17 The BMPs that are routinely implemented in the construction industry and have proven successful
18 at reducing adverse water quality effects include, but are not limited to, the following broad
19 categories of actions (letters refer to categories of specific BMPs identified in Appendix 3B,
20 *Environmental Commitments, AMMs, and CMs*), for which Appendix 3B identifies specific BMPs
21 within these categories:

- 22 • Waste Management and Spill Prevention and Response (BMP categories A.2 and A.3): Waste
23 management BMPs are designed to minimize exposure of waste materials at all construction
24 sites and staging areas such as waste collection and disposal practices, containment and
25 protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention
26 and response BMPs involve planning, equipment, and training for personnel for emergency
27 event response.
- 28 • Erosion and Sedimentation Control (BMP categories A.4 and A.5): Erosion control BMPs are
29 designed to prevent erosion processes or events including scheduling work to avoid rain events,
30 stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff
31 before it leaves the site; and slow runoff rates across construction sites. Identification of
32 appropriate temporary and long-term seeding, mulching, and other erosion control measures as
33 necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion
34 has occurred involving drainage controls, perimeter controls, detention/sedimentation basins,
35 or other containment features.
- 36 • Good Housekeeping and Non-Stormwater Discharge Management (BMP category A.6 and A.7):
37 Good housekeeping BMPs are designed to reduce exposure of construction sites and materials
38 storage to stormwater runoff including truck tire tracking control facilities; equipment washing;
39 litter and construction debris; and designated refueling and equipment inspection/maintenance
40 practices Non-stormwater discharge management BMPs involve runoff measures for
41 contaminants not directly associated with rain or wind including vehicle washing and street
42 cleaning operations.

- 1 • Construction Site Dewatering and Pipeline Testing (BMP category A.8). Dewatering BMPs
2 involve actions to prevent discharge of contaminants present in dewatering of groundwater
3 during construction, discharges of water from testing of pipelines or other facilities, or the
4 indirect erosion that may be caused by dewatering discharges.
- 5 • BMP Inspection and Monitoring (BMP category A.9): Identification of clear objectives for
6 evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring
7 procedures, environmental awareness training, contractor and agency roles and responsibilities,
8 reporting procedures, and communication protocols.

9 In addition to the Category “A” BMPs for surface land disturbances identified in the environmental
10 commitments (Appendix 3B, *Environmental Commitments, AMMs, and CMs*), BMPs implemented for
11 Alternative 4 also would include the Category “B” BMPs for tunnel/pipeline construction that
12 involves actions primarily to avoid and minimize sediment and contaminant discharges associated
13 with RTM excavation, hauling, and RTM dewatering operations. Additionally, habitat restoration
14 activities under CM2 and CM4–CM10 would be subject to implementation of the Category “C” BMPs
15 (In-Water Construction BMPs) and Category “D” BMPs (Tidal and Wetland Restoration) designed to
16 minimize disturbance and direct discharge of turbidity/suspended solids to the water during in-
17 water construction activities. Category “E” BMPs identify general permanent post-construction
18 actions that would be implemented for all terrestrial, in-water, and habitat restoration activities and
19 would involve planning, design, and development of final site stabilization, revegetation, and
20 drainage control features.

21 Finally, acquisition of applicable environmental permits may be required for specific conservation
22 measures, which as described for the No Action Alternative, may include specific WDRs or CWA
23 Section 401 water quality certifications from the appropriate Regional Water Boards, CDFW
24 Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits. These other
25 permit processes may include requirements to implement additional action-specific BMPs that may
26 reduce potential adverse discharge effects of constituents of concern.

27 The potential construction-related contaminant discharges that could result from projects defined
28 under Alternative 4 would not be anticipated to result in adverse water quality effects at a
29 magnitude, frequency, or regional extent that would cause substantial adverse effects to aquatic life.
30 Relative to Existing Conditions, this assessment indicates the following.

- 31 • Projects would be managed under state water quality regulations and project-defined actions to
32 avoid and minimize contaminant discharges.
- 33 • Individual projects would generally be dispersed, and involve infrequent and temporary
34 activities, thus not likely resulting in substantial exceedances of water quality standards or long-
35 term degradation.
- 36 • Potential construction-related contaminant discharges under the Alternative 4 would not cause
37 additional exceedance of applicable water quality objectives where such objectives are not
38 exceeded under Existing Conditions. Long-term water quality degradation is not anticipated,
39 and hence would not be expected to adversely affect beneficial uses.
- 40 • By the intermittent and temporary frequency of construction-related activities and potential
41 contaminant discharges, the constituent-specific effects would not be of substantial magnitude
42 or duration to contribute to long-term bioaccumulation processes, or cause measureable long-

1 term degradation such that existing 303(d) impairments would be made discernibly worse or
2 TMDL actions to reduce loading would be adversely affected.

3 Consequently, because the construction-related activities for the conservation measures would be
4 conducted with implementation of environmental commitments, including but not limited to those
5 identified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, with respect to the Existing
6 Conditions and No Action Alternative conditions, Alternative 4 would not be expected to cause
7 constituent discharges of sufficient frequency and magnitude to result in a substantial increase of
8 exceedances of water quality objectives/criteria, or substantially degrade water quality with respect
9 to the constituents of concern, and thus would not adversely affect any beneficial uses in the Delta.

10 In summary, with implementation of environmental commitments in Appendix 3B, the potential
11 construction-related water quality effects are considered to be not adverse.

12 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 4
13 for construction-related activities along with agency-issued permits that also contain construction
14 requirements to protect water quality, the construction-related effects, relative to Existing
15 Conditions, would not be expected to cause or contribute to substantial alteration of existing
16 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
17 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
18 water quality with respect to the constituents of concern on a long-term average basis, and thus
19 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
20 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
21 would be temporary and intermittent in nature, the construction would involve negligible
22 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
23 environment. As such, construction activities would not contribute measurably to bioaccumulation
24 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
25 Based on these findings, this impact is determined to be less than significant. No mitigation is
26 required.

27 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 28 **and Maintenance (CM1)**

29 ***Upstream of the Delta***

30 Impacts from *Microcystis* upstream of the Delta have only been documented in lakes such as Clear
31 Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over other
32 phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
33 characterized by low nutrient concentrations, where other phytoplankton outcompete
34 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
35 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
36 Joaquin River upstream of the Delta, under Existing Conditions and the No Action Alternative, bloom
37 development is limited by high water velocity and low residence times. These conditions are not
38 expected to change under the four operational scenarios of Alternative 4. Consequently, any
39 modified reservoir operations under any of the four operational scenarios of Alternative 4 are not
40 expected to promote *Microcystis* production upstream of the Delta, relative to Existing Conditions
41 and the No Action Alternative.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related changes of water residence times and its effects on
6 *Microcystis* production (i.e., CM1). Other effects of CM2 through CM21 not attributable to
7 hydrodynamics are discussed within the impact header for CM2 through CM21.

8 Table 8-60a shows modeled long-term average residence times in the six Delta sub-regions during
9 the *Microcystis* summer and fall bloom periods for Existing Conditions, No Action Alternative, and
10 Operational Scenario H3 of Alternative 4. Modeled average residence times for Operational
11 Scenarios H1, H2, and H4 of Alternative 4 are not available. However, during the summer and fall
12 period, the operations and maintenance of Operational Scenarios H3 and H4 are identical, and
13 operations and maintenance of Operational Scenarios H1 and H2 during the summer and fall
14 periods are identical to those of Alternative 3. Thus, the assessment of effects of water residence
15 times on *Microcystis* during the summer and fall bloom periods under Operational Scenarios H1 and
16 H2 of Alternative 4 are based on the assumption that the changes in modeled residence times that
17 would occur under these two operational scenarios would be equivalent to those that would occur
18 under Alternative 3, as shown in Table 8-60a. Likewise, the assessment of effects of water residence
19 times which would occur under Operational Scenario H4 assumes that the changes in modeled
20 residence times that would occur under Operational Scenario H4 would be equivalent to those that
21 would occur under Operational Scenario H3, as shown in Table 8-60a.

22 Under the four operational scenarios of Alternative 4, modeled long-term average residence times in
23 the six Delta sub-regions during the *Microcystis* bloom season of June through October show varying
24 levels of change, depending on sub-region and timeframe (Table 8-60a). Although an increase in
25 residence time throughout the Delta is expected under the No Action Alternative, relative to Existing
26 Conditions, because of climate change and sea level rise, the change is fairly small in most areas of
27 the Delta. Below, residence times under Alternative 4 is compared to residence times under the No
28 Action Alternative to remove the effect of climate change and sea level rise, thereby revealing the
29 effect due to CM1 (i.e., operations) and the effect of the CM2 and CM4 restoration areas, which were
30 accounted for in the modeling performed for CM1.

31 For Operational Scenarios H1 and H2 of Alternative 4 (as shown for Alternative 3 in Table 8-60a),
32 relative to the No Action Alternative, water residence time is expected to increase 3–10 days in the
33 North Delta (summer and fall); increase 24 days in the summer and decrease 3 days in the fall in the
34 Cache Slough sub-region; increase 6 days in the West Delta (both summer and fall); increase 8 days
35 in the summer and decrease 3 days in the fall in the East Delta; increase 4 days in the summer and
36 decrease 3 days in the fall in the South Delta; and decrease 22 days in the summer and increase 20
37 days in the fall in the Suisun Marsh sub-region.

38 For Operational Scenarios H3 and H4 of Alternative 4 (as shown for Alternative 4 in Table 8-60a),
39 relative to the No Action Alternative, water residence time is expected to increase 1–7 days in the
40 North Delta (summer and fall); increase 18 days in the summer and decrease 6 days in the fall in the
41 Cache Slough sub-region; increase 3–4 days in the West Delta (both summer and fall); increase 8–13
42 days in the East Delta (summer and fall); increase 6 days in the summer and 32 days in the fall in the
43 South Delta; and decrease 23 days in the summer and increase 15 days in the fall in the Suisun
44 Marsh sub-region.

1 The summer and fall period average residence times provide a general direction in which residence
2 time may change under the four operational scenarios of Alternative 4 compared to the No Action
3 Alternative. The changes in residence time are driven by a number of factors accounted for in the
4 modeling, including the hydrodynamic effects of restoration actions planned under CM2 and CM4,
5 diversion of Sacramento River water at the proposed north Delta intake facility, as well as changes
6 in net Delta outflows. Variability in local residence times is expected within any Delta sub-region
7 because major portions of the Delta are comprised of complex networks of intertwining channels,
8 shallow back water areas, and submerged islands. Siting and design of restoration areas has
9 substantial influence on the magnitude of residence time increases that would occur under
10 Alternative 4. However, the expected residence time increases that would occur during the summer
11 bloom period at various Delta locations under the four operational scenarios of Alternative 4,
12 compared to the No Action Alternative, are in a direction and of magnitude that could lead to an
13 increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout the
14 Delta.

15 The relationship between Delta water temperatures, climate change, and changes in water
16 deliveries from upstream reservoirs are discussed in Appendix 29C, *Climate Change and the Effects*
17 *of Reservoir Operations on Water Temperatures in the Study Area*. In short, ambient meteorological
18 conditions are the primary driver of Delta water temperatures, meaning that climate warming and
19 not water operations will determine future water temperatures in the Delta. Climate projections for
20 the Central Valley discussed in Appendix 5A, Section D, indicate substantial warming of ambient air
21 temperatures with a median increase in annual temperature of about 1.1°C (2.0°F) by 2025 and
22 2.2°C (4.0°F) by 2060. The projected water temperature change ranges from 0.7 to 1.4°C (1.3 to
23 2.5°F) by 2025 and 1.6 to 2.7°C (2.9-4.9°F) by 2060. Increasing water temperatures could lead to
24 earlier attainment of the water temperature threshold of 19°C required to initiate *Microcystis* bloom
25 formation, and thus earlier occurrences of *Microcystis* blooms in the Delta, relative to Existing
26 Conditions. Warmer water temperatures could also increase bloom duration and magnitude,
27 relative to Existing Conditions. Elevated ambient water temperatures in the Delta, and thus an
28 increase in *Microcystis* bloom duration and magnitude, are expected under Operational Scenarios
29 H1-H4 of Alternative 4, relative to Existing Conditions, but these impacts are due entirely to climate
30 change and not the project alternative. Because climate change is assumed under the No Action
31 Alternative, potential water temperature-driven increases in *Microcystis* blooms in the Delta,
32 relative to Existing Conditions, also would occur under the No Action Alternative. Therefore, no
33 water temperature-driven increases in *Microcystis* blooms would occur in the Delta under
34 Alternative 4, relative to the No Action Alternative.

35 ***SWP/CVP Export Service Areas***

36 The assessment of effects from *Microcystis* in the SWP/CVP Export Service Areas is based on the
37 assessment of *Microcystis* production in source waters to Banks and Jones Pumping plants, and upon
38 the effects of residence time and water temperature on the potential for *Microcystis* blooms to occur
39 in the Export Service Area.

40 Under Operational Scenarios H1-H4 of Alternative 4, exports from Banks and Jones pumping plants
41 will consist of a mixture of Sacramento River water diverted around the Delta, with water quality
42 characteristic of both upstream Sacramento River water, and Sacramento and San Joaquin River
43 water that has flowed through various portions of the North, South, and West Delta. Water diverted
44 from the Sacramento River in the North Delta is expected to be unaffected by *Microcystis* and
45 microcystins. However, the fraction of water flowing through the Delta that reaches the existing

1 south Delta intakes is expected to be influenced by an increase in the frequency, magnitude, and
2 geographic extent of *Microcystis* blooms discussed in the *Delta* section above. Therefore, relative to
3 Existing Conditions and the No Action Alternative, the addition of Sacramento River water from the
4 North Delta under Alternative 4 serves to dilute *Microcystis* and microcystins in water diverted from
5 the South Delta with water that is not expected to contain them. Because the degree to which
6 *Microcystis* blooms, and thus microcystins concentrations, will increase in source water from the
7 South Delta is unknown, it cannot be determined whether Alternative 4 will result in increased or
8 decreased levels of microcystins in the mixture of source waters exported from Banks and Jones
9 pumping plants, relative to Existing Conditions and the No Action Alternative.

10 *Microcystis* blooms have not occurred in the Export Service Areas even though source waters to the
11 SWP and CVP have been affected. Conditions in the Export Service Areas under the four operational
12 scenarios of Alternative 4 may become more conducive to *Microcystis* bloom formation, relative to
13 Existing Conditions, because water temperatures will increase in the Export Service Areas due to the
14 expected increase in ambient air temperatures resulting from climate change. Residence times in
15 this area are not expected to substantially change under the four operational scenarios of
16 Alternative 4, relative to Existing Conditions. Conditions in the Export Service Areas under the four
17 operational scenarios of Alternative 4 are not expected to become more conducive to *Microcystis*
18 bloom formation, relative to the No Action Alternative, because neither water residence time nor
19 water temperatures will increase in the Export Service Areas.

20 **NEPA Effects:** In summary, operations and maintenance under the four operational scenarios of
21 Alternative 4, relative to the No Action Alternative, would result in long-term increases in hydraulic
22 residence time of various Delta sub-regions during the summer and fall *Microcystis* bloom period.
23 During this period, the increased residence time could result in a concurrent increase in the
24 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus microcystin levels, in
25 affected areas of the Delta. As a result, Alternative 4 operation and maintenance activities would
26 cause further degradation to water quality with respect to *Microcystis* in the Delta. Under the four
27 operational scenarios of Alternative 4, relative to No Action Alternative, water exported to the
28 SWP/CVP Export Service Area will be a mixture of *Microcystis*-affected source water from the south
29 Delta intakes and unaffected source water from the Sacramento River, diverted at the north Delta
30 intakes. It cannot be determined whether operations and maintenance under Alternative 4 will
31 result in increased or decreased levels of *Microcystis* and microcystins in the mixture of source
32 waters exported from Banks and Jones pumping plants. Mitigation Measure WQ-32a and WQ-32b
33 are available to reduce the effects of degraded water quality in the Delta. Although there is
34 considerable uncertainty regarding this impact, the effects on *Microcystis* from implementing CM1 is
35 determined to be adverse.

36 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2,
38 *Determination of Effects*) for the purpose of making the CEQA impact determination for this
39 constituent. For additional details on the effects assessment findings that support this CEQA impact
40 determination, see the effects assessment discussion that immediately precedes this conclusion.

41 Under the various operational scenarios of Alternative 4 additional impacts from *Microcystis* in the
42 reservoirs and watersheds upstream of the Delta are not expected, relative to Existing Conditions.
43 Operations and maintenance occurring under any of the operational scenarios of Alternative 4 is not
44 expected to change nutrient levels in upstream reservoirs or hydrodynamic conditions in upstream
45 rivers and streams such that conditions would be more conducive to *Microcystis* production.

1 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
2 expected to increase under all operational scenarios of Alternative 4, resulting in an increase in the
3 frequency, magnitude and geographic extent of *Microcystis* blooms in the Delta. However, the
4 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
5 temperatures is driven entirely by climate change, not effects of CM1. Increases in Delta residence
6 times are expected throughout the Delta during the summer and fall bloom period, due in small part
7 to climate change and sea level rise, but due more proportionately to CM1 and the hydrodynamic
8 impacts of restoration included in CM2 and CM4. The precise change in local residence times and
9 *Microcystis* production expected within any Delta sub-region is unknown because conditions will
10 vary across the complex networks of intertwining channels, shallow back water areas, and
11 submerged islands that compose the Delta. Nonetheless, residence times are, in general, expected to
12 increase during the *Microcystis* bloom period at various Delta locations under all operational
13 scenarios of Alternative 4. Consequently, it is possible that increases in the frequency, magnitude,
14 and geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
15 maintenance under the four operational scenarios of Alternative 4 and the hydrodynamic impacts of
16 restoration (CM2 and CM4).

17 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
18 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
19 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
20 Under the various operational scenarios of Alternative 4, relative to Existing Conditions, the
21 potential for *Microcystis* to occur in the Export Service Area is expected to increase due to increasing
22 water temperature, but this impact is driven entirely by climate change and not Alternative 4. Water
23 exported from the Delta to the Export Service Area is expected to be a mixture of *Microcystis*-
24 affected source water from the south Delta intakes and unaffected source water from the
25 Sacramento River. Because of this, it cannot be determined whether operations and maintenance
26 under the four operational scenarios of Alternative 4, relative to existing conditions, will result in
27 increased or decreased levels of *Microcystis* and microcystins in the mixture of source waters
28 exported from Banks and Jones pumping plants.

29 Based on the above, this alternative would not be expected to cause additional exceedance of
30 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
31 would cause significant impacts on any beneficial uses of waters in the affected environment.
32 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
33 increases that could occur in some areas would not make any existing *Microcystis* impairment
34 measurably worse because no such impairments currently exist. However, because it is possible that
35 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
36 occur due to the operations and maintenance of the four operational scenarios of Alternative 4 and
37 the hydrodynamic impacts of restoration (CM2 and CM4), long-term water quality degradation may
38 occur and, thus, significant impacts on beneficial uses could occur. Further, microcystin is
39 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
40 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
41 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
42 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
43 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM1 is determined
44 to be significant.

1 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
2 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
3 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
4 remain significant and unavoidable.

5 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased** 6 ***Microcystis* Blooms**

7 It remains to be determined whether, or to what degree, *Microcystis* production will increase in
8 Delta areas as a result of increased residence times associated with the implementation of the
9 four operational scenarios of the project alternative. Mitigation actions shall be focused on those
10 incremental effects attributable to implementation of operations under the project alternative
11 only. Development of mitigation actions for the incremental increase in *Microcystis* effects
12 attributable to water temperature and residence time increases driven by climate change and
13 sea level rise is not required because these changed conditions would occur with or without
14 implementation of the project alternative. The goal of specific actions would be to reduce/avoid
15 additional degradation of Delta water quality conditions with respect to occurrences of
16 *Microcystis* blooms.

17 Additional evaluation will be conducted as part of the development of tidal habitat restoration
18 areas to determine the feasibility of using site placement and design criteria to reduce or
19 eliminate local conditions conducive to *Microcystis* production. Design criteria would be
20 developed to provide guidelines for developing restoration areas to discourage *Microcystis*
21 growth by maintaining adequate flushing, while maintaining the benefits of habitat restoration
22 in terms of zooplankton production, fish food quality, and fish feeding success. For example, a
23 target range of typical summer/fall hydraulic residence time that is long enough to promote
24 phytoplankton growth, but not so long as to promote growth of *Microcystis*, could be used to aid
25 restoration site design. However, currently there is not sufficient scientific certainty to evaluate
26 whether or not longer residence times would result in greater *Microcystis* production, and also
27 whether longer residence times might produce greater benefits to fish and other aquatic life
28 than shorter residence times. This mitigation measure requires that residence time
29 considerations be incorporated into restoration area site design for CM2 and CM4 using best
30 available science at the time of design. It is possible that through these efforts, increases in
31 *Microcystis* attributable to the project alternative, relative to Existing Conditions, could be
32 mitigated. However, there may be instances where this design consideration may not be
33 feasible, and thus, achieving *Microcystis* reduction pursuant to this mitigation measure would
34 not be feasible.

35 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage** 36 **Water Residence Time**

37 Because it is not known where, when, and to what extent *Microcystis* will be more abundant
38 under CM1 than under Existing Conditions, specific mitigation measures cannot be described.
39 However, this mitigation measure requires the project proponents to monitor for *Microcystis*
40 abundance in the Delta and use appropriate statistical methods to determine whether increases
41 in abundance are significant. This mitigation measure also requires that if *Microcystis* abundance
42 increases, relative to Existing Conditions, the project proponents will investigate and evaluate
43 measures that could be taken to reduce residence time in the affected areas of the Delta.
44 Operational actions could include timing of temporary or operable barrier openings and

1 closings, reservoir releases, and location of Delta exports (i.e., North Delta vs. South Delta
 2 pumping facilities). Depending on the location and severity of the increases, one or more of
 3 these actions may be feasible for reducing residence times. If so, these actions could mitigate
 4 increases in *Microcystis* under CM1 attributable to the project alternative, relative to Existing
 5 Conditions. However, it is possible that these actions would not be feasible because they would
 6 conflict with other project commitments, would cause their own environmental impacts, or
 7 would not be expected to reduce or mitigate increases in *Microcystis*. In this case, achieving
 8 *Microcystis* reduction pursuant to this mitigation measure would not be feasible.

9 **Impact WQ-33: Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 10 **Measures (CM2–CM21)**

11 Implementation of CM3 and CM6–CM21 is unlikely to affect *Microcystis* abundance in the rivers and
 12 reservoirs upstream of the Delta, in the Delta region, or the waters exported to the CVP and SWP
 13 service areas. Implementation of CM5, Seasonally Inundated Floodplain Restoration, could result in
 14 increased local water temperatures in areas near restored seasonally inundated floodplains.
 15 However, floodplain inundation typically occurs during spring and winter months when *Microcystis*
 16 growth is limited in general by low water temperatures and by insufficient surface water irradiance,
 17 and water temperatures would not increase sufficiently due to floodplain inundation such that
 18 effects on *Microcystis* growth would occur. Therefore, implementation of CM5 is unlikely to affect
 19 *Microcystis* blooms in the project area. Implementation of CM13, Invasive Aquatic Vegetation
 20 Control, may increase turbidity and flow velocity, particularly in restored aquatic habitats, which
 21 could discourage *Microcystis* growth in these areas. To the extent that IAV removal would affect
 22 turbidity and water velocity, it is possible that IAV removal could, to some degree, help offset the
 23 increase in *Microcystis* production expected under Alternative 4, relative to the No Action
 24 Alternative.

25 As discussed in detail in Impact WQ-32, development of restoration areas which will occur under
 26 CM2 and CM4 could possibly increase the frequency, magnitude, and geographic extent of
 27 *Microcystis* blooms due to the hydrodynamic impacts that are expected to increase water residence
 28 times throughout various areas of the Delta relative to Existing Conditions and the No Action
 29 Alternative. Additionally, restoration activities that create shallow backwater areas, due to
 30 implementation of CM2 and CM4, could result in local warmer water that may encourage *Microcystis*
 31 growth during the summer bloom forming season and result in further degradation of water quality.
 32 Mitigation to specifically address the effects of local increases in water temperatures on *Microcystis*
 33 in the vicinity of such restoration areas is not available. Regardless of elevated water temperatures,
 34 sufficient residence time is required for *Microcystis* bloom formation. Thus, the combined effect on
 35 *Microcystis* from increased local water temperatures and increased water residence times may be
 36 reduced by implementation of Mitigation Measure WQ-32a. The effectiveness of these mitigation
 37 measures to result in feasible measures for reducing water quality effects is uncertain.

38 **NEPA Effects:** Although there is considerable uncertainty regarding this impact, the effects on
 39 *Microcystis* from implementing CM2–CM21 are determined to be adverse.

40 **CEQA Conclusions:** Based on the above, this alternative would not be expected to cause additional
 41 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 42 extent that would cause significant impacts on any beneficial uses of waters in the affected
 43 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 44 and thus any increases that could occur in some areas would not make any existing *Microcystis*

1 impairment measurably worse because no such impairments currently exist. However, microcystin
 2 is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 3 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 4 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 5 would, in turn, pose health risks to fish, wildlife or humans. Because restoration actions
 6 implemented under CM2 and CM4 will increase residence time throughout the Delta and create local
 7 areas of warmer water during the bloom season, it is possible that increases in the frequency,
 8 magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water quality
 9 degradation and significant impacts on beneficial uses, could occur. Although there is considerable
 10 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 11 determined to be significant.

12 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 13 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 14 measures for reducing water quality effects is uncertain, this impact is considered to remain
 15 significant and unavoidable.

16 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 17 ***Microcystis* Blooms**

18 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 4.

19 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 20 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

21 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 22 that Alternative 4 would have a less than significant impact/no adverse effect on the following
 23 constituents in the Delta:

- 24 ● Boron
- 25 ● DO
- 26 ● Pathogens
- 27 ● Pesticides
- 28 ● Trace Metals
- 29 ● Turbidity and TSS

30 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 31 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 32 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 33 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 34 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 35 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 36 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 37 quality of the of San Francisco Bay.

1 The effects of Alternative 4 on bromide, chloride, and DOC, in the Delta were determined to be
2 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
3 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
4 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
5 adversely affect any beneficial uses of San Francisco Bay.

6 The effects of Alternative 4 on EC in the Delta were determined to be significant/adverse. Elevated
7 EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use and fish and
8 wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR beneficial use
9 designation. However, potential effects on bay salinity are discussed further below, with
10 consideration to effects on fish and wildlife beneficial uses.

11 While effects of Alternative 4 on the nutrients ammonia, nitrate, and phosphorus were determined
12 to be less than significant/not adverse, these constituents are addressed further below because the
13 response of the seaward bays to changed nutrient concentrations/loading may differ from the
14 response of the Delta. Because the potential change in *Microcystis* levels were found to be significant
15 in the Delta, potential effects on *Microcystis* levels and microcystin concentrations in San Francisco
16 Bay are discussed. Selenium and mercury are discussed further, because they are bioaccumulative
17 constituents where changes in load due to both changes in Delta concentrations and exports are of
18 concern.

19 **Nutrients: Ammonia, Nitrate, and Phosphorus**

20 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 4 would be
21 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
22 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
23 decrease by 24–28%, relative to Existing Conditions, and increase by 5–12%, relative to the No
24 Action Alternative, depending on operations scenario (Appendix 80, *San Francisco Bay Analysis*,
25 Table O-1). The change in nitrogen loading to Suisun and San Pablo Bays under Alternative 4 would
26 not adversely impact primary productivity in these embayments because light limitation and
27 grazing currently limit algal production in these embayments. To the extent that algal growth
28 increases in relation to a change in ammonia concentration, this would have net positive benefits,
29 because current algal levels in these embayments are low. Nutrient levels and ratios are not
30 considered a direct driver of *Microcystis* and cyanobacteria levels in the North Bay.

31 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 4 is
32 estimated to increase by -1–+5%, relative to Existing Conditions and increase by 0–6% relative to
33 the No Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in
34 phosphorus loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry
35 on primary productivity. However, there is uncertainty regarding the impact of nutrient ratios on
36 phytoplankton community composition and abundance. Any effect on phytoplankton community
37 composition would likely be small compared to the effects of grazing from introduced clams and
38 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
39 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
40 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
41 would result in adverse effects to beneficial uses.

1 **Mercury**

2 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
3 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
4 are estimated to change relatively little due to changes in source water fractions and net Delta
5 outflow that would occur under Alternative 4. Mercury load to the Bay is estimated to increase by 1–
6 5 kg/year (<1–2%), relative to Existing Conditions, and to increase by -2–+2kg/year (-1–+1%),
7 relative to the No Action Alternative, depending on operations scenario. Methylmercury load is
8 estimated to increase by 0–0.13 kg/year (0–4%), relative to Existing Conditions, and increase
9 by -0.09–+0.04 kg/year (-2–+1%) relative to the No Action Alternative. The estimated total mercury
10 load to the Bay is 261–265 kg/year, which would be less than the San Francisco Bay mercury TMDL
11 WLA for the Delta of 330 kg/year. The estimated changes in mercury and methylmercury loads
12 would be within the overall uncertainty associated with the estimates of long-term average net
13 Delta outflow and the long-term average mercury and methylmercury concentrations in Delta
14 source waters. The estimated changes in mercury load under the alternative would also be
15 substantially less than the considerable differences among estimates in the current mercury load to
16 San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006; David et al.
17 2009).

18 Given that the estimated incremental increases of mercury and methylmercury loading to San
19 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
20 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
21 Francisco Bay due to Alternative 4 are not expected to result in adverse effects to beneficial uses or
22 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
23 303(d) impairment measurably worse.

24 **Salinity**

25 Salinity throughout San Francisco Bay is largely a function of the tides, as well as to some extent the
26 freshwater inflow from upstream. Thus, Delta outflow is the main mechanism by which the
27 alternative could affect salinity in San Francisco Bay. According to the Delta Atlas (California
28 Department of Water Resources 1995), average historical tidal flow through the Golden Gate Bridge
29 is 2,300,000 cfs and average historical tidal flow at Chipps Island is 170,000 cfs. The historical
30 average tidal flows are two to three orders of magnitude larger than the largest mean monthly
31 change in Delta outflow due to the No Action Alternative (shown in Appendix 5A, Section C.7). Thus,
32 the changes in Delta outflow due to Alternative 4 would be minor compared to tidal flows, and thus
33 no substantial adverse effects on salinity, or fish and wildlife beneficial uses, downstream of the
34 Delta are expected.

35 **Selenium**

36 Changes in source water fraction and net Delta outflow under Alternative 4, relative to Existing
37 Conditions, are projected to cause the total selenium load to the North Bay to increase by 6–11%,
38 relative to Existing Conditions, and increase by 2–8%, relative to the No Action Alternative,
39 depending on operations scenario (Appendix 80, *San Francisco Bay Analysis*, Table O-3). Changes in
40 long-term average selenium concentrations of the North Bay are assumed to be proportional to
41 changes in North Bay selenium loads. Under Alternative 4, the long-term average total selenium
42 concentration of the North Bay is estimated to be 0.013–0.14 µg/L and the dissolved selenium
43 concentration is estimated to be 0.12 µg/L, which would be 0.01 µg/L higher than Existing
44 Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved selenium

1 concentration would be below the target of 0.202 µg/L developed by Presser and Luoma (2013) to
2 coincide with a white sturgeon whole-body fish tissue selenium concentration not greater than 8
3 mg/kg in the North Bay. The incremental increase in dissolved selenium concentrations in the North
4 Bay, relative to Existing Conditions, would be negligible (0.01 µg/L) under this alternative. Thus, the
5 estimated changes in selenium loads in Delta exports to San Francisco Bay due to Alternative 4 are
6 not expected to result in adverse effects to beneficial uses or substantially degrade the water quality
7 with regard to selenium, or make the existing CWA Section 303(d) impairment measurably worse.

8 ***Microcystis***

9 *Microcystis* has not been detected in embayments of the San Francisco Bay downstream of Suisun
10 Bay. Low levels of microcystins occur throughout San Francisco Bay, but their concentrations do not
11 correspond to *Microcystis* abundance, nor is there evidence that they have been transported
12 downstream from *Microcystis* blooms that have occurred in the Delta (Senn and Novick 2013). The
13 low levels of microcystins present in San Francisco Bay are likely derived from cyanobacteria
14 besides *Microcystis*, such as *Cyanobium sp.* and *Synechocystis*, which are currently resident in the San
15 Francisco Bay at levels well below bloom magnitude (Senn and Novick 2013). Elevated microcystin
16 levels could occur at various locations in the Delta during *Microcystis* blooms under Alternative 4,
17 but because of the sufficient dilution available in San Francisco Bay, downstream transport of Delta-
18 derived microcystins are not expected to result in measurable changes in the microcystin levels of
19 San Francisco Bay.

20 The absence of *Microcystis* in San Francisco Bay is likely directly related to its intolerance of elevated
21 salinity, as its growth ceases and breakdown of its cellular tissues starts at salinities of 10–12.6 ppt
22 (Tonk et al. 2007; Black et al. 2011). San Pablo Bay is the only embayment of San Francisco Bay
23 downstream of Suisun Bay that would experience salinities of this magnitude for any significant
24 duration of the year, although these and lower salinities would only occur under conditions of high
25 Delta outflow. However, high Delta outflows occur during wet years and during the winter and
26 spring runoff season, under which water temperatures are expected to be low, turbidity high, and
27 water residence times low, making the environment of San Pablo Bay unsuitable for *Microcystis*
28 growth. Additionally, these hydrodynamics conditions typically only occur when the potential for
29 *Microcystis* blooms to occur upstream of, and thus potentially seed *Microcystis* to, San Pablo Bay are
30 minimal. Alternative 4 is not expected to result in significant modification to net Delta outflows or
31 the timing of high outflow events related to wet season runoff. Thus, the effects of Alternative 4 on
32 *Microcystis* levels in San Francisco Bay are expected to be negligible.

33 **NEPA Effects:** Based on the discussion above, Alternative 4, relative to the No Action Alternative,
34 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
35 DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia, nitrate, phosphorus), trace
36 metals, or turbidity and TSS in the San Francisco Bay. Further, changes in these constituent
37 concentrations in Delta outflow would not be expected to cause changes in Bay concentrations of
38 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses. In
39 summary, based on the discussion above, effects on the San Francisco Bay from implementation of
40 CM1–CM21 are considered to be not adverse.

1 **CEQA Conclusion:** Based on the above, Alternative 4 would not be expected to cause long-term
2 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
3 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
4 would result in substantially increased risk for adverse effects to one or more beneficial uses.
5 Further, based on the above, this alternative would not be expected to cause additional exceedance
6 of applicable water quality objectives/criteria in the San Francisco Bay by frequency, magnitude,
7 and geographic extent that would cause significant impacts on any beneficial uses of waters in the
8 affected environment. Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay
9 would not adversely affect beneficial uses, because the uses most affected by changes in these
10 parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial changes in DO,
11 pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta, relative to
12 Existing Conditions, therefore, no substantial changes these constituents' levels in the Bay are
13 anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay salinity, as
14 the change in Delta outflow would two to three orders of magnitude lower than (and thus minimal
15 compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in the Delta
16 would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant of the
17 Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 24–28%
18 decrease in total nitrogen load and -1–+5% increase in phosphorus load, relative to Existing
19 Conditions, are expected to have minimal effect on water quality degradation, primary productivity,
20 or phytoplankton community composition. The estimated increase in mercury load (1–5 kg/year;
21 <1–2%) and methylmercury load (0.00–0.13 kg/year; 0–4%), relative to Existing Conditions, is
22 within the level of uncertainty in the mass load estimate and not expected to contribute to water
23 quality degradation, make the CWA Section 303(d) mercury impairment measurably worse or cause
24 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
25 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
26 load would be 6–11%, but estimated total and dissolved selenium concentrations under this
27 alternative would be nearly the same as Existing Conditions, and less than the target associated with
28 white sturgeon whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium
29 load is not expected to contribute to water quality degradation, or make the CWA Section 303(d)
30 selenium impairment measurably worse or cause selenium to bioaccumulate to greater levels in
31 aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This
32 impact is considered to be less than significant.

8.3.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

Alternative 5 would comprise physical/structural components similar to those under Alternative 1A with the principal exception that Alternative 5 would convey up to 3,000 cfs of water from the north Delta to the south Delta. Diverted water would be conveyed through pipelines/tunnels from a single screened intake (i.e., Intake 1) located on the east bank of the Sacramento River between Clarksburg and Walnut Grove. Alternative 5 would include a 750-acre intermediate forebay and pumping plant. A new 600-acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to the south Delta pumping plants. Water supply and conveyance operations would follow the guidelines described as Scenario C, which includes Fall X2. CM2–CM21 would be implemented under this alternative, and would be the same as those under Alternative 1A with the exception of CM4, which would involve 25,000 acres of tidal habitat restoration instead of 65,000 acres under the other BDCP alternatives. See Chapter 3, *Description of Alternatives*, Section 3.5.10, for additional details on Alternative 5.

Effects of the Alternative on Delta Hydrodynamics

Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can substantially affect water quality within the Delta:

- Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-sourced water and a concurrent increase in San Joaquin River-sourced water can increase the concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity, nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by decreased exports of San Joaquin River water (due to increased Sacramento River water exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows also can affect water residence time and many related physical, chemical, and biological variables.
- Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta outflow can increase the concentration of salts (bromide, chloride) and levels of electrical conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet and above normal water years) will decrease levels of these constituents, particularly in the west Delta.

Under Alternative 5, over the long term, average annual delta exports are anticipated to decrease by 358 TAF relative to Existing Conditions, and increase by 346 TAF relative to the No Action Alternative. Because, over the long-term, approximately 25% of the exported water would be from the new north Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more information). The result of this would be increased San Joaquin River water influence throughout the south, west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This can be seen, for example, in Appendix 8D, ALT 5–Old River at Rock Slough for ALL years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

1 Under Alternative 5, long-term average annual Delta outflow is anticipated to increase 401 TAF
 2 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 3 capacity of 3,000 cfs and numerous other components of Operational Scenario C) and climate
 4 change/sea level rise (see Chapter 5, *Water Supply*, for more information). Long-term average
 5 annual Delta outflow is anticipated to decrease under Alternative 5 by 349 TAF relative to the No
 6 Action Alternative, due only to changes in operations. The result of this is increased sea water
 7 intrusion in the west Delta. The increases in sea water intrusion (represented by an increase in San
 8 Francisco Bay (BAY) percentage) can be seen, for example, in Appendix 8D, ALT 5–Sacramento River
 9 at Mallard Island for ALL years (1976–1991).

10 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and**
 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if
 14 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 15 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 16 concentrations that could occur in the water bodies of the affected environment located upstream of
 17 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 18 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 19 ammonia.

20 ***Delta***

21 Assessment of effects of ammonia under Alternative 5 is the same as discussed under Alternative
 22 1A, except that because flows in the Sacramento River at Freeport are different between the two
 23 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 24 concentrations in the Sacramento River downstream of Freeport are different.

25 As Table 8-68 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 26 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 5 and the No
 27 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
 28 occur during January through March, August, September, November, and December, and remaining
 29 months would be unchanged or have a minor decrease. A minor increase in the annual average
 30 concentration would occur under Alternative 5, compared to the No Action Alternative. Moreover,
 31 the estimated concentrations downstream of Freeport under Alternative 5 would be similar to
 32 existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently,
 33 changes in source water fraction anticipated under Alternative 5, relative to the No Action
 34 Alternative, are not expected to substantially increase ammonia concentrations at any Delta
 35 locations.

Table 8-68. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 5

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 5	0.072	0.088	0.070	0.061	0.058	0.061	0.058	0.064	0.064	0.060	0.070	0.067	0.066

Any negligible increases in ammonia-N concentrations that could occur at certain locations in the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

SWP/CVP Export Service Areas

The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for Alternative 1A, under Alternative 5 for areas of the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease, relative to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water quality of exported water, with regards to ammonia.

Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and Jones pumping plants, ammonia-N concentrations are not expected to be substantially different under Alternative 5, relative to No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur at Banks and Jones pumping plants would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

NEPA Effects: In summary, based on the discussion above, effects on ammonia from implementation of CM1 are considered to be not adverse.

CEQA Conclusion: Key findings discussed in the effects assessment provided above are summarized here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this constituent. For additional details on the effects assessment findings that support this CEQA impact determination, see the effects assessment discussion that immediately precedes this conclusion.

Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently, any modified reservoir operations and subsequent changes in river flows under Alternative 5, relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream of the Delta in the San Joaquin River watershed.

1 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 2 substantially lower under Alternative 5, relative to Existing Conditions, due to upgrades to the
 3 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 4 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 5 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 6 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 7 either of these concentrations.

8 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 9 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 10 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 11 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 5,
 12 relative to Existing Conditions.

13 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 14 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 15 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
 16 alternative is not expected to cause additional exceedance of applicable water quality
 17 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 18 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
 19 not expected to increase substantially, no long-term water quality degradation is expected to occur
 20 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 21 affected environment and thus any minor increases that could occur in some areas would not make
 22 any existing ammonia-related impairment measurably worse because no such impairments
 23 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 24 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 25 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 26 significant. No mitigation is required.

27 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 28 CM21**

29 **NEPA Effects:** Effects of CM2-CM21 on ammonia under Alternative 5 would be the same as those
 30 discussed for Alternative 1A and are considered to be not adverse.

31 **CEQA Conclusion:** CM2-CM21 proposed under Alternative 5 would be similar to conservation
 32 measures proposed under Alternative 1A. As such, effects on ammonia resulting from the
 33 implementation of CM2-CM21 would be similar to those previously discussed for Alternative 1A.
 34 This impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and 36 Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Effects of CM1 on boron under Alternative 5 in areas upstream of the Delta would be very similar to
 39 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 40 in the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 41 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 42 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin

1 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
 2 project operations, climate change, and increased water demands) and would be similar compared
 3 to the No Action Alternative considering only changes due to Alternative 5 operations. The reduced
 4 flow would result in possible increases in long-term average boron concentrations of up to about
 5 3% relative to the Existing Conditions (Appendix 8F, *Boron*, Table Bo-32). The increased boron
 6 concentrations would not increase the frequency of exceedances of any applicable objectives or
 7 criteria and would not be expected to cause further degradation at measurable levels in the lower
 8 San Joaquin River, and thus would not cause the existing impairment there to be discernibly worse.
 9 Consequently, Alternative 5 would not be expected to cause exceedance of boron objectives/criteria
 10 or substantially degrade water quality with respect to boron, and thus would not adversely affect
 11 any beneficial uses of the Sacramento River, the eastside tributaries, associated reservoirs upstream
 12 of the Delta, or the San Joaquin River.

13 **Delta**

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 19 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 20 information.

21 Effects of CM1 on boron under Alternative 5 in the Delta would be similar to the effects discussed for
 22 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 5 would
 23 result in increased long-term average boron concentrations for the 16-year period modeled at
 24 interior and western Delta locations (by as much as 7% at the SF Mokelumne River at Staten Island,
 25 2% at the San Joaquin River at Buckley Cove, 8% at Franks Tract, and 7% at Old River at Rock
 26 Slough) (Appendix 8F, *Boron*, Table Bo-14). This comparison to Existing Conditions reflects changes
 27 due to both Alternative 5 operations (including north Delta intake capacity of 3,000 cfs and
 28 numerous other components of Operational Scenario C) and climate change/sea level rise. The
 29 comparison to the No Action Alternative reflects changes due only to operations.

30 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
 31 concentrations at western Delta assessment locations (more discussion of this phenomenon is
 32 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
 33 diversions which occur primarily at interior Delta locations. The long-term annual average and
 34 monthly average boron concentrations, for either the 16-year period or drought period modeled,
 35 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
 36 agricultural objective at any of the eleven Delta assessment locations, which represents no change
 37 from the Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-3A).
 38 Reductions in long-term average assimilative capacity of up to 4% at interior Delta locations (i.e.,
 39 Franks Tract and Old River at Rock Slough) would be small with respect to the 500 µg/L agricultural
 40 objective (Appendix 8F, *Boron*, Table Bo-15). However, because the absolute boron concentrations
 41 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
 42 beneficial use under Alternative 5, the levels of boron degradation would not be of sufficient
 43 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
 44 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
 45 (Appendix 8F, Figure Bo-4).

1 **SWP/CVP Export Service Areas**

2 Effects of CM1 on boron under Alternative 5 in the Delta would be similar to the effects discussed for
3 Alternative 1A. Under Alternative 5, long-term average boron concentrations would decrease by as
4 much as 11% at the Banks Pumping Plant and Jones Pumping Plant relative to the Existing
5 Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-14) as a result of export of a
6 greater proportion of low-boron Sacramento River water. Commensurate with the decrease in
7 exported boron concentrations, boron concentrations in the lower San Joaquin River may be
8 reduced and would likely alleviate or lessen any expected increase in boron concentrations at
9 Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
10 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
11 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
12 Joaquin River and associated TMDL actions for reducing boron loading.

13 Maintenance of SWP and CVP facilities under Alternative 5 would not be expected to create new
14 sources of boron or contribute towards a substantial change in existing sources of boron in the
15 affected environment. Maintenance activities would not be expected to cause any substantial
16 increases in boron concentrations or degradation with respect to boron such that objectives would
17 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 5 would
20 result in relatively small increases in long-term average boron concentrations in the Delta and not
21 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes
22 would not be expected to cause exceedances of applicable objectives or further measurable water
23 quality degradation, and thus would not constitute an adverse effect on water quality.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
26 purpose of making the CEQA impact determination for this constituent. For additional details on the
27 effects assessment findings that support this CEQA impact determination, see the effects assessment
28 discussion that immediately precedes this conclusion.

29 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
30 river flow rate and reservoir storage reductions that would occur under the Alternative 5, relative to
31 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
32 Additionally, relative to Existing Conditions, Alternative 5 would not result in reductions in river
33 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
34 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

35 Small increased boron levels predicted for interior and western Delta locations in response (i.e., up
36 to 8% increase) to a shift in the Delta source water percentages and tidal habitat restoration under
37 this alternative would not be expected to cause exceedances of objectives, or substantial
38 degradation of these water bodies. Alternative 5 maintenance also would not result in any
39 substantial increases in boron concentrations in the affected environment. Boron concentrations
40 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
41 reflecting a potential improvement to boron loading in the lower San Joaquin River.

42 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 5
43 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to

Existing Conditions, Alternative 5 would not result in substantially increased boron concentrations such that frequency of exceedances of municipal and agricultural water supply objectives would increase. The levels of boron degradation that may occur under Alternative 5 would not be of sufficient magnitude to cause substantially increased risk for adverse effects to municipal or agricultural beneficial uses within the affected environment. Long-term average boron concentrations would decrease in Delta water exports to the SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of agricultural beneficial uses in the lower San Joaquin River. Based on these findings, this impact is determined to be less than significant. No mitigation is required.

Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21

NEPA Effects: Effects of CM2–CM21 on boron under Alternative 5 would be the same as those discussed for Alternative 1A and are determined to be not adverse.

CEQA Conclusion: CM2–CM21 proposed under Alternative 5 would be similar to conservation measures proposed under Alternative 1A. As such, effects on boron resulting from the implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is considered to be less than significant. No mitigation is required.

Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and Maintenance (CM1)

Upstream of the Delta

Under Alternative 5 there would be no expected change to the sources of bromide in the Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged and resultant changes in flows from altered system-wide operations under Alternative 5 would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these watersheds. Consequently, Alternative 5 would not be expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their associated reservoirs upstream of the Delta.

Under Alternative 5, modeling indicates that long-term annual average flows on the San Joaquin River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). These decreases in flow would result in possible increases in long-term average bromide concentrations of about 3%, relative to Existing Conditions and less than <1% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower San Joaquin River bromide levels that could occur under Alternative 5, relative to existing and the No Action Alternative conditions would not be expected to adversely affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

Delta

Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing of source waters, these effects are included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
2 information.

3 Under Alternative 5, the geographic extent of effects pertaining to long-term average bromide
4 concentrations in the Delta would be similar to that previously described for Alternative 1A,
5 although the magnitude of predicted long-term change and relative frequency of concentration
6 threshold exceedances would be different. Using the mass-balance modeling approach for bromide
7 (see Section 8.3.1.3), relative to Existing Conditions, modeled long-term average bromide
8 concentrations would increase at Staten Island, Emmaton, and Barker Slough, while modeled long-
9 term average bromide concentrations would decrease at the other assessment locations (Appendix
10 8E, *Bromide*, Table 12). Overall effects would be greatest at Barker Slough, where predicted long-
11 term average bromide concentrations would increase from 51 µg/L to 63 µg/L (23% relative
12 increase) for the modeled 16-year hydrologic period and would increase from 54 µg/L to 98 µg/L
13 (84% relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L
14 exceedance frequency would decrease from 49% under Existing Conditions to 38% under
15 Alternative 5, but would increase from 55% to 68% during the drought period. At Barker Slough, the
16 predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to
17 18% under Alternative 5, and would increase from 0% to 38% during the drought period. In
18 contrast, increases in bromide at Staten Island would result in a 50 µg/L bromide threshold
19 exceedance increase from 47% under Existing Conditions to 67% under Alternative 5 (52% to 77%
20 during the modeled drought period). However, unlike Barker Slough, modeling shows that long-
21 term average bromide concentration at Staten Island would exceed the 100 µg/L assessment
22 threshold concentration 1% under Existing Conditions and 2% under Alternative 5 (0% to 2%
23 during the modeled drought period). The long-term average bromide concentrations would be 59
24 µg/L (62 µg/L for the modeled drought period) at Staten Island under Alternative 5. Changes in
25 exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds, as well as relative
26 change in long-term average concentration, at other assessment locations would be less substantial.
27 This comparison to Existing Conditions reflects changes in bromide due to both Alternative 5
28 operations (including north Delta intake capacity of 3,000 cfs and numerous other components of
29 Operational Scenario C) and climate change/sea level rise.

30 Due to the relatively small differences between modeled Existing Conditions and No Action baseline,
31 changes in long-term average bromide concentrations and changes in exceedance frequencies
32 relative to the No Action Alternative would be generally of similar magnitude to those previously
33 described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 12). Modeled long-
34 term average bromide concentration increases would similarly be greatest at Barker Slough, where
35 long-term average concentrations are predicted to increase by 27% (83% for the modeled drought
36 period) relative to the No Action Alternative. However, unlike the Existing Conditions comparison,
37 long-term average bromide concentrations at Buckley Cove, Rock Slough, and Contra Costa PP No. 1
38 would increase relative to No Action Alternative, although the increases would be relatively small
39 ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No Action Alternative
40 reflects changes in bromide due only to Alternative 5 operations.

41 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
42 conditions are very similar (Appendix 8E, *Bromide*, Table 12). Such similarity demonstrates that the
43 modeled Alternative 5 change in bromide is almost entirely due to Alternative 5 operations, and not
44 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
45 Barker Slough, regardless whether Alternative 5 is compared to Existing Conditions, or compared to
46 the No Action Alternative.

1 Results of the modeling approach which used relationships between EC and chloride and between
2 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
3 mass-balance approach (see Appendix 8E, *Bromide*, Table 13). For most locations, the frequency of
4 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
5 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
6 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
7 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
8 that presented above from the mass-balance modeling approach. However, there were still
9 substantial increases, resulting in 9% exceedance over the modeled period under Alternative 5, as
10 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
11 period, exceedance frequency increased from 0% under Existing Conditions and the No Action
12 Alternative, to 20% under Alternative 5. Because the mass-balance approach predicts a greater level
13 of impact at Barker Slough, determination of impacts was based on the mass-balance results.

14 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
15 the relative increase in 100 µg/L exceedance frequency, would result in a substantial change in
16 source water quality for existing drinking water treatment plants drawing water from the North Bay
17 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
18 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
19 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
20 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
21 changes in the formation of disinfection byproducts such that considerable treatment plant
22 upgrades may be necessary in order to achieve equivalent levels of health protection. Because many
23 of the other modeled locations already frequently exceed the 100 µg/L threshold under Existing
24 Conditions and the No Action Alternative, these locations likely already require treatment plant
25 technologies to achieve equivalent levels of health protection, and thus no additional treatment
26 technologies would be triggered by the small increases in the frequency of exceeding the 100 µg/L
27 threshold. Hence, no further impact on the drinking water beneficial use would be expected at these
28 locations.

29 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
30 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
31 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
32 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
33 Slough and City of Antioch under Alternative 5 would experience a period average increase in
34 bromide during the months when these intakes would most likely be utilized. For those wet and
35 above normal water year types where mass balance modeling would predict water quality typically
36 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 128
37 µg/L (25% increase) at City of Antioch and would increase from 150 µg/L to 194 µg/L (30%
38 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
39 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
40 to chloride and chloride to bromide relationships show increases during these months, but the
41 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of
42 the differences in the data between the two modeling approaches, the decisions surrounding the use
43 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
44 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
45 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
46 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

1 Important to the results presented above is the assumed habitat restoration footprint on both the
 2 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
 3 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
 4 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
 5 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
 6 deviations from modeled habitat restoration and implementation schedule will lead to different
 7 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
 8 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
 9 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
 10 management changes to BDCP restoration activities, including location, magnitude, and timing of
 11 restoration, the estimates are not predictive of the bromide levels that would actually occur in
 12 Barker Slough or elsewhere in the Delta.

13 ***SWP/CVP Export Service Areas***

14 Under Alternative 5, improvement in long-term average bromide concentrations would occur at the
 15 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
 16 year hydrologic period at these locations would decrease by as much as 30% relative to Existing
 17 Conditions and 20% relative to No Action Alternative. Relative change in long-term average bromide
 18 concentration would be less during drought conditions ($\leq 27\%$), but would still represent
 19 considerable improvement (Appendix 8E, *Bromide*, Table 12). As a result, less frequent bromide
 20 concentration exceedances of the 50 $\mu\text{g/L}$ and 100 $\mu\text{g/L}$ assessment thresholds would be predicted
 21 and an overall improvement in Export Service Areas water quality would be experienced respective
 22 to bromide. Commensurate with the decrease in exported bromide, an improvement in lower San
 23 Joaquin River bromide would also be observed since bromide in the lower San Joaquin River is
 24 principally related to irrigation water deliveries from the Delta. While the magnitude of this
 25 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
 26 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
 27 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
 28 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
 29 much of the south Delta.

30 The discussion above is based on results of the mass-balance modeling approach. Results of the
 31 modeling approach which used relationships between EC and chloride and between chloride and
 32 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
 33 using these data results in the same conclusions as are presented above for the mass-balance
 34 approach (see Appendix 8E, *Bromide*, Table 13).

35 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 36 facilities under Alternative 5 would not be expected to create new sources of bromide or contribute
 37 towards a substantial change in existing sources of bromide in the affected environment.
 38 Maintenance activities would not be expected to cause any substantial change in bromide such that
 39 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
 40 affected environment.

41 ***NEPA Effects:*** In summary, Alternative 5 operations and maintenance, relative to the No Action
 42 Alternative, would result in small increases (i.e., $<1\%$) in long-term average bromide concentrations
 43 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
 44 However, Alternative 5 operation and maintenance activities would cause substantial degradation

1 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
2 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
3 changes in water treatment plant operations or require treatment plant upgrades in order to
4 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
5 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
6 separate other commitment as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
7 *AMMs*, and *CMs*, relating to the potential increased treatment costs associated with bromide-related
8 changes would reduce these effects).

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Under Alternative 5 there would be no expected change to the sources of bromide in the Sacramento
15 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
16 and resultant changes in flows from altered system-wide operations under Alternative 5 would have
17 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
18 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
19 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
20 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 5, long-term
21 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
22 increases in long-term average bromide of about 3% relative to Existing Conditions.

23 Relative to Existing Conditions, Alternative 5 would result in small decreases in long-term average
24 bromide concentration at most Delta assessment locations, with principal exceptions being the
25 North Bay Aqueduct at Barker Slough, Staten Island, and Emmaton on the Sacramento River. Overall
26 effects would be greatest at Barker Slough, where substantial increases in long-term average
27 bromide concentrations would be predicted. The increase in long-term average bromide
28 concentrations predicted for Barker Slough would result in a substantial change in source water
29 quality to existing drinking water treatment plants drawing water from the North Bay Aqueduct.
30 These modeled increases in bromide at Barker Slough could lead to adverse changes in the
31 formation of disinfection byproducts at drinking water treatment plants such that considerable
32 water treatment plant upgrades would be necessary in order to achieve equivalent levels of drinking
33 water health protection.

34 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
35 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 5,
36 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
37 long-term average bromide concentrations are predicted to decrease by as much as 30% relative to
38 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
39 in the SWP/CVP Export Service Areas.

40 Based on the above, Alternative 5 operation and maintenance would not result in any substantial
41 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
42 Alternative 5, water exported from the Delta to the SWP/CVP service area would be substantially
43 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
44 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life

1 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 5
 2 operation and maintenance activities would not cause substantial long-term degradation to water
 3 quality respective to bromide with the exception of water quality at Barker Slough, source of the
 4 North Bay Aqueduct. At Barker Slough, modeled long-term annual average concentrations of
 5 bromide would increase by 23%, and 84% during the modeled drought period. For the modeled 16-
 6 year hydrologic period the frequency of predicted bromide concentrations exceeding 100 µg/L
 7 would increase from 0% under Existing Conditions to 18% under Alternative 5, while for the
 8 modeled drought period, the frequency would increase from 0% to 38%. Substantial changes in
 9 long-term average bromide could necessitate changes in treatment plant operation or require
 10 treatment plant upgrades in order to maintain DBP compliance. The model predicted change at
 11 Barker Slough is substantial and, therefore, would represent a substantially increased risk for
 12 adverse effects on existing MUN beneficial uses should treatment upgrades not be undertaken. The
 13 impact is considered significant.

14 Implementation of Mitigation Measure WQ-5 along with a separate other commitment relating to
 15 the potential increased treatment costs associated with bromide-related changes would reduce
 16 these effects. While mitigation measures to reduce these water quality effects in affected water
 17 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
 18 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
 19 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 20 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 21 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
 22 discussion of Alternative 1A.

23 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
 24 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
 25 separate other commitment to address the potential increased water treatment costs that could
 26 result from bromide-related concentration effects on municipal water purveyor operations.
 27 Potential options for making use of this financial commitment include funding or providing other
 28 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 29 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 30 water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that
 31 could be taken pursuant to this commitment in order to reduce the water quality treatment costs
 32 associated with water quality effects relating to chloride, electrical conductivity, and bromide.

33 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality** 34 **Conditions**

35 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

36 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–** 37 **CM21**

38 **NEPA Effects:** CM2–CM21 proposed under Alternative 5 would be the same as those proposed
 39 under Alternative 1A, except that 25,000 acres rather than 65,000 acres of tidal habitat would be
 40 restored. As discussed for Alternative 1A, implementation of the CM2–CM21 would not present new
 41 or substantially changed sources of bromide to the study area. Some conservation measures may
 42 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 43 is not expected to substantially increase or present new sources of bromide. CM2–CM21 would not

1 be expected to cause any substantial change in bromide such that MUN beneficial uses, or any other
2 beneficial use, would be adversely affected anywhere in the affected environment.

3 In summary, implementation of CM2–CM21 under Alternative 5, relative to the No Action
4 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
5 from implementing CM2–CM21 are determined to not be adverse.

6 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
7 measures proposed under Alternative 1A, except that 25,000 acres rather than 65,000 acres of tidal
8 habitat would be restored. As discussed for Alternative 1A, implementation of the CM2–CM21
9 (CM2–CM21) would not present new or substantially changed sources of bromide to the study area.
10 As such, effects on bromide resulting from the implementation of CM2–CM21 would be similar to
11 those previously discussed for Alternative 1A. This impact is considered to be less than significant.
12 No mitigation is required.

13 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 14 **Maintenance (CM1)**

15 ***Upstream of the Delta***

16 Under Alternative 5 there would be no expected change to the sources of chloride in the Sacramento
17 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
18 and resultant changes in flows from altered system-wide operations would have negligible, if any,
19 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
20 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
21 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
22 result of climate change). The reduced flow would result in possible increases in long-term average
23 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
24 Action Alternative (Appendix 8G, *Chloride*, Table CI-62). Consequently, Alternative 5 would not be
25 expected to cause exceedance of chloride objectives/criteria or substantially degrade water quality
26 with respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento
27 River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

28 ***Delta***

29 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
30 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
31 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
32 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
33 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
34 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
35 information.

36 Relative to Existing Conditions, modeling predicts that Alternative 5 would result in similar or
37 reduced long-term average chloride concentrations for the 16-year period modeled at most of the
38 assessment locations, and, depending on modeling approach (see Section 8.3.1.3), would result in
39 increased concentrations at the North Bay Aqueduct at Barker Slough (i.e., ≤18%), Sacramento River
40 at Emmaton (i.e., ≤3%), and SF Mokelumne at Staten Island (i.e., ≤16%) (Appendix 8G, *Chloride*,
41 Table CI-31 and Table CI-32). Additionally, implementation of tidal habitat restoration under CM4
42 would increase the tidal exchange volume in the Delta, and thus may contribute to increased

1 chloride concentrations in the Bay source water as a result of increased salinity intrusion. More
2 discussion of this phenomenon is included in Section 8.3.1.3. Consequently, while uncertain, the
3 magnitude of chloride increases may be greater than indicated herein and would affect the western
4 Delta assessment locations the most which are influenced to the greatest extent by the Bay source
5 water. This comparison to Existing Conditions reflects changes in chloride due to both Alternative 5
6 operations (including north Delta intake capacity of 3,000 cfs and numerous other components of
7 Operational Scenario C) and climate change/sea level rise.

8 Relative to the No Action Alternative conditions, the mass balance analysis of modeling results
9 indicated that Alternative 5 would result in similar or reduced long-term average chloride
10 concentrations for the 16-year period modeled at four of the assessment locations. Chloride
11 concentrations would increase at the SF Mokelumne River at Staten Island (up to 19%) and the
12 North Bay Aqueduct at Barker Slough (up to 23%) compared to the No Action Alternative conditions
13 and increase only incrementally (3% or less) at five other stations (Appendix 8G, *Chloride*, Table Cl-
14 31). The comparison to the No Action Alternative reflects changes in chloride due only to operations.

15 The following outlines the modeled chloride changes relative to the applicable objectives and
16 beneficial uses of Delta waters.

17 *Municipal Beneficial Uses—Relative to Existing Conditions*

18 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
19 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
20 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
21 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
22 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
23 Pumping Plant #1 locations. For Alternative 5, the modeled frequency of objective exceedance
24 would remain unchanged at 7% of years under Existing Conditions and Alternative 5 (Appendix 8G,
25 *Chloride*, Table Cl-64).

26 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
27 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
28 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
29 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
30 year period. For Alternative 5, the modeled frequency of objective exceedance would decrease by
31 approximately one half, from 6% of modeled days under Existing Conditions, to 3% of modeled days
32 under Alternative 5 (Appendix 8G, *Chloride*, Table Cl-63).

33 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
34 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
35 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
36 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
37 approach to model monthly average chloride concentrations for the 16-year period, the predicted
38 frequency of exceeding the 250 mg/L objective would decrease at the Contra Costa Canal at
39 Pumping Plant #1 (Appendix 8G, *Chloride*, Table Cl-33 and Figure Cl-9). The frequency of
40 exceedances would increase for the 16-year period modeled at the San Joaquin River at Antioch (i.e.,
41 from 66% under Existing Conditions to 72%) and Sacramento River at Mallard Island (i.e., from 85%
42 under Existing Conditions to 87%) (Appendix 8G, Table Cl-33), and would cause further degradation
43 at Antioch in March and April (i.e., maximum reduction of 45% of assimilative capacity for the 16-

1 year period modeled, and 100% reduction, or elimination of assimilative capacity, during the
2 drought period modeled) (Appendix 8G, Table Cl-35 and Figure Cl-9).

3 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
4 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
5 capacity would be similar to those discussed when utilizing the mass balance modeling approach
6 (Appendix 8G, *Chloride*, Table Cl-34 and Table Cl-36). However, as with Alternative 1A the modeling
7 approach utilizing the chloride-EC relationships predicted changes of lesser magnitude, where
8 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
9 thus more conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach
10 that yielded the more conservative predictions was used as the basis for determining adverse
11 impacts.

12 Based on the additional predicted annual and seasonal exceedances of the 250 mg/L Bay Delta
13 WQCP objectives for chloride, and magnitude of associated long-term average water quality
14 degradation in the western Delta, the potential exists for substantial adverse effects on the
15 municipal and industrial beneficial uses through reduced opportunity for diversion of water with
16 acceptable chloride levels.

17 *303(d) Listed Water Bodies—Relative to Existing Conditions*

18 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
19 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
20 nearest DSM2-modeled location to Tom Paine in the south Delta, would generally be similar
21 compared to Existing Conditions, and thus, would not be further degraded on a long-term basis
22 (Appendix 8G, Figure Cl-10).

23 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
24 modeled would generally increase compared to Existing Conditions in some months during October
25 through May at the Sacramento River at Collinsville (Appendix 8G, Figure Cl-11), Mallard Island
26 (Appendix 8G, Figure Cl-9), and increase substantially at the Montezuma Slough at Beldon's Landing
27 (i.e., over a doubling of concentration in December through February) (Appendix 8G, Figure Cl-12).
28 Although modeling of Alternative 5 assumed no operation of the Montezuma Slough Salinity Control
29 Gates, the project description assumes continued operation of the Salinity Control Gates, consistent
30 with assumptions included in the No Action Alternative. A sensitivity analysis modeling run
31 conducted for Alternative 4 with the gates operational consistent with the No Action Alternative
32 resulted in substantially lower EC levels than indicated in the original Alternative 4 modeling results
33 for Suisun Marsh, but EC levels were still somewhat higher than EC levels under Existing Conditions
34 for several locations and months. Although chloride was not specifically modeled in this sensitivity
35 analysis, it is expected that chloride concentrations would be nearly proportional to EC levels in
36 Suisun Marsh. Another modeling run with the gates operational and restoration areas removed
37 resulted in EC levels nearly equivalent to Existing Conditions, indicating that design and siting of
38 restoration areas has notable bearing on EC levels at different locations within Suisun Marsh (see
39 Appendix 8H, Attachment 1, for more information on these sensitivity analyses). These analyses also
40 indicate that increases in salinity are related primarily to the hydrodynamic effects of CM4, not
41 operational components of CM1. Based on the sensitivity analyses, optimizing the design and siting
42 of restoration areas may limit the magnitude of long-term chloride increases in the Marsh. However,
43 the chloride concentration increases at certain locations could be substantial, depending on siting
44 and design of restoration areas. Thus, these increased chloride levels in Suisun Marsh are

1 considered to contribute to additional, measureable long-term degradation that potentially would
2 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

3 *Municipal Beneficial Uses—Relative to No Action Alternative*

4 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
5 generated using EC-chloride relationships and DSM2 EC output (see Section 8.3.1.3) were used to
6 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses. For
7 Alternative 5, the modeled frequency of objective exceedance would increase from 0% under the No
8 Action Alternative to 7% of years under Alternative 5 (Appendix 8G, *Chloride*, Table CI-64). The
9 increase was due to a single year, 1977, which fell just short of the required number of days (i.e., was
10 within 6 days minimum number of required days < 150 mg/L). Given the uncertainty in the chloride
11 modeling approach, it is likely that real time operations of the SWP and CVP could achieve
12 compliance with this objective (see Section 8.3.1.1 for a discussion of chloride compliance modeling
13 uncertainties and a description of real time operations of the SWP and CVP).

14 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
15 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
16 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. For Alternative
17 5, the modeled frequency of objective exceedance would decrease slightly from 5% of modeled days
18 under the No Action Alternative to 3% of modeled days under Alternative 5 (Appendix 8G, *Chloride*,
19 Table CI-63).

20 Similar to Existing Conditions, a comparative assessment of modeling approaches was utilized to
21 evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of both frequency of exceedance and use
22 of assimilative capacity on a monthly average basis. When utilizing the mass balance approach to
23 model monthly average chloride concentrations for the 16-year period, a small decrease in
24 exceedance frequency would be predicted at the San Joaquin River at Antioch (i.e., from 73% for the
25 No Action Alternative to 72%), however, available assimilative capacity would be reduced in April
26 (i.e., up to 10% for the 16 year period modeled, and 100% [i.e., eliminated] for the drought period
27 modeled) (Appendix 8G, *Chloride*, Table CI-35). The exceedance frequency would increase slightly at
28 the Sacramento River at Mallard Island (i.e., from 86% to 87%) and at the Contra Costa Canal at
29 Pumping Plant #1 (i.e., from 14% to 18%) (Appendix 8G, Table CI-33), along with reduced
30 assimilative capacity at the Contra Costa Canal at Pumping Plant #1 in September (i.e., up to 56%),
31 reflecting substantial degradation during when average concentrations would be near, or exceed,
32 the objective (Appendix 8G, Table CI-35).

33 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
34 concentrations for the 16-year period, trends in frequency of exceedance and use of assimilative
35 capacity would be similar to those discussed when utilizing the mass balance modeling approach
36 (Appendix 8G, *Chloride*, Table CI-34 and Table CI-36). However, as with Alternative 1A, the modeling
37 approach utilizing the chloride-EC relationships predicted changes of lesser magnitude, where
38 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
39 thus more conservative. As discussed in Section 8.3.1.3, in cases of such disagreement, the approach
40 that yielded the more conservative predictions was used as the basis for determining adverse
41 impacts.

42 Based on the additional predicted annual and seasonal exceedances of the 250 mg/L Bay Delta
43 WQCP objectives for chloride, and the associated long-term average water quality degradation at
44 interior and western Delta locations, the potential exists for substantial adverse effects on the

1 municipal and industrial beneficial uses through reduced opportunity for diversion of water with
2 acceptable chloride levels.

3 *303(d) Listed Water Bodies—Relative to No Action Alternative*

4 With respect to the 303(d) listing for chloride, Alternative 5 would generally result in changes
5 similar to those discussed for the comparison to Existing Conditions. Monthly average chloride
6 concentrations at Tom Paine Slough would not be further degraded on a long-term basis, based on
7 results for Old River at Tracy Road, which represents the nearest DSM2-modeled location to Tom
8 Paine in the south Delta (Appendix 8G, Figure Cl-10).

9 Monthly average chloride concentrations at source water channel locations for the Suisun Marsh
10 (Appendix 8G, *Chloride*, Figures Cl-9, Cl-11, and Cl-12) would increase substantially in some months
11 during October through May compared to the No Action Alternative conditions, but sensitivity
12 analyses suggest that operation of the Salinity Control Gates and restoration area siting and design
13 considerations could reduce these increases. However, the chloride concentration increases at
14 certain locations could be substantial, depending on siting and design of restoration areas. Thus,
15 these increased chloride levels in Suisun Marsh are considered to contribute to additional,
16 measureable long-term degradation would occur in Suisun Marsh that potentially would adversely
17 affect the necessary actions to reduce chloride loading for any TMDL that is developed.

18 ***SWP/CVP Export Service Areas***

19 Under Alternative 5, long-term average chloride concentrations based on the mass balance analysis
20 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
21 decrease by as much as 29% relative to Existing Conditions and 19% compared to No Action
22 Alternative (Appendix 8G, *Chloride*, Table Cl-31). The modeled frequency of exceedances of
23 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
24 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
25 *Chloride*, Table Cl-33). Consequently, water exported to the SWP/CVP service area would generally
26 be of similar or better quality with regards to chloride relative to Existing Conditions and the No
27 Action Alternative conditions.

28 Results of the modeling approach which used relationships between EC and chloride (see Section
29 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
30 results in the same conclusions as are presented above for the mass-balance approach (Appendix
31 8G, *Chloride*, Table Cl-32 and Table Cl-34).

32 Commensurate with the reduced chloride concentrations in water exported to the SWP/CVP service
33 area, reduced chloride loading in the lower San Joaquin River would be anticipated which would
34 likely alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual
35 average San Joaquin River flows (see discussion of Upstream of the Delta).

36 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
37 contribute towards a substantial change in existing sources of chloride in the affected environment.
38 Maintenance activities would not be expected to cause any substantial change in chloride such that
39 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
40 affected anywhere in the affected environment.

1 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 5 would
2 result in increased water quality degradation and frequency of exceedance of the 250 mg/L
3 municipal and industrial objective at interior and western Delta locations on a monthly average
4 chloride basis, and could contribute to measureable water quality degradation relative to the 303(d)
5 impairment in Suisun Marsh. The predicted chloride increases constitute an adverse effect on water
6 quality (see Mitigation Measure WQ-7; implementation of this measure along with a separate other
7 commitment relating to the potential increased chloride treatment costs would reduce these
8 effects). Additionally, the predicted changes relative to the No Action Alternative conditions indicate
9 that in addition to the effects of climate change/sea level rise, implementation of CM1 and CM4
10 under Alternative 5 would contribute substantially to the adverse water quality effects.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
13 purpose of making the CEQA impact determination for this constituent. For additional details on the
14 effects assessment findings that support this CEQA impact determination, see the effects assessment
15 discussion that immediately precedes this conclusion.

16 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
17 thus river flow rate and reservoir storage reductions that would occur under the Alternative 5,
18 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
19 chloride levels. Additionally, relative to Existing Conditions, the Alternative 5 would not result in
20 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
21 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
22 watershed.

23 Relative to Existing Conditions, the Alternative 5 would result in substantially increased chloride
24 concentrations in the Delta such that frequency of exceedance of the 250 mg/L Bay-Delta WQCP
25 objective would increase at the San Joaquin River at Antioch (by 6%) and at Mallard Slough (by 2%),
26 and long-term degradation may occur, that may result in adverse effects on the municipal and
27 industrial water supply beneficial use (see Mitigation Measure WQ-7; implementation of this
28 measure along with a separate other commitment relating to the potential increased chloride
29 treatment costs would reduce these effects). Relative to the Existing Conditions, the modeled
30 increased chloride concentrations and degradation in the western Delta could further contribute, at
31 measurable levels, to the existing 303(d) listed impairment due to chloride in Suisun Marsh for the
32 protection of fish and wildlife.

33 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
34 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
35 River.

36 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
37 5 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
38 Alternative 5 maintenance would not result in any substantial changes in chloride concentration
39 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
40 this impact is determined to be significant due to increased chloride concentrations and degradation
41 at western Delta locations and its effects on municipal and industrial water supply and fish and
42 wildlife beneficial uses.

1 While mitigation measures to reduce these water quality effects in affected water bodies to less-
 2 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
 3 recommended to attempt to reduce the effect that increased chloride concentrations may have on
 4 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
 5 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 6 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
 7 discussion of Alternative 1A.

8 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 9 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
 10 separate other commitment to address the potential increased water treatment costs that could
 11 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 12 operations. Potential options for making use of this financial commitment include funding or
 13 providing other assistance towards acquiring alternative water supplies or towards modifying
 14 existing operations when chloride concentrations at a particular location reduce opportunities to
 15 operate existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
 16 potential actions that could be taken pursuant to this commitment in order to reduce the water
 17 quality treatment costs associated with water quality effects relating to chloride, electrical
 18 conductivity, and bromide.

19 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 20 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

21 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

22 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 23 **CM21**

24 **NEPA Effects:** Under Alternative 5, the types and geographic extent of effects on chloride
 25 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 26 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
 27 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 28 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
 29 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
 30 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-
 31 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 32 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 33 considered an improvement compared to No Action Alternative conditions.

34 In summary, based on the discussion above, the effects on chloride from implementing CM2–CM21
 35 are considered to be not adverse.

36 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 5 would not present new or
 37 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 38 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 39 with habitat restoration conservation measures may result in some reduction in discharge of
 40 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 41 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 42 mitigation is required.

1 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 **NEPA Effects:** Effects of CM1 on DO under Alternative 5 would be the same as those discussed for
4 Alternative 1A and are considered to not be adverse.

5 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 5 would be similar to those discussed for
6 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
7 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
8 constituent. For additional details on the effects assessment findings that support this CEQA impact
9 determination, see the effects assessment discussion under the Alternative 1A.

10 Reservoir storage reductions that would occur under Alternative 5, relative to Existing Conditions,
11 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
12 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
13 Similarly, river flow rate reductions that would occur would not be expected to result in a
14 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
15 flows would remain within the ranges historically seen under Existing Conditions and the affected
16 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
17 water temperature would not be expected to cause DO levels to be outside of the range seen
18 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
19 change sufficiently to affect DO levels.

20 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
21 Delta source water percentages under this alternative or substantial degradation of these water
22 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
23 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
24 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
25 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
26 the reaeration of Delta waters would not be expected to change substantially.

27 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
28 Export Service Areas waters under Alternative 5, relative to Existing Conditions. Because the
29 biochemical oxygen demand of the exported water would not be expected to substantially differ
30 from that under Existing Conditions (due to ever increasing water quality regulations), canal
31 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
32 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
33 downstream reservoirs.

34 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
35 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
36 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
37 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
38 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
39 because no substantial decreases in DO levels would be expected, greater degradation and DO-
40 related impairment of these areas would not be expected. This impact would be less than significant.
41 No mitigation is required.

1 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

2 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 5 would be the same as those discussed
3 for Alternative 1A and are considered to not be adverse.

4 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
5 measures proposed under Alternative 1A. As such, effects on DO resulting from the implementation
6 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
7 considered to be less than significant. No mitigation is required.

8 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 9 **Operations and Maintenance (CM1)**

10 ***Upstream of the Delta***

11 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
12 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
13 the San Joaquin River upstream of the Delta under Alternative 5 are not expected to be outside the
14 ranges occurring under Existing Conditions or that would occur under the No Action Alternative.
15 Any minor changes in EC levels that could occur under Alternative 5 in water bodies upstream of the
16 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
17 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

18 ***Delta***

19 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
20 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
21 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
22 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
23 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
24 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
25 information.

26 Relative to Existing Conditions, Alternative 5 would result in an increase in the number of days the
27 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, San Joaquin
28 River at San Andreas Landing, Jersey Point and Prisoners Point, and Old River at Tracy Bridge
29 (Appendix 8H, *Electrical Conductivity*, Table EC-5).

30 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
31 (1976–1991) would increase from 6% under Existing Conditions to 25% under Alternative 5, and
32 the percentage of days out of compliance would increase from 11% under Existing Conditions to
33 38% under Alternative 5.

34 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
35 from 1% under Existing Conditions to 5% under Alternative 5, and the percentage of days out of
36 compliance with the EC objective would increase from 1% under Existing Conditions to 9% under
37 Alternative 5. Sensitivity analyses were performed for Alternative 4 Scenario H3, and indicated that
38 many similar exceedances were modeling artifacts, and the small number of remaining exceedances
39 were small in magnitude, lasted only a few days, and could be addressed with real time operations
40 of the SWP and CVP (see Section 8.3.1.1 for a description of real time operations of the SWP and

1 CVP). Due to similarities in the nature of the exceedances between alternatives, the findings from
2 these analyses can be extended to this alternative as well.

3 The percentage of days the Jersey Point fish and wildlife EC objective would be exceeded and the
4 percentage of days out of compliance for the entire period modeled would increase from 0% under
5 Existing Conditions to 3% under Alternative 5. The percentage of days the Prisoners Point EC
6 objective would be exceeded for the entire period modeled would increase from 6% under Existing
7 Conditions to 8% under Alternative 5, and the percentage of days out of compliance with the EC
8 objective would increase from 10% under Existing Conditions to 12% under Alternative 5. These
9 changes are very small, and are likely within the uncertainty of the modeling approach.

10 Nevertheless, further discussion of EC increases relative to this objective can be found in Appendix
11 8H, Attachment 2.

12 In Old River at Tracy Bridge, the percentage of days exceeding the EC objective would increase from
13 4% under Existing Conditions to 5% under Alternative 5; the percentage of days out of compliance
14 would increase by <1% and would be 10% under both Existing Conditions and Alternative 5. These
15 changes are minimal, but, regardless, as noted in Section 8.1.3.7, SWP and CVP operations have
16 relatively little influence on salinity levels at this location, and the elevated salinity in south Delta
17 channels is affected substantially by local salt contributions discharged into the San Joaquin River
18 downstream of Vernalis. Thus, the modeling has limited ability to estimate salinity accurately in this
19 region.

20 Average EC levels at the western and southern Delta compliance locations, except at Emmaton in the
21 western Delta, would decrease from 2–35% for the entire period modeled and 3–32% during the
22 drought period modeled (1987–1991) (Appendix 8H, *Electrical Conductivity*, Table EC-16). At
23 Emmaton, average EC would increase by 3% for the entire period modeled and 10% for the drought
24 period modeled. At the two interior Delta locations, there would be increases in average EC: the S.
25 Fork Mokelumne River at Terminous average EC would increase 3% for the entire and drought
26 periods modeled; and San Joaquin River at San Andreas Landing average EC would increase 5% for
27 the entire period modeled and 10% during the drought period modeled. On average, EC would
28 increase at Emmaton during February through August. Average EC would increase at San Andreas
29 Landing from January through September. Average EC in the S. Fork Mokelumne River at Terminous
30 would increase from March through December (Appendix 8H, Table EC-16). The comparison to
31 Existing Conditions reflects changes in EC due to both Alternative 5 operations (including north
32 Delta intake capacity of 3,000 cfs and numerous other components of Operational Scenario C) and
33 climate change/sea level rise.

34 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
35 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
36 Jersey Point, San Andreas Landing, and Prisoners Point; and Old River near Middle River and at
37 Tracy Bridge (Appendix 8H, *Electrical Conductivity*, Table EC-5). The increase in percentage of days
38 exceeding the EC objective would be 11% at Emmaton and 7% or less at the remaining locations.
39 The increase in percentage of days out of compliance would be 13% at Emmaton and 11% or less at
40 the remaining locations. For the entire period modeled, average EC levels would increase at:
41 Sacramento River at Emmaton (2%), S. Fork Mokelumne River (4%), San Joaquin River at San
42 Andreas Landing (10%), and San Joaquin River at Prisoners Point (4%) (Appendix 8H, Table EC-16).
43 During the drought period modeled, average EC would increase at these same locations, except at
44 Emmaton, by a similar percentage as well as the San Joaquin River at Brandt Bridge (1%). The
45 comparison to the No Action Alternative reflects changes in EC due only to Alternative 5 operations

1 (including north Delta intake capacity of 3,000 cfs and numerous other components of Operational
2 Scenario C).

3 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
4 fish and wildlife apply. Long-term average EC would increase under Alternative 5, relative to
5 Existing Conditions, during the months of March through May by 0.4–0.6 mS/cm in the Sacramento
6 River at Collinsville (Appendix 8H, *Electrical Conductivity*, Table EC-21). Long-term average EC
7 would decrease relative to Existing Conditions in Montezuma Slough at National Steel during
8 October–May (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon
9 Landing, with long-term average EC levels increasing by 1.6–5.0 mS/cm, depending on the month, at
10 least doubling during some months the long-term average EC relative to Existing Conditions
11 (Appendix 8H, Table EC-23). Sunrise Duck Club and Volanti Slough also would have long-term
12 average EC increases during all months of 0.9–2.8 mS/cm (Appendix 8H, Tables EC-24 and EC-25).
13 Modeling of this alternative assumed no operation of the Montezuma Slough Salinity Control Gates,
14 but the project description assumes continued operation of the Salinity Control Gates, consistent
15 with assumptions included in the No Action Alternative. A sensitivity analysis modeling run
16 conducted for Alternative 4 Scenario H3 with the gates operational consistent with the No Action
17 Alternative resulted in substantially lower EC levels than indicated in the original Alternative 4
18 modeling results, but EC levels were still somewhat higher than EC levels under Existing Conditions
19 and the No Action Alternative for several locations and months. Another modeling run with the
20 gates operational and restoration areas removed resulted in EC levels nearly equivalent to Existing
21 Conditions and the No Action Alternative, indicating that design and siting of restoration areas has
22 notable bearing on EC levels at different locations within Suisun Marsh (see Appendix 8H
23 Attachment 1 for more information on these sensitivity analyses). These analyses also indicate that
24 increases are related primarily to the hydrodynamic effects of CM4, not operational components of
25 CM1. Based on the sensitivity analyses, optimizing the design and siting of restoration areas may
26 limit the magnitude of long-term EC increases to be on the order of 1 mS/cm or less. Due to
27 similarities in the nature of the EC increases between alternatives, the findings from these analyses
28 can be extended to this alternative as well.

29 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
30 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
31 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
32 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
33 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
34 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
35 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
36 certain locations could be substantial, depending on siting and design of restoration areas, and it is
37 uncertain the degree to which current management plans for the Suisun Marsh would be able to
38 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
39 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
40 Long-term average EC increases in Suisun Marsh under Alternative 5 relative to the No Action
41 Alternative would be similar to the increases relative to Existing Conditions.

42 The western and southern Delta are CWA section 303(d) listed for elevated EC and the increased EC
43 that could occur in the western Delta, relative to Existing Conditions and the No Action Alternative
44 could lead to water quality degradation that would make beneficial use impairment measurably
45 worse. Since there would be very little change in EC levels in the southern Delta and there is not
46 expected to be an increase in frequency of exceedances of objectives, this alternative is not expected

1 to make beneficial use impairment measurably worse in the southern Delta. Suisun Marsh also is
2 section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
3 average EC concentrations could contribute to additional impairment.

4 ***SWP/CVP Export Service Area***

5 At the Banks and Jones pumping plants, Alternative 5 would result in no exceedances of the Bay-
6 Delta WQCP's 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, *Electrical*
7 *Conductivity*, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
8 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 5.

9 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 5
10 would decrease 19% for the entire period modeled and 18% during the drought period modeled.
11 Relative to the No Action Alternative, average EC levels would decrease by 13% for the entire period
12 modeled and 12% during the drought period modeled. (Appendix 8H, *Electrical Conductivity*, Table
13 EC-16)

14 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 5
15 would decrease 15% for the entire period modeled and 16% during the drought period modeled.
16 Relative to the No Action Alternative, average EC levels would decrease by 11% for the entire period
17 modeled and 12% during the drought period modeled. (Appendix 8H, *Electrical Conductivity*, Table
18 EC-16).

19 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
20 pumping plants, Alternative 5 would not cause degradation of water quality with respect to EC in
21 the SWP/CVP Export Service Areas; rather, Alternative 5 would improve long-term average EC
22 conditions in the SWP/CVP Export Service Areas.

23 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
24 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
25 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
26 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
27 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
28 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
29 impact discussion under the No Action Alternative).

30 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
31 elevated EC. Alternative 5 would result in lower average EC levels relative to Existing Conditions and
32 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
33 related to elevated EC in the SWP/CVP Export Service Areas waters.

34 ***NEPA Effects:*** In summary, the increased frequency of exceedance of EC objectives and increased
35 long-term and drought period average EC levels that would occur at western Delta compliance
36 locations under Alternative 5, relative to the No Action Alternative, would contribute to adverse
37 effects on the agricultural beneficial uses. In addition, the increased frequency of exceedance of the
38 San Joaquin River at Prisoners Point EC objective and long-term and drought period average EC
39 could contribute to adverse effects on fish and wildlife beneficial uses (specifically, indirect adverse
40 effects on striped bass spawning), though there is a high degree of uncertainty associated with this
41 impact. Given that the western is Clean Water Act section 303(d) listed as impaired due to elevated
42 EC, the increase in the incidence of exceedance of EC objectives and long-term average and drought
43 period average EC in these portions of the Delta has the potential to contribute to additional

1 beneficial use impairment. The increases in long-term average EC levels that could occur in Suisun
 2 Marsh could further degrade existing EC levels and could contribute additional to adverse effects on
 3 the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to
 4 elevated EC, and the potential increases in long-term average EC levels could contribute to
 5 additional beneficial use impairment. These increases in EC constitute an adverse effect on water
 6 quality. Mitigation Measure WQ-11 would be available to reduce these effects (implementation of
 7 this measure along with a separate other commitment as set forth in EIR/EIS Appendix 3B,
 8 *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-related changes would
 9 reduce these effects).

10 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 11 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 12 purpose of making the CEQA impact determination for this constituent. For additional details on the
 13 effects assessment findings that support this CEQA impact determination, see the effects assessment
 14 discussion that immediately precedes this conclusion.

15 River flow rate and reservoir storage reductions that would occur under Alternative 5, relative to
 16 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
 17 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
 18 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
 19 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
 20 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
 21 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
 22 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
 23 Delta.

24 Relative to Existing Conditions, Alternative 5 would not result in any substantial increases in long-
 25 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
 26 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
 27 would decrease at both plants and, thus, this alternative would not contribute to additional
 28 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
 29 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
 30 relative to Existing Conditions.

31 In the Plan Area, Alternative 5 would result in an increase in the frequency with which Bay-Delta
 32 WQCP EC objectives are exceeded for the entire period modeled (1976–1991): in the Sacramento
 33 River at Emmaton (agricultural objective; 19%; increase) and at Jersey Point (fish and wildlife
 34 objective, 3%), and the San Joaquin River at Prisoners Point (fish and wildlife objective; 2%
 35 increase) in the interior Delta. Further, long-term average EC levels would increase in the
 36 Sacramento River at Emmaton by 3% for the entire period modeled and 10% during the drought
 37 period modeled, and in the San Joaquin River at San Andreas Landing by 5% during for the entire
 38 period modeled and 10% during the drought period modeled. The increases in long-term and
 39 drought period average EC levels and increased frequency of exceedance of EC objectives that would
 40 occur in the Sacramento River at Emmaton, and the increased long-term and drought period average
 41 EC levels in the San Joaquin River at San Andreas Landing would potentially contribute to adverse
 42 effects on the agricultural beneficial uses in the western and interior Delta. Further, the increased
 43 frequency of exceedance of the fish and wildlife objective at Jersey Point and Prisoners Point could
 44 contribute to adverse effects on aquatic life (specifically, indirect adverse effects on striped bass
 45 spawning), though there is a high degree of uncertainty associated with this impact. Because EC is

1 not bioaccumulative, the increases in long-term average EC levels would not directly cause
 2 bioaccumulative problems in aquatic life or humans. The western Delta is Clean Water Act section
 3 303(d) listed for elevated EC and the increased frequency of exceedance of EC objectives that would
 4 occur in this portions of the Delta could make beneficial use impairment measurably worse. This
 5 impact is considered to be significant.

6 Further, relative to Existing Conditions, Alternative 5 could result in substantial increases in long-
 7 term average EC during the months of October through May in Suisun Marsh. The increases in long-
 8 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
 9 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
 10 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
 11 bioaccumulative problems in fish and wildlife. Suisun Marsh is Clean Water Act section 303(d) listed
 12 for elevated EC and the increases in long-term average EC that would occur in the marsh could make
 13 beneficial use impairment measurably worse. This impact is considered to be significant.

14 Implementation of Mitigation Measure WQ-11 along with a separate other commitment relating to
 15 the potential increased costs associated with EC-related changes would reduce these effects. While
 16 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
 17 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
 18 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
 19 However, because the effectiveness of this mitigation measure to result in feasible measures for
 20 reducing water quality effects is uncertain, this impact is considered to remain significant and
 21 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
 22 Alternative 1A.

23 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 24 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 25 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
 26 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 27 purveyor operations. Potential options for making use of this financial commitment include funding
 28 or providing other assistance towards acquiring alternative water supplies or towards modifying
 29 existing operations when EC concentrations at a particular location reduce opportunities to operate
 30 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
 31 actions that could be taken pursuant to this commitment in order to reduce the water quality
 32 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
 33 bromide.

34 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 35 **Quality Conditions**

36 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

37 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 38 **CM21**

39 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 5 would be the same as those discussed
 40 for Alternative 1A and are considered not to be adverse.

1 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
 2 measures proposed under Alternative 1A. As such, effects on EC resulting from the implementation
 3 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 4 considered to be less than significant. No mitigation is required.

5 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Under Alternative 5, the magnitude and timing of reservoir releases and river flows upstream of the
 9 Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 10 Existing Conditions and the No Action Alternative.

11 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 12 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 13 relationships for mercury and methylmercury. No significant, predictive regression relationships
 14 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 15 (monthly or annual) (Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
 16 total mercury and flow is to be expected based on the association of mercury with suspended
 17 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 18 Sacramento River under Alternative 5 relative to Existing Conditions and the No Action Alternative
 19 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
 20 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
 21 In addition, even though it may be flow-affected, total mercury concentrations remain well below
 22 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
 23 the water bodies of the affected environment located upstream of the Delta would not be of
 24 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 25 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
 26 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
 27 remain above guidance levels at upstream of Delta locations, but will not change substantially
 28 relative to Existing Conditions or the No Action Alternative due to changes in flows under
 29 Alternative 5.

30 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 31 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 32 Mercury Control Program. These projects will target specific sources of mercury and methylation
 33 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 34 The implementation of these projects could help to ensure that upstream of Delta environments will
 35 not be substantially degraded for water quality with respect to mercury or methylmercury.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 38 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 41 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 42 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 43 information.

1 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
 2 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
 3 change in assimilative capacity of waterborne total mercury of Alternative 5 relative to the 25 ng/L
 4 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
 5 0.9% at Old River at Rock Slough and the Contra Costa Pumping Plant, and 0.9% at Franks Tract
 6 relative to the No Action Alternative (Figures 8-53a and 8-54a). These changes are not expected to
 7 result in adverse effects to beneficial uses. Similarly, changes in methylmercury concentration are
 8 expected to be very small. The greatest annual average methylmercury concentration for drought
 9 conditions was 0.165 ng/L for the San Joaquin River at Buckley Cove which was slightly higher than
 10 Existing Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167
 11 ng/L)(Appendix 8I, *Mercury*, Table I-6). All modeled input concentrations exceeded the
 12 methylmercury TMDL guidance objective of 0.06 ng/L, therefore percentage change in assimilative
 13 capacity was not evaluated for methylmercury.

14 Fish tissue estimates show only small or no increases in exceedance quotients based on long-term
 15 annual average concentrations for mercury at the Delta locations. The greatest change in exceedance
 16 quotients of 6–8% is expected for Franks Tract and Old River at Rock Slough relative to Existing
 17 Conditions and 7% for the Mokelumne River (South Fork) at Staten Island relative to the No Action
 18 Alternative (Figures 8-55a and 8-55b; Appendix 8I, *Mercury*, Table I-12b). Because these increases
 19 are relatively small, and it is not evident that substantive increases are expected at numerous
 20 locations throughout the Delta, these changes are expected to be within the uncertainty inherent in
 21 the modeling approach, and would likely not be measurable in the environment. See Appendix 8I for
 22 a discussion of the uncertainty associated with the fish tissue estimates.

23 ***SWP/CVP Export Service Areas***

24 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
 25 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
 26 methylmercury concentrations for Alternative 5 are projected to be lower than Existing Conditions
 27 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, *Mercury*, Figures
 28 I-6 and I-7). Therefore, mercury shows an increased assimilative capacity at these locations (Figures
 29 8-53a and 8-54a). Bass tissue mercury concentrations are also improved under Alternative 5,
 30 relative to Existing Conditions and the No Action Alternative (Figure 8-55a and 8-55b; Appendix 8I,
 31 *Mercury*, Tables I-12a and I-12b).

32 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
 33 comparison of Alternative 5 to the No Action Alternative (as waterborne and bioaccumulated forms)
 34 are not considered to be adverse.

35 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 36 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 37 purpose of making the CEQA impact determination for this constituent. For additional details on the
 38 effects assessment findings that support this CEQA impact determination, see the effects assessment
 39 discussion that immediately precedes this conclusion.

40 Under Alternative 5, greater water demands and climate change would alter the magnitude and
 41 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
 42 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
 43 methylmercury upstream of the Delta will not be substantially different relative to Existing

1 Conditions due to the lack of important relationships between mercury/methylmercury
2 concentrations and flow for the major rivers.

3 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
4 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
5 over the period of record, are very similar to Existing Conditions. Similarly, estimates of fish tissue
6 mercury concentrations show almost no differences would occur among sites for Alternative 5 as
7 compared to Existing Conditions for Delta sites.

8 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
9 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
10 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
11 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 5 as
12 compared to Existing Conditions.

13 As such, this alternative is not expected to cause additional exceedance of applicable water quality
14 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
15 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
16 not expected to increase substantially, no long-term water quality degradation is expected to occur
17 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
18 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
19 or fish tissue mercury concentrations would not make any existing mercury-related impairment
20 measurably worse. In comparison to Existing Conditions, Alternative 5 would not increase levels of
21 mercury by frequency, magnitude, and geographic extent such that the affected environment would
22 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
23 substantially increasing the health risks to wildlife (including fish) or humans consuming those
24 organisms. This impact is considered to be less than significant. No mitigation is required.

25 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2- 26 CM21**

27 **NEPA Effects:** Some habitat restoration activities under Alternative 5 would occur on lands in the
28 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
29 Alternative 5 have the potential to increase water residence times and increase accumulation of
30 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
31 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
32 possible but uncertain depending on the specific restoration design implemented at a particular
33 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
34 not currently available. However, DSM2 modeling for Alternative 5 operations does incorporate
35 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
36 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
37 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
38 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
39 potential for increased mercury and methylmercury concentrations under Alternative 5.

40 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
41 activities and acknowledges the uncertainties associated with mitigating or minimizing this
42 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
43 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control

1 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
2 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 3 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
4 better inform restoration design,
- 5 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
6 techniques,
- 7 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
8 organic material at a restoration site,
- 9 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
10 biologically unavailable, inorganic form of mercury,
- 11 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 12 • Considering capping mercury laden sediments, where possible to reduce methylation potential
13 at a site.

14 Because of the uncertainties associated with site-specific estimates of methylmercury
15 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
16 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
17 need to be evaluated separately for each restoration effort, as part of design and implementation.
18 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
19 potential effect of implementing CM2–CM21 is considered adverse.

20 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
21 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
22 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
23 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
24 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
25 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
26 measurable increase in methylmercury concentrations would make existing mercury-related
27 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
28 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
29 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
30 Design of restoration sites under Alternative 5 would be guided by CM12 which requires
31 development of site specific mercury management plans as restoration actions are implemented.
32 The effectiveness of minimization and mitigation actions implemented according to the mercury
33 management plans is not known at this time although the potential to reduce methylmercury
34 concentrations exists based on current research. Although the BDCP will implement CM12 with the
35 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
36 and the potential for increases in methylmercury concentrations in the Delta result in this potential
37 impact being considered significant. No mitigation measures would be available until specific
38 restoration actions are proposed. Therefore this programmatic impact is considered significant and
39 unavoidable.

1 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if
5 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
6 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

7 Under Alternative 5, modeling indicates that long-term annual average flows on the San Joaquin
8 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
9 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
10 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
11 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
12 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
13 affected, if at all, by changes in flow rates under Alternative 5.

14 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
15 environment located upstream of the Delta would not be of frequency, magnitude and geographic
16 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
17 water bodies, with regards to nitrate.

18 ***Delta***

19 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
20 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
21 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
22 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
23 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
24 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
25 information.

26 Results of the mixing calculations indicate that under Alternative 5, relative to Existing Conditions
27 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
28 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 19 and 20). Although
29 changes at specific Delta locations and for specific months may be substantial on a relative basis, the
30 absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the
31 drinking water MCL of 10 mg/L-N, as well as all other thresholds identified in Table 8-50. Long-term
32 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 assessment
33 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
34 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
35 concentration would be somewhat reduced under Alternative 5, relative to Existing Conditions, and
36 slightly increased relative to the No Action Alternative. No additional exceedances of the MCL are
37 anticipated at any location (Appendix 8J, *Nitrate*, Table 19). On a monthly average basis and on a
38 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
39 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
40 relative to the drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for all locations
41 and months, except San Joaquin River at Buckley Cove in August, which showed a 5.6% use of
42 assimilative capacity available under the No Action Alternative, for the drought period (1987–1991)
43 (Appendix 8J, *Nitrate*, Table 21).

1 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 2 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 3 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 4 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 5 the modeling.

- 6 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 7 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 8 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 9 the increase becoming greater with increasing distance downstream. However, the increase in
 10 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 11 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 12 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board
 13 2010a:32).
- 14 • Under Alternative 5, the planned upgrades to the SRWTP, which include nitrification/partial
 15 denitrification, would substantially decrease ammonia concentrations in the discharge, but
 16 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
 17 higher than under Existing Conditions.
- 18 • Overall, under Alternative 5, the nitrogen load from the SRWTP discharge is expected to
 19 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 20 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
 21 of the facility are expected to be higher than modeling results indicate for both Existing
 22 Conditions and Alternative 5, the increase is expected to be greater under Existing Conditions
 23 than for Alternative 5 due to the upgrades that are assumed under Alternative 5.

24 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 25 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 26 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 27 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 28 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 29 State has determined that no beneficial uses are adversely affected by the discharge, and that the
 30 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
 31 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
 32 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
 33 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
 34 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
 35 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
 36 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

37 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
 38 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 39 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

40 ***SWP/CVP Export Service Areas***

41 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 42 nitrate-N at the Banks and Jones pumping plants.

1 Results of the mixing calculations indicate that under Alternative 5, relative to Existing Conditions
2 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
3 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Tables 19 and
4 20). During the late summer, particularly in the drought period assessed, concentrations are
5 expected to increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally,
6 given the many factors that contribute to potential algal blooms in the SWP and CVP canals within
7 the Export Service Area, and the lack of studies that have shown a direct relationship between
8 nutrient concentrations in the canals and reservoirs and problematic algal blooms in these water
9 bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal increases
10 in nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
11 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, *Nitrate*,
12 Table 19). On a monthly average basis and on a long term annual average basis, for all modeled
13 years and for the drought period (1987–1991) only, use of assimilative capacity available under
14 Existing Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible
15 (<4%) for both Banks and Jones pumping plants (Appendix 8J, *Nitrate*, Table 21).

16 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
17 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
18 degrade the quality of exported water, with regards to nitrate.

19 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
20 CM1 are considered to be not adverse.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
22 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
23 purpose of making the CEQA impact determination for this constituent. For additional details on the
24 effects assessment findings that support this CEQA impact determination, see the effects assessment
25 discussion that immediately precedes this conclusion.

26 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
27 substantial dilution available for point sources and the lack of substantial nonpoint sources of
28 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
29 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
30 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
31 Consequently, any modified reservoir operations and subsequent changes in river flows under
32 Alternative 5, relative to Existing Conditions, are expected to have negligible, if any, effects on
33 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
34 watershed and upstream of the Delta in the San Joaquin River watershed.

35 In the Delta, results of the mixing calculations indicate that under Alternative 5, relative to Existing
36 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
37 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
38 location, and use of assimilative capacity available under Existing Conditions, relative to the
39 drinking water MCL of 10 mg/L-N, was low or negligible (i.e., <4%) for virtually all locations and
40 months.

41 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
42 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
43 indicate that under Alternative 5, relative to Existing Conditions, long-term average nitrate
44 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No

1 additional exceedances of the MCL are anticipated, and use of assimilative capacity available under
 2 Existing Conditions, relative to the MCL was negligible (i.e., <4%) for both Banks and Jones pumping
 3 plants for all months.

4 Based on the above, there would be no substantial, long-term increase in nitrate-N concentrations in
 5 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 6 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
 7 alternative is not expected to cause additional exceedance of applicable water quality
 8 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 9 on any beneficial uses of waters in the affected environment. Because nitrate concentrations are not
 10 expected to increase substantially, no long-term water quality degradation is expected to occur and,
 11 thus, no adverse effects to beneficial uses would occur. Nitrate is not 303(d) listed within the
 12 affected environment and thus any increases that may occur in some areas and months would not
 13 make any existing nitrate-related impairment measurably worse because no such impairments
 14 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 15 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 16 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 17 significant. No mitigation is required.

18 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2-**
 19 **CM21**

20 **NEPA Effects:** Effects of CM2–CM21 on nitrate under Alternative 5 would be the same as those
 21 discussed for Alternative 1A and are considered not to be adverse.

22 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
 23 measures proposed under Alternative 1A. As such, effects on nitrate resulting from the
 24 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 25 This impact is considered to be less than significant. No mitigation is required.

26 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 27 **Operations and Maintenance (CM1)**

28 ***Upstream of the Delta***

29 Under Alternative 5, there would be no substantial change to the sources of DOC within the
 30 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 31 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 32 system operations and resulting reservoir storage levels and river flows would not be expected to
 33 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 34 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 35 5, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 36 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 37 degrade the quality of these water bodies, with regards to DOC.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are

1 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
2 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
3 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
4 information.

5 Under Alternative 5, the geographic extent of effects pertaining to long-term average DOC
6 concentrations in the Delta would be similar to that previously described for Alternative 1A,
7 although the magnitude of predicted long-term change and relative frequency of concentration
8 threshold exceedances would be distributed differently. Modeled effects would be greatest at Franks
9 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
10 modeled drought period, long-term average concentration increases ranging from 0.2–0.3 mg/L
11 would be predicted ($\leq 8\%$ net increase) (Appendix 8K, *Organic Carbon*, DOC Table 6). Increases in
12 long-term average concentrations would correspond to more frequent concentration threshold
13 exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1 locations.
14 For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase from
15 52% under Existing Conditions to 64% under the Alternative 5 (an increase from 47% to 62% for
16 the drought period), and concentrations exceeding 4 mg/L would increase from 30% to 32% (32%
17 to 37% for the drought period). For Contra Costa PP No. 1, long-term average DOC concentrations
18 exceeding 3 mg/L would increase from 52% under Existing Conditions to 70% under Alternative 5
19 (45% to 75% for the drought period), and concentrations exceeding 4 mg/L would increase from
20 32% to 35% (35% to 40% for the drought period). Relative change in frequency of threshold
21 exceedance for other assessment locations would be similar or less. While Alternative 5 would
22 generally lead to slightly higher long-term average DOC concentrations (≤ 0.3 mg/L) at some
23 municipal water intakes and Delta interior locations, the predicted change would not be expected to
24 adversely affect MUN beneficial uses, or any other beneficial use. This comparison to Existing
25 Conditions reflects changes in DOC due to both Alternative 5 operations (including north Delta
26 intake capacity of 3,000 cfs and numerous other components of Operational Scenario C) and climate
27 change/sea level rise.

28 In comparison, Alternative 5 relative to the No Action Alternative would generally result in a
29 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
30 increases of 0.1–0.2 mg/L DOC (i.e., $\leq 6\%$) would be predicted at Franks Tract, Rock Slough, and
31 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table 6).
32 Threshold concentration exceedance frequency trends would also be similar to those discussed for
33 the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance frequency
34 at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average
35 DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 31% (42% to
36 53% for the modeled drought period). While the Alternative 5 would generally lead to slightly
37 higher long-term average DOC concentrations at some Delta assessment locations when compared
38 to No Action Alternative conditions, the predicted change would not be expected to adversely affect
39 MUN beneficial uses, or any other beneficial use, particularly when considering the relatively small
40 change in long-term annual average concentration. Unlike the comparison to Existing Conditions,
41 this comparison to the No Action Alternative reflects changes in DOC due only to Alternative 5
42 operations.

43 As discussed for Alternative 1A, substantial change in ambient DOC concentrations would need to
44 occur before significant changes in drinking water treatment plant design or operations are
45 triggered. The increases in long-term average DOC concentrations estimated to occur at various
46 Delta locations under Alternative 5 are of sufficiently small magnitude that they would not require

1 existing drinking water treatment plants to substantially upgrade treatment for DOC removal above
2 levels currently employed.

3 Relative to existing and No Action Alternative conditions, Alternative 5 would lead to predicted
4 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
5 Jones pumping plants (discussed below). At Barker Slough, long-term average DOC concentrations
6 would be predicted to decrease by as much as 0.1–0.2 mg/L depending on baseline conditions
7 comparison and modeling period.

8 ***SWP/CVP Export Service Areas***

9 Under Alternative 5, modeled long-term average DOC concentrations would decrease at Banks and
10 Jones pumping plants for the modeled 16-year hydrologic period, relative to Existing Conditions and
11 No Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at
12 Banks would be predicted to decrease by 0.3 mg/L (0.1 mg/L during drought period) (Appendix 8K,
13 *Organic Carbon*, DOC Table 6). At Jones, long-term average DOC concentrations would be predicted
14 to decrease by 0.2 mg/L, but be predicted to increase by 0.1 mg/L for the modeled drought period.
15 Such decreases in long-term average DOC, however, would not necessarily translate into lower
16 exceedance frequencies for concentration thresholds. To the contrary, long-term average DOC
17 concentrations at Banks exceeding 3 mg/L would increase from 64% under Existing Conditions to
18 69% under Alternative 5 (57% to 83% for the drought period), and at Jones would increase from
19 71% to 78% (72% to 93% for the drought period). Relative to the 4 mg/L concentration threshold,
20 long-term average DOC concentrations at Banks would decrease from 33% under Existing
21 Conditions to 27% under Alternative 5, but would increase slightly from 42% to 44% for the
22 modeled drought period. At Jones, concentrations exceeding 4 mg/L would increase slightly from
23 26% to 27% (35% to 39% for the drought period). Frequency of exceedance comparisons to the No
24 Action Alternative yield similar trends, but with slightly smaller 16-year hydrologic period and
25 drought period changes. Overall, modeling results for the SWP/CVP Export Service Areas predict a
26 slight long-term improvement in Export Service Areas water quality respective to DOC. This
27 improvement is principally obtained through overall lower long-term average DOC concentrations
28 at Banks and Jones.

29 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
30 facilities under Alternative 5 would not be expected to create new sources of DOC or contribute
31 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
32 would not be expected to cause any substantial change in long-term average DOC concentrations
33 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

34 ***NEPA Effects:*** In summary, Alternative 5, relative to the No Action Alternative, would not cause a
35 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
36 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
37 decrease by as much as 0.3 mg/L, while long-term average DOC concentrations for some Delta
38 interior locations, including Contra Costa PP #1, are predicted to increase by as much as 0.2 mg/L.
39 The increase in long-term average DOC concentration that could occur within the Delta interior
40 would not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other
41 beneficial uses, of Delta waters. The effect of Alternative 1A operations and maintenance (CM1) on
42 DOC is determined not to be adverse.

43 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
44 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the

1 purpose of making the CEQA impact determination for this constituent. For additional details on the
2 effects assessment findings that support this CEQA impact determination, see the effects assessment
3 discussion that immediately precedes this conclusion.

4 While greater water demands under the Alternative 5 would alter the magnitude and timing of
5 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
6 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
7 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
8 flows would not be expected to cause a substantial long-term change in DOC concentrations
9 upstream of the Delta.

10 Relative to Existing Conditions, Alternative 5 would result in relatively small increases (i.e., $\leq 8\%$) in
11 long-term average DOC concentrations at some Delta interior locations, including Franks Tract, Rock
12 Slough, and Contra Costa PP No. 1. However, these increases would not substantially increase the
13 frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L. While
14 Alternative 5 would generally lead to slightly higher long-term average DOC concentrations (≤ 0.3
15 mg/L) within the Delta interior and some municipal water intakes, the predicted change would not
16 be expected to adversely affect MUN beneficial uses, or any other beneficial use.

17 The assessment of Alternative 5 effects on DOC in the SWP/CVP Export Service Areas is based on
18 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
19 Existing Conditions, long-term average DOC concentrations would decrease by as much as 0.3 mg/L
20 at Banks and Jones pumping plants, although slightly more frequent export of >3 mg/L DOC water is
21 predicted. Nevertheless, an overall improvement in DOC-related water quality would be predicted in
22 the SWP/CVP Export Service Areas.

23 Based on the above, Alternative 5 operation and maintenance would not result in any substantial
24 change in long-term average DOC concentration upstream of the Delta or result in substantial
25 increase in the frequency with which long-term average DOC concentrations exceeds 2, 3, or 4 mg/L
26 levels at the 11 assessment locations analyzed for the Delta. Modeled long-term average DOC
27 concentrations would increase by no more than 0.3 mg/L at any single Delta assessment location
28 (i.e., $\leq 8\%$ relative increase), with long-term average concentrations estimated to remain at or below
29 4.0 mg/L at all Delta locations assessed, with the exception of Buckley Cove on the San Joaquin River
30 during the drought period modeled. Nevertheless, long-term average concentrations at Buckley
31 Cove are expected to decrease slightly during the drought period, relative to Existing Conditions.
32 The increases in long-term average DOC concentration that could occur within the Delta would not
33 be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of
34 Delta waters or waters of the SWP/CVP Service Area. Because DOC is not bioaccumulative, the
35 increases in long-term average DOC concentrations would not directly cause bioaccumulative
36 problems in aquatic life or humans. Finally, DOC is not causing beneficial use impairments and thus
37 is not 303(d) listed for any water body within the affected environment. Thus, the increases in long-
38 term average DOC that could occur at various locations would not make any beneficial use
39 impairment measurably worse. Because long-term average DOC concentrations are not expected to
40 increase substantially, no long-term water quality degradation with respect to DOC is expected to
41 occur and, thus, no adverse effects on beneficial uses would occur. This impact is considered to be
42 less than significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 2 **Implementation of CM2–CM21**

3 **NEPA Effects:** CM2–CM21 proposed under Alternative 5 would be the same as those proposed
 4 under Alternative 1A, except that 25,000 acres rather than 65,000 acres of tidal habitat would be
 5 restored. Effects on DOC resulting from the implementation of CM2–CM21 would be similar to those
 6 previously discussed for Alternative 1A, except that the reduced acreage of proposed tidal habitat
 7 would reduce the overall Alternative 5-related DOC loading to the Delta. While this reduced acreage
 8 would result in reduced DOC loading relative to other action alternatives, CM4–CM7 and CM10 could
 9 still contribute substantial amounts of DOC to raw drinking water supplies, largely depending on
 10 final design and operational criteria for the related wetland and riparian habitat restoration
 11 activities. Substantially increased long-term average DOC in raw water supplies could lead to a need
 12 for treatment plant upgrades in order to appropriately manage DBP formation in treated drinking
 13 water. This potential for future DOC increases would lead to substantially greater associated risk of
 14 long-term adverse effects on the MUN beneficial use.

15 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 5 would
 16 present new localized sources of DOC to the study area, and in some circumstances would substitute
 17 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 18 proximity to municipal drinking water intakes, such restoration activities could contribute
 19 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 20 DOC could necessitate changes in water treatment plant operations or require treatment plant
 21 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 22 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

23 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 5 would be similar to
 24 those discussed for Alternative 1A, although the overall magnitude of effect is expected to be less
 25 due to the smaller acreage proposed for tidal habitat restoration. Regardless of the smaller proposed
 26 acreage, these restoration activities could present a substantial source of DOC loading to the Delta.
 27 Similar to Alternative 1A, this impact is considered to be significant and mitigation is required. It is
 28 uncertain whether implementation of Mitigation Measure WQ-18 would reduce identified impacts
 29 to a less-than-significant level. Hence, this impact remains significant and unavoidable.

30 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 31 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 32 *AMMs, and CMs,* a separate other commitment to address the potential increased water treatment
 33 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 34 operations. Potential options for making use of this financial commitment include funding or
 35 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 36 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 37 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 38 water quality effects relating to DOC.

39 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 40 **Effects on Municipal Intakes**

41 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

1 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
2 **(CM1)**

3 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 5 would be the same as those
4 discussed for Alternative 1A and are considered to not be adverse.

5 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 5 would be the same as those
6 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
7 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
8 this constituent. For additional details on the effects assessment findings that support this CEQA
9 impact determination, see the effects assessment discussion under Alternative 1A.

10 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
11 (water facilities and operations) under Alternative 5, relative to Existing Conditions, would not be
12 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
13 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
14 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
15 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
16 related regulations.

17 It is expected there would be no substantial change in Delta pathogen concentrations in response to
18 a shift in the Delta source water percentages under this alternative or substantial degradation of
19 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
20 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
21 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
22 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
23 and livestock-related uses, would continue under this alternative.

24 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
25 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
26 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
27 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
28 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
29 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
30 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

31 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
32 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
33 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
34 expected to increase substantially, no long-term water quality degradation for pathogens is
35 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
36 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
37 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
38 are expected to occur on a long-term basis, further degradation and impairment of this area is not
39 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
40 considered to be less than significant. No mitigation is required.

1 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

2 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 5 would be the same as those
3 discussed for Alternative 1A and are considered to not be adverse.

4 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
5 measures proposed under Alternative 1A. As such, effects on pathogens resulting from the
6 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
7 This impact is considered to be less than significant. No mitigation is required.

8 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 9 **Maintenance (CM1)**

10 ***Upstream of the Delta***

11 For the same reasons stated for the No Action Alternative, under Alternative 5 no specific operations
12 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
13 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
14 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
15 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

16 Under Alternative 5, winter (November–March) and summer (April–October) season average flow
17 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
18 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
19 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
20 the summer and 4% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River,
21 average flow rates would decrease no more than 4% during the summer, but would increase by as
22 much as 5% in the winter. American River average flow rates would decrease by as much as 15% in
23 the summer and 1% in the winter. Seasonal average flow rates on the San Joaquin River would
24 decrease by as much as 12% in the summer, but increase by as much as 1% in the winter. For the
25 same reasons stated for the No Action Alternative, decreased seasonal average flow of $\leq 15\%$ is not
26 considered to be of sufficient magnitude to substantially increase pesticide concentrations or alter
27 the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial
28 uses of water bodies upstream of the Delta.

29 ***Delta***

30 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
31 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
32 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

33 Under Alternative 5, the distribution and mixing of Delta source waters would change. Percentage
34 change in monthly average source water fraction was evaluated for the modeled 16-year (1976–
35 1991) hydrologic period and a representative drought period (1987–1991), with special attention
36 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
37 fractions. Relative to Existing Conditions, under Alternative 5 modeled San Joaquin River fractions
38 would increase greater than 10% (excluding Banks and Jones pumping plants) at Rock Slough and
39 Contra Costa PP No. 1 (Appendix 8D, *Source Water Fingerprinting Results*). At Rock Slough, modeled
40 San Joaquin River source water fractions would increase 16% during November (13% for the
41 modeled drought period), while at Contra Costa PP No. 1 San Joaquin River source water fractions
42 would increase 15% during November and 12% during March. Corresponding increases for the

1 modeled drought period would not be greater than 8% at Contra Costa PP No. 1. Relative to Existing
 2 Conditions, there would be no modeled increases in Sacramento River fractions greater than 14%
 3 (with exception to Banks and Jones which are discussed below) and Delta agricultural fractions
 4 greater than 7%. These modeled changes in the source water fractions of Sacramento, San Joaquin
 5 and Delta agriculture water are not of sufficient magnitude to substantially alter the long-term risk
 6 of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial uses of the Delta.

7 When compared to the No Action Alternative, changes in source water fractions would be similar in
 8 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
 9 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
 10 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
 11 River) for all months of the year but July and August. In July and August, the combined operational
 12 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
 13 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
 14 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
 15 year. Under Alternative 5, however, modeled July and August San Joaquin River fractions at Buckley
 16 Cove would increase relative to the No Action Alternative, with increases of 12% in July (25% for the
 17 modeled drought period) and 22% in August (43% for the modeled drought period) (Appendix 8D,
 18 *Source Water Fingerprinting Results*). Despite these San Joaquin River increases, the resulting net
 19 San Joaquin River source water fraction for July and August would remain less than all other
 20 months. As a result, these modeled changes in the source water fractions are not of sufficient
 21 magnitude to substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor
 22 adversely affect other beneficial uses of the Delta.

23 **SWP/CVP Export Service Areas**

24 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 25 the Banks and Jones pumping plants. Under Alternative 5, Sacramento River source water fractions
 26 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
 27 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
 28 pumping plant, Sacramento source water fractions would generally increase from 14–28% for
 29 March through June (17% for April of the modeled drought period) and at Jones pumping plant
 30 Sacramento source water fractions would generally increase from 12–24% for January through June
 31 (15–27% for March through May of the modeled drought period). These increases in Sacramento
 32 source water fraction would primarily balance through equivalent decreases in San Joaquin River
 33 water. Based on the general observation that San Joaquin River, in comparison to the Sacramento
 34 River, is a greater contributor of OP insecticides in terms of greater frequency of incidence and
 35 presence at concentrations exceeding water quality benchmarks, modeled increases in Sacramento
 36 River fraction at Banks and Jones would generally represent an improvement in export water
 37 quality respective to pesticides.

38 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
 39 American, and San Joaquin Rivers, under Alternative 5 relative to the No Action Alternative, are of
 40 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
 41 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
 42 Similarly, modeled changes in source water fractions to the Delta are of insufficient magnitude to
 43 substantially alter the long-term risk of pesticide-related water quality degradation and related
 44 toxicity to aquatic life in the Delta or CVP/SWP export service areas. The effects on pesticides from
 45 operations and maintenance (CM1) are determined not to be adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
2 provided above are summarized here, and are then compared to the CEQA thresholds of significance
3 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
4 constituent. For additional details on the effects assessment findings that support this CEQA impact
5 determination, see the effects assessment discussion that immediately precedes this conclusion.

6 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
7 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
8 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
9 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
10 substantially increase the long-term risk of pesticide-related water quality degradation and related
11 toxicity to aquatic life in these water bodies upstream of the Delta.

12 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
13 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
14 and maintenance activities would not affect these sources, changes in Delta source water fraction
15 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
16 Alternative 5, however, modeled changes in source water fractions relative to Existing Conditions
17 are of insufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
18 aquatic life within the Delta, nor would such changes result in adverse pesticide-related effects on
19 any other beneficial uses of Delta waters.

20 The assessment of Alternative 5 effects on pesticides in the SWP/CVP Export Service Areas is based
21 on assessment of changes predicted at Banks and Jones pumping plants. As just discussed regarding
22 effects to pesticides in the Delta, modeled changes in source water fractions at the Banks and Jones
23 pumping plants are of insufficient magnitude to substantially alter the long-term risk of pesticide-
24 related toxicity to aquatic life beneficial uses, or any other beneficial uses, in water bodies of the
25 SWP and CVP export service area.

26 Based on the above, Alternative 5 would not result in any substantial change in long-term average
27 pesticide concentration or result in substantial increase in the anticipated frequency with which
28 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
29 beneficial use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for
30 the Delta, or the SWP/CVP service area. Numerous pesticides are currently used throughout the
31 affected environment, and while some of these pesticides may be bioaccumulative, those present-
32 use pesticides for which there is sufficient evidence for their presence in waters affected by SWP
33 and CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
34 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
35 problems in aquatic life or humans. Furthermore, while there are numerous 303(d) listings
36 throughout the affected environment that name pesticides as the cause for beneficial use
37 impairment, the modeled changes in upstream river flows and Delta source water fractions would
38 not be expected to make any of these beneficial use impairments measurably worse. Because long-
39 term average pesticide concentrations are not expected to increase substantially, no long-term
40 water quality degradation with respect to pesticides is expected to occur and, thus, no adverse
41 effects on beneficial uses would occur. This impact is considered to be less than significant. No
42 mitigation is required.

1 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-**
2 **CM21**

3 **NEPA Effects:** CM2–CM21 proposed under Alternative 5 would be the same as those proposed
4 under Alternative 1A, except that 25,000 acres rather than 65,000 acres of tidal habitat would be
5 restored. As such, effects on pesticides resulting from the implementation of CM2–CM21 would be
6 similar to those previously discussed for Alternative 1A, except that the likely overall use of
7 herbicides to control invasive aquatic vegetation would likely be reduced commensurate with the
8 reduction in restored acres of tidal habitat. Nevertheless, herbicides directly applied to water could
9 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
10 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency
11 and magnitude such that beneficial uses would be impacted, thus constituting an adverse effect on
12 water quality.

13 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM21
14 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
15 effect.

16 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 5 are similar to
17 conservation measures discussed for Alternative 1A. Potential environmental effects related only to
18 CM13 are considered to be significant. Mitigation is required. While Mitigation Measure WQ-22 is
19 available to partially reduce this impact of pesticides, no feasible mitigation is available that would
20 reduce it to a level that would be less than significant.

21 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
22 **Strategies**

23 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

24 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
25 **and Maintenance (CM1)**

26 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
27 of the affected environment under Alternative 5 would be very similar (i.e., nearly the same) to
28 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
29 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
30 5, which are considered to be not adverse.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
32 provided above are summarized here, and are then compared to the CEQA thresholds of significance
33 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
34 constituent. For additional details on the effects assessment findings that support this CEQA impact
35 determination, see the effects assessment discussion that immediately precedes this conclusion.

36 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
37 because changes in flows do not necessarily result in changes in concentrations or loading of
38 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
39 Delta are not anticipated for Alternative 5, relative to Existing Conditions.

40 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
41 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a

1 long term-average basis under Alternative 5, relative to Existing Conditions. Algal growth rates are
 2 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
 3 that may occur at some locations and times within the Delta would be expected to have little effect
 4 on primary productivity in the Delta.

5 The assessment of effects of phosphorus under Alternative 5 in the SWP and CVP Export Service
 6 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
 7 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
 8 anticipated to change substantially on a long term-average basis.

9 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
 10 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 11 CVP and SWP service areas under Alternative 5 relative to Existing Conditions. As such, this
 12 alternative is not expected to cause additional exceedance of applicable water quality
 13 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 14 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 15 are not expected to increase substantially, no long-term water quality degradation is expected to
 16 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 17 within the affected environment and thus any minor increases that may occur in some areas would
 18 not make any existing phosphorus-related impairment measurably worse because no such
 19 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 20 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 21 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 22 than significant. No mitigation is required.

23 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 24 **CM2–CM21**

25 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
 26 environment under Alternative 5 would be very similar (i.e., nearly the same) to those discussed for
 27 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 28 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
 29 effects of these same actions under Alternative 5, which are considered to be not adverse.

30 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
 31 measures proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 32 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 33 This impact is considered to be less than significant. No mitigation is required.

34 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 35 **Maintenance (CM1)**

36 ***Upstream of the Delta***

37 For the same reasons stated for the No Action Alternative, Alternative 5 would have negligible, if
 38 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 39 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 40 concentrations that could occur in the water bodies of the affected environment located upstream of
 41 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect

1 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
2 selenium.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
9 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
10 information.

11 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
12 locations under Alternative 5, relative to Existing Conditions and the No Action Alternative, are
13 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-15 and M-25 for most biota
14 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
15 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
16 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
17 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
18 water at each modeled assessment location for all years. Appendix 8M, Figure M-23 provides more
19 detail in the form of monthly patterns of selenium concentrations in water during the modeling
20 period.

21 Alternative 5 would result in small changes in average selenium concentrations in water at all
22 modeled Delta assessment locations relative to Existing Conditions and the No Action Alternative
23 (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some interior and
24 western Delta locations would increase by 0.01–0.02 µg/L for the entire period modeled (1976–
25 1991). These small increases in selenium concentrations in water would result in small reductions
26 (1–2% or less) in available assimilative capacity for selenium, relative to the 1.3 µg/L USEPA draft
27 water quality criterion (Figures 8-59a and 8-60a). The long-term average selenium concentrations
28 in water for Alternative 5 (range 0.09–0.39 µg/L) would be similar to those for Existing Conditions
29 (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and would be well
30 below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, *Selenium*, Table M-9a).

31 Relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in very
32 small changes (less than 1%) in estimated selenium concentrations in most biota (whole-body fish,
33 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout the Delta, with little
34 difference among locations (Figures 8-61a through 8-64b; Appendix 8M, *Selenium*, Table M-25).
35 Level of Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern
36 benchmarks) for selenium concentrations in those biota for all years and for drought years are less
37 than 1.0 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
38 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
39 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
40 predicted to increase by about 7% relative to Existing Conditions and the No Action Alternative in all
41 years (from about 4.7 to 5.0 mg/kg dry weight), and those for sturgeon in the Sacramento River at
42 Mallard Island are predicted to increase by about 4% in all years (from about 4.4 to 4.6 mg/kg dry
43 weight) (Appendix 8M, Tables M-30 and M-31). Selenium concentrations in sturgeon during drought
44 years are expected to increase by only 2–5% at those locations (Appendix 8M, Tables M-30 and M-

1 31). Detection of small changes in whole-body sturgeon such as those estimated for the western
2 Delta would require very large sample sizes because of the inherent variability in fish tissue
3 selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium concentrations
4 in sturgeon in the western Delta would exceed 1.0 (indicating a higher probability for adverse
5 effects) for drought years at both locations (as they do for Existing Conditions and the No Action
6 Alternative); however, for the entire period modeled, the quotient would not be exceeded at either
7 location (Appendix 8M, Table M-32).

8 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
9 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
10 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
11 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
12 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
13 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
14 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
15 the two western Delta locations and used literature-derived uptake factors and trophic transfer
16 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
17 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
18 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
19 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
20 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
21 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
22 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
23 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
24 waterborne selenium concentration at the two locations in different time periods.

25 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
26 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
27 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
28 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
29 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
30 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
31 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
32 most areas of the Delta.

33 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
34 Alternative 5 would be greater in the East Delta than in other sub-regions. Relative to Existing
35 Conditions, annual average residence times for Alternative 5 in the East Delta are expected to
36 increase by more than 16 days (Table 8-60a). Relative to the No Action Alternative, annual average
37 residence times for Alternative 5 in the East Delta are expected to increase by less than 9 days.
38 Increases in residence times for other sub-regions would be smaller, especially as compared to
39 Existing Conditions and the No Action Alternative (which are longer than those modeled for the
40 South Delta). As mentioned above, these results incorporate hydrodynamic effects of both CM1 and
41 CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of CM2 and CM4.
42 However, it is expected that CM2 and CM4 are substantial drivers of the increased residence time.

43 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
44 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
45 concentrations in particulates, as the lowest level of the food chain, relative to the water-borne

1 concentration], and associated tissue concentrations [especially in clams and their consumers, such
2 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
3 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
4 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
5 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
6 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

7 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
8 as related to residence time, but the effects of residence time are incorporated in the
9 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
10 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
11 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
12 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
13 concentrations are currently low and not approaching thresholds of concern (which, as discussed
14 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
15 residence time alone would not be expected to cause them to then approach or exceed thresholds of
16 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
17 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
18 sparse, the most likely area in which biota tissues would be at levels high enough that additional
19 bioaccumulation due to increased residence time from restoration areas would be a concern is the
20 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
21 increase in residence time estimated in the western Delta is 5 days relative to Existing Conditions,
22 and 3 days relative to the No Action Alternative. Given the available information, these increases are
23 small enough that they are not expected to substantially affect selenium bioaccumulation in the
24 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
25 residence times, further discussion is included in Impact WQ-26 below,

26 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 5 would
27 result in essentially no change in selenium concentrations throughout the Delta for most biota (less
28 than 1%), although increases in selenium concentrations are predicted for sturgeon in the western
29 Delta. Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a
30 low potential for effects. The modeling of bioaccumulation for sturgeon is less calibrated to site-
31 specific conditions than that for other biota, which was calibrated on a robust dataset for modeling
32 of bioaccumulation in largemouth bass as a representative species for the Delta. Overall, Alternative
33 5 would not be expected to substantially increase the frequency with which applicable benchmarks
34 would be exceeded in the Delta (there being only a small increase for sturgeon relative to the low
35 benchmark and no exceedance of the high benchmark) or substantially degrade the quality of water
36 in the Delta, with regard to selenium.

37 ***SWP/CVP Export Service Areas***

38 Alternative 5 would result in small decreases in long-term average selenium concentrations in water
39 at the Banks and Jones pumping plants, relative to Existing Conditions and the No Action Alternative,
40 for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a). These decreases in long-term
41 average selenium concentrations in water would result in increases in available assimilative
42 capacity for selenium of 2–4%. Furthermore, the long-term average selenium concentrations in
43 water for Alternative 5 (range 0.19–0.25 $\mu\text{g}/\text{L}$) would be well below the USEPA draft water quality
44 criterion of 1.3 $\mu\text{g}/\text{L}$ (Appendix 8M, Table M-9a).

1 Relative to Existing Conditions and the No Action Alternative, Alternative 5 would result in very
2 small changes (less than 1%) in estimated selenium concentrations in biota (whole-body fish, bird
3 eggs [invertebrate diet] bird eggs [fish diet], and fish fillets) (Figures 8-61a through 8-64b; Appendix
4 8M, *Selenium*, Table M-25) at Banks and Jones pumping plants. Concentrations in biota would not
5 exceed any selenium benchmarks for Alternative 5 (Figures 8-61a through 8-64b).

6 **NEPA Effects:** Based on the discussion above, the effects on selenium (both as waterborne and as
7 bioaccumulated in biota) from Alternative 5 are not considered to be adverse.

8 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
9 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
10 purpose of making the CEQA impact determination for selenium. For additional details on the effects
11 assessment findings that support this CEQA impact determination, see the effects assessment
12 discussion that immediately precedes this conclusion.

13 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
14 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
15 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
16 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
17 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
18 Valley Regional Water Quality Control Board 2010d; State Water Resources Control Board 2010b,
19 2010c) that are expected to result in decreasing discharges of selenium from the San Joaquin River
20 to the Delta. Consequently, any modified reservoir operations and subsequent changes in river flows
21 under Alternative 5, relative to Existing Conditions, are expected to cause negligible changes in
22 selenium concentrations in water. Any negligible changes in selenium concentrations that may occur
23 in the water bodies of the affected environment located upstream of the Delta would not be of
24 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
25 substantially degrade the quality of these water bodies as related to selenium.

26 Relative to Existing Conditions, modeling estimates indicate that Alternative 5 would result in
27 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
28 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
29 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
30 would increase slightly, from 0.94 for Existing Conditions to 1.0 for Alternative 5. Concentrations of
31 selenium in sturgeon would exceed only the lower benchmark, indicating a low potential for effects.
32 Overall, Alternative 5 would not be expected to substantially increase the frequency with which
33 applicable benchmarks would be exceeded in the Delta (there being only a small exceedance relative
34 to the low benchmark for sturgeon and no exceedance of the high benchmark) or substantially
35 degrade the quality of water in the Delta, with regard to selenium.

36 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
37 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
38 Alternative 5 would cause no increase in the frequency with which applicable benchmarks would be
39 exceeded and would slightly improve the quality of water in selenium concentrations at the Banks
40 and Jones pumping plants.

41 Based on the above, selenium concentrations that would occur in water under Alternative 5 would
42 not cause additional exceedances of applicable state or federal numeric or narrative water quality
43 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
44 (Table 8-54), by frequency, magnitude, and geographic extent that would result in adverse effects to

1 one or more beneficial uses within affected water bodies. In comparison to Existing Conditions and
2 the No Action Alternative, water quality conditions under this alternative would not increase levels
3 of selenium by frequency, magnitude, and geographic extent such that the affected environment
4 would be expected to have measurably higher body burdens of selenium in aquatic organisms,
5 thereby substantially increasing the health risks to wildlife (including fish) or humans consuming
6 those organisms. Water quality conditions under this alternative with respect to selenium would not
7 cause long-term degradation of water quality in the affected environment, and therefore would not
8 result in use of available assimilative capacity such that exceedances of water quality
9 objectives/criteria would be likely and would result in substantially increased risk for adverse
10 effects to one or more beneficial uses. This alternative would not further degrade water quality by
11 measurable levels, on a long-term basis, for selenium and, thus, cause the 303(d)-listed impairment
12 of beneficial use to be made discernibly worse. This impact is considered to be less than significant.
13 No mitigation is required.

14 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
15 **CM21**

16 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 5 would be the same as those
17 discussed for Alternative 1A and are considered not to be adverse.

18 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
19 measures proposed under Alternative 1A. As such, effects on selenium resulting from the
20 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
21 This impact is considered to be less than significant. No mitigation is required.

22 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
23 **and Maintenance (CM1)**

24 ***Upstream of the Delta***

25 For the same reasons stated for the No Action Alternative, Alternative 5 would result in negligible,
26 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
27 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
28 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
29 annual and long-term average basis. As such, Alternative 5 would not be expected to substantially
30 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
31 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
32 degrade the quality of these water bodies, with regard to trace metals.

33 ***Delta***

34 For the same reasons stated for the No Action Alternative, Alternative 5 would not result in
35 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
36 the No Action Alternative. Effects due to the operation and maintenance of the conveyance facilities
37 are expected to be negligible, on a long-term average basis. As such, Alternative 5 would not be
38 expected to substantially increase the frequency with which applicable Basin Plan objectives or CTR
39 criteria would be exceeded in the Delta or substantially degrade the quality of Delta waters, with
40 regard to trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 5 would not result in
3 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
4 from the Sacramento River through the proposed conveyance facilities. As such, there is not
5 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
6 area waters under Alternative 5, relative to Existing Conditions and the No Action Alternative. As
7 such, Alternative 5 would not be expected to substantially increase the frequency with which
8 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
9 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
10 water bodies, with regard to trace metals.

11 **NEPA Effects:** In summary, Alternative 5, relative to the No Action Alternative, would not cause a
12 substantial increase in long-term average trace metals concentrations within the affected
13 environment, nor would it cause an increased frequency of water quality objective/criteria
14 exceedances within the affected environment. The effect on trace metals is determined not to be
15 adverse.

16 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 5 would be similar to those
17 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
18 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
19 this constituent. For additional details on the effects assessment findings that support this CEQA
20 impact determination, see the effects assessment discussion under Alternative 1A.

21 While greater water demands under the Alternative 5 would alter the magnitude and timing of
22 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
23 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
24 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
25 therefore, changes in river flows would not be expected to cause a substantial long-term change in
26 trace metal concentrations upstream of the Delta.

27 Average and 95th percentile trace metal concentrations are very similar across the primary source
28 waters to the Delta. Given this similarity, very large changes in source water fraction would be
29 necessary to effect a relatively small change in trace metal concentration at a particular Delta
30 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
31 waters are all below their respective water quality criteria, including those that are hardness-based
32 without a WER adjustment. No mixing of these three source waters could result in a metal
33 concentration greater than the highest source water concentration, and given that trace metals do
34 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
35 not be expected to occur under the Alternative 5.

36 The assessment of the Alternative 5 effects on trace metals in the SWP/CVP Export Service Areas is
37 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
38 As just discussed regarding similarities in Delta source water trace metal concentrations, the
39 Alternative 5 is not expected to result in substantial changes in trace metal concentrations in Delta
40 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
41 in the SWP/CVP Export Service Area are expected to be negligible.

42 Based on the above, there would be no substantial long-term increase in trace metal concentrations
43 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export

1 service area waters under Alternative 5 relative to Existing Conditions. As such, this alternative is
 2 not expected to cause additional exceedance of applicable water quality objectives by frequency,
 3 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 4 in the affected environment. Because trace metal concentrations are not expected to increase
 5 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
 6 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
 7 trace metal concentrations that may occur in water bodies of the affected environment would not be
 8 expected to make any existing beneficial use impairments measurably worse. The trace metals
 9 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 10 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
 11 significant. No mitigation is required.

12 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 13 **CM2–CM21**

14 **NEPA Effects:** CM2–CM21 proposed under Alternative 5 would be the same as those proposed
 15 under Alternative 1A, except that 25,000 acres rather than 65,000 acres of tidal habitat would be
 16 restored. Effects on trace metals resulting from the implementation of CM2–CM21 would be similar
 17 to those previously discussed for Alternative 1A. As they pertain to trace metals, implementation of
 18 CM2–CM21 would not be expected to adversely affect beneficial uses of the affected environment or
 19 substantially degrade water quality with respect to trace metals.

20 In summary, implementation of CM2–CM21 under Alternative 5, relative to the No Action
 21 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 22 metals from implementing CM2–CM21 is determined not to be adverse.

23 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 5 would not cause substantial
 24 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 25 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 26 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 27 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 28 environment. Because trace metal concentrations are not expected to increase substantially, no
 29 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 30 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 31 concentrations that may occur throughout the affected environment would not be expected to make
 32 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 33 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 34 problems in aquatic life or humans. This impact is considered to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 37 **Maintenance (CM1)**

38 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 5 would be the same as those
 39 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
 40 to not be adverse.

41 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 5 would be similar to those
 42 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 43 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for

1 this constituent. For additional details on the effects assessment findings that support this CEQA
2 impact determination, see the effects assessment discussion under Alternative 1A.

3 Changes river flow rate and reservoir storage that would occur under Alternative 5, relative to
4 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
5 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
6 suspended sediment concentrations are more affected by season than flow. Site-specific and
7 temporal exceptions may occur due to localized temporary construction activities, dredging
8 activities, development, or other land use changes would be site-specific and temporal, which would
9 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
10 than substantial levels.

11 Within the Delta, geomorphic changes associated with sediment transport and deposition are
12 usually gradual, occurring over years, and high storm event inflows would not be substantially
13 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
14 would not be substantially different from the levels under Existing Conditions. Consequently, this
15 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
16 region, relative to Existing Conditions.

17 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
18 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 5, relative to Existing
19 Conditions, because as stated above, this alternative is not expected to result in substantial changes
20 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
21 Conditions.

22 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
24 concentrations and turbidity levels are not expected to be substantially different, long-term water
25 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
26 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
27 listed constituents. This impact is considered to be less than significant. No mitigation is required.

28 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

29 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 5 would be the same as
30 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
31 is determined to not be adverse.

32 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 5 would be similar to conservation
33 measures proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
34 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
35 This impact is considered to be less than significant. No mitigation is required.

36 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities (CM1– 37 CM21)**

38 The conveyance features for CM1 under Alternative 5 would be very similar to those discussed for
39 Alternative 1A. The primary difference between Alternative 5 and Alternative 1A is that under
40 Alternative 5, there would be four fewer intakes and four fewer pumping plant locations, which
41 would result in a reduced level of construction activity. However, construction techniques and
42 locations of major features of the conveyance system within the Delta would be similar. The

1 remainder of the facilities constructed under Alternative 5, including CM2–CM21, would be very
 2 similar to, or the same as, those to be constructed for Alternative 1A. However, under Alternative 5,
 3 there would only be up to 25,000 acres of tidal marsh habitat restored (as opposed to 65,000 acres
 4 under the majority of the other alternatives), thus resulting in less in-water construction-related
 5 disturbances.

6 **NEPA Effects:** The types of potential construction-related water quality effects associated with
 7 implementation of CM1–CM21 under Alternative 5 would be very similar to the effects discussed for
 8 Alternative 1A, and the effects anticipated with implementation of CM2–CM21 would be essentially
 9 identical. However, the construction of fewer intakes and smaller conveyance features for CM1, and
 10 less tidal marsh habitat restoration, under Alternative 5 would be anticipated to result in a lower
 11 magnitude of construction-related activities. Nevertheless, the construction of CM1, and any
 12 individual components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs
 13 specified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, and other agency permitted
 14 construction requirements would result in the potential water quality effects being largely avoided
 15 and minimized. The specific environmental commitments that would be implemented under
 16 Alternative 5 would be similar to those described for Alternative 1A. Consequently, relative to
 17 Existing Conditions, Alternative 5 would not be expected to cause exceedance of applicable water
 18 quality objectives/criteria or substantial water quality degradation with respect to constituents of
 19 concern, and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta,
 20 or in the SWP and CVP service area.

21 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 22 construction-related water quality effects are considered to be not adverse.

23 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 5
 24 for construction-related activities along with agency-issued permits that also contain construction
 25 requirements to protect water quality, the construction-related effects, relative to Existing
 26 Conditions, would not be expected to cause or contribute to substantial alteration of existing
 27 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
 28 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
 29 water quality with respect to the constituents of concern on a long-term average basis, and thus
 30 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 31 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 32 would be temporary and intermittent in nature, the construction would involve negligible
 33 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 34 environment. As such, construction activities would not contribute measurably to bioaccumulation
 35 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 36 Based on these findings, this impact is determined to be less than significant. No mitigation is
 37 required.

38 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 39 **and Maintenance (CM1)**

40 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
 41 concentrations, in water bodies of the affected environment under Alternative 5 would be very
 42 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
 43 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
 44 Services Areas under Alternative 1A would similarly change under Alternative 5, relative to Existing

1 Conditions and the No Action Alternative. For the Delta in particular, there are differences in the
2 direction and magnitude of water residence time changes during the *Microcystis* bloom period
3 among the six Delta sub-regions under Alternative 5 compared to Alternative 1A, relative to Existing
4 Conditions and No Action Alternative. However, under Alternative 5, relative to Existing Conditions
5 and No Action Alternative, water residence times during the *Microcystis* bloom period in various
6 Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A, lead to
7 an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout
8 the Delta.

9 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
10 would occur in the Delta under Alternative 5, which could lead to earlier occurrences of *Microcystis*
11 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
12 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
13 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
14 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative 5
15 may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
16 because water temperatures will increase in the Export Service Areas due to the expected increase
17 in ambient air temperatures resulting from climate change.

18 **NEPA Effects:** Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
19 affected environment under Alternative 5 would be very similar to (i.e., nearly the same) to those
20 discussed for Alternative 1A. In summary, Alternative 5 operations and maintenance, relative to the
21 No Action Alternative, would result in long-term increases in hydraulic residence time of various
22 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
23 increased residence time could result in a concurrent increase in the frequency, magnitude, and
24 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
25 As a result, Alternative 5 operation and maintenance activities would cause further degradation to
26 water quality with respect to *Microcystis* in the Delta. Under Alternative 5, relative to No Action
27 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
28 affected source water from the south Delta intakes and unaffected source water from the
29 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
30 and maintenance under Alternative 5 will result in increased or decreased levels of *Microcystis* and
31 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
32 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
33 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
34 *Microcystis* from implementing CM1 is determined to be adverse.

35 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
36 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
37 purpose of making the CEQA impact determination for this constituent. For additional details on the
38 effects assessment findings that support this CEQA impact determination, see the effects assessment
39 discussion that immediately precedes this conclusion.

40 Under Alternative 5, additional impacts from *Microcystis* in the reservoirs and watersheds upstream
41 of the Delta are not expected, relative to Existing Conditions. Operations and maintenance occurring
42 under Alternative 5 is not expected to change nutrient levels in upstream reservoirs or
43 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
44 conducive to *Microcystis* production.

1 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
2 expected to increase under Alternative 5, resulting in an increase in the frequency, magnitude and
3 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
4 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
5 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
6 throughout the Delta during the summer and fall bloom period, due in small part to climate change
7 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
8 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
9 production expected within any Delta sub-region is unknown because conditions will vary across
10 the complex networks of intertwining channels, shallow back water areas, and submerged islands
11 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
12 to Alternative 5. Consequently, it is possible that increases in the frequency, magnitude, and
13 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
14 maintenance of Alternative 5 and the hydrodynamic impacts of restoration (CM2 and CM4).

15 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
16 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
17 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
18 Under Alternative 5, relative to Existing Conditions, the potential for *Microcystis* to occur in the
19 Export Service Area is expected to increase due to increasing water temperature, but this impact is
20 driven entirely by climate change and not Alternative 5. Water exported from the Delta to the Export
21 Service Area is expected to be a mixture of *Microcystis*-affected source water from the south Delta
22 intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
23 determined whether operations and maintenance under Alternative 5, relative to existing
24 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
25 of source waters exported from Banks and Jones pumping plants.

26 Based on the above, this alternative would not be expected to cause additional exceedance of
27 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
28 would cause significant impacts on any beneficial uses of waters in the affected environment.
29 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
30 increases that could occur in some areas would not make any existing *Microcystis* impairment
31 measurably worse because no such impairments currently exist. However, because it is possible that
32 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
33 occur due to the operations and maintenance of Alternative 5 and the hydrodynamic impacts of
34 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
35 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
36 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
37 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
38 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
39 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
40 the effects on *Microcystis* from implementing CM1 is determined to be significant.

41 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
42 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
43 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
44 remain significant and unavoidable.

1 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 2 ***Microcystis* Blooms**

3 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

4 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 5 **Water Residence Time**

6 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

7 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 8 **Measures (CM2–CM21)**

9 The effects of CM2–CM21 on *Microcystis* under Alternative 5 would be the same as those discussed
 10 for Alternative 1A. In summary, potential environmental effects related to CM2 and CM4 could result
 11 in an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta,
 12 relative to Existing Conditions and the No Action Alternative, as a result of increased residence times
 13 for Delta waters from implementing CM2 and CM4 restoration areas. Because the hydrodynamic
 14 effects associated with implementing CM2 and CM4 were incorporated into the modeling used to
 15 assess CM1, a detailed assessment of the effects of implementing CM2 and CM4 on *Microcystis*
 16 blooms in the Delta via their effects on Delta water residence time is provided under CM1 (above).
 17 The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation of Mitigation
 18 Measures WQ-32a. The effectiveness of the mitigation measure to result in feasible measures for
 19 reducing water quality effects is uncertain. CM3 and CM5–CM21 would not result in an increase in
 20 the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta.

21 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 5 would be the same as those
 22 discussed for Alternative 1A and are considered to be adverse.

23 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
 24 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 25 extent that would cause significant impacts on any beneficial uses of waters in the affected
 26 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 27 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 28 impairment measurably worse because no such impairments currently exist. However, microcystin
 29 is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 30 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 31 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 32 would, in turn, pose health risks to fish, wildlife or humans. Because restoration actions
 33 implemented under CM2 and CM4 will increase residence time throughout the Delta and create local
 34 areas of warmer water during the bloom season, it is possible that increases in the frequency,
 35 magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water quality
 36 degradation and significant impacts on beneficial uses, could occur. Although there is considerable
 37 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 38 determined to be significant.

39 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 40 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 41 measures for reducing water quality effects is uncertain, this impact is considered to remain
 42 significant and unavoidable.

1 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 2 ***Microcystis* Blooms**

3 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

4 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 5 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

6 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 7 that Alternative 5 would have a less than significant impact/no adverse effect on the following
 8 constituents in the Delta:

- 9 • Boron
- 10 • DO
- 11 • Pathogens
- 12 • Pesticides
- 13 • Trace Metals
- 14 • Turbidity and TSS

15 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 16 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 17 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 18 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 19 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 20 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 21 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 22 quality of the of San Francisco Bay.

23 The effects of Alternative 5 on bromide, chloride, and DOC, in the Delta were determined to be
 24 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 25 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 26 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 27 adversely effect any beneficial uses of San Francisco Bay.

28 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
 29 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
 30 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
 31 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
 32 which would be the primary driver of salinity changes, would be two to three orders of magnitude
 33 lower than (and thus minimal compared to) the Bay's tidal flow.

34 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
 35 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
 36 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
 37 Suisun Bay.

38 While effects of Alternative 5 on the nutrients ammonia, nitrate, and phosphorus were determined
 39 to be less than significant/not adverse, these constituents are addressed further below because the
 40 response of the seaward bays to changed nutrient concentrations/loading may differ from the

1 response of the Delta. Selenium and mercury are discussed further, because they are
2 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
3 and exports are of concern.

4 ***Nutrients: Ammonia, Nitrate, and Phosphorus***

5 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 5 would be
6 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
7 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
8 decrease by 31%, relative to Existing Conditions, and increase by 2%, relative to the No Action
9 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
10 Suisun and San Pablo Bays under Alternative 5 would not adversely impact primary productivity in
11 these embayments because light limitation and grazing currently limit algal production in these
12 embayments. To the extent that algal growth increases in relation to a change in ammonia
13 concentration, this would have net positive benefits, because current algal levels in these
14 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
15 cyanobacteria levels in the North Bay.

16 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 5 is
17 estimated to increase by 3%, relative to Existing Conditions, and decrease by 2% relative to the No
18 Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus
19 loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary
20 productivity. However, there is uncertainty regarding the impact of nutrient ratios on
21 phytoplankton community composition and abundance. Any effect on phytoplankton community
22 composition would likely be small compared to the effects of grazing from introduced clams and
23 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
24 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
25 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
26 would result in adverse effects to beneficial uses.

27 ***Mercury***

28 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
29 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
30 are estimated to change relatively little due to changes in source water fractions and net Delta
31 outflow that would occur under Alternative 5. Mercury load to the Bay is estimated to increase by 3
32 kg/year (1%), relative to Existing Conditions, and be unchanged relative to the No Action
33 Alternative. Methylmercury load is estimated to increase by 0.06 kg/year (2%), relative to Existing
34 Conditions, and decrease by 0.03 kg/year (1%) relative to the No Action Alternative. The estimated
35 total mercury load to the Bay is 263 kg/year, which would be less than the San Francisco Bay
36 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
37 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
38 term average net Delta outflow and the long-term average mercury and methylmercury
39 concentrations in Delta source waters. The estimated changes in mercury load under the alternative
40 would also be substantially less than the considerable differences among estimates in the current
41 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
42 David et al. 2009).

43 Given that the estimated incremental increases of mercury and methylmercury loading to San
44 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load

1 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
 2 Francisco Bay due to Alternative 5 are not expected to result in adverse effects to beneficial uses or
 3 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
 4 303(d) impairment measurably worse.

5 **Selenium**

6 Changes in source water fraction and net Delta outflow under Alternative 5, relative to Existing
 7 Conditions, are projected to cause the total selenium load to the North Bay to increase by 4%,
 8 relative to Existing Conditions, and increase by 1%, relative to the No Action Alternative (Appendix
 9 80, *San Francisco Bay Analysis*, Table O-3). Changes in long-term average selenium concentrations of
 10 the North Bay are assumed to be proportional to changes in North Bay selenium loads. Under
 11 Alternative 5, the long-term average total selenium concentration of the North Bay is estimated to be
 12 0.13 µg/L and the dissolved selenium concentration is estimated to be 0.11 µg/L, which would be the
 13 same as Existing Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved
 14 selenium concentration would be below the target of 0.202 µg/L developed by Presser or Luoma
 15 (2013) to coincide with a white sturgeon whole-body fish tissue selenium concentration not greater
 16 than 8 mg/kg in the North Bay. The incremental increase in dissolved selenium concentrations in
 17 the North Bay, relative to Existing Conditions, would be negligible (0.00 µg/L) under this alternative.
 18 Thus, the estimated changes in selenium loads in Delta exports to San Francisco Bay due to
 19 Alternative 5 are not expected to result in adverse effects to beneficial uses or substantially degrade
 20 the water quality with regard to selenium, or make the existing CWA Section 303(d) impairment
 21 measurably worse.

22 **NEPA Effects:** Based on the discussion above, Alternative 5, relative to the No Action Alternative,
 23 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
 24 DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia, nitrate, phosphorus), trace
 25 metals, or turbidity and TSS in the San Francisco Bay. Further, changes in these constituent
 26 concentrations in Delta outflow would not be expected to cause changes in Bay concentrations of
 27 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses. In
 28 summary, based on the discussion above, effects on the San Francisco Bay from implementation of
 29 CM1–CM21 are considered to be not adverse.

30 **CEQA Conclusion:** Based on the above, Alternative 5 would not be expected to cause long-term
 31 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
 32 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
 33 would result in substantially increased risk for adverse effects to one or more beneficial uses.
 34 Further, based on the above, this alternative would not be expected to cause additional exceedance
 35 of applicable water quality objectives/criteria in the San Francisco Bay by frequency, magnitude,
 36 and geographic extent that would cause significant impacts on any beneficial uses of waters in the
 37 affected environment. Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay
 38 would not adversely affect beneficial uses, because the uses most affected by changes in these
 39 parameters, MUN and AGR, are not beneficial uses of the Bay. Further, no substantial changes in DO,
 40 pathogens, pesticides, trace metals or turbidity or TSS are anticipated in the Delta, relative to
 41 Existing Conditions, therefore, no substantial changes these constituents levels in the Bay are
 42 anticipated. Changes in Delta salinity would not contribute to measurable changes in Bay salinity, as
 43 the change in Delta outflow would two to three orders of magnitude lower than (and thus minimal
 44 compared to) the Bay's tidal flow. Adverse changes in *Microcystis* levels that could occur in the Delta
 45 would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis* are intolerant of the

1 Bay's high salinity and, thus not have not been detected downstream of Suisun Bay. The 31%
 2 decrease in total nitrogen load and 3% increase in phosphorus load, relative to Existing Conditions,
 3 are expected to have minimal effect on water quality degradation, primary productivity, or
 4 phytoplankton community composition. The estimated increase in mercury load (3 kg/year; 1%)
 5 and methylmercury load (0.06 kg/year; 2%), relative to Existing Conditions, is within the level of
 6 uncertainty in the mass load estimate and not expected to contribute to water quality degradation,
 7 make the CWA section 303(d) mercury impairment measurably worse or cause
 8 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
 9 turn, pose substantial health risks to fish, wildlife, or humans. The estimated increase in selenium
 10 load would be 4%, but estimated total and dissolved selenium concentrations under this alternative
 11 would be the same as Existing Conditions, and less than the target associated with white sturgeon
 12 whole-body fish tissue levels for the North Bay. Thus, the small increase in selenium load is not
 13 expected to contribute to water quality degradation, or make the CWA section 303(d) selenium
 14 impairment measurably worse or cause selenium to bioaccumulate to greater levels in aquatic
 15 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. This impact
 16 is considered to be less than significant.

17 **8.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and** 18 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

19 Alternative 6A would comprise physical/structural components similar to those under Alternative
 20 1A with the principal exception that Alternative 6A would be an “isolated” conveyance, no longer
 21 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 22 Forebay and Jones Pumping Plant. Alternative 6A would convey up to 15,000 cfs of water from the
 23 north Delta to the south Delta through pipelines/tunnels from five screened intakes (i.e., Intakes 1
 24 through 5) on the east bank of the Sacramento River between Clarksburg and Walnut Grove.
 25 Alternative 6A would include a 750-acre intermediate forebay and pumping plant. A new 600-acre
 26 Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which
 27 would provide water to the south Delta pumping plants. However, this. Water supply and
 28 conveyance operations would follow the guidelines described as Scenario D, which includes Fall X2.
 29 CM2–CM21 would be implemented under this alternative, and would be the same as those under
 30 Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.11, for additional details on
 31 Alternative 6A.

32 **Effects of the Alternative on Delta Hydrodynamics**

33 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
 34 substantially affect water quality within the Delta:

- 35 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
 36 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
 37 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
 38 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
 39 decreased exports of San Joaquin River water (due to increased Sacramento River water
 40 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
 41 also can affect water residence time and many related physical, chemical, and biological
 42 variables.

- 1 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
2 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
3 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
4 and above normal water years) will decrease levels of these constituents, particularly in the
5 west Delta.

6 The primary differences between Alternative 6A and Alternative 1A are that all of the Delta exports
7 would be via the north Delta diversion intakes, with none through the existing south Delta intakes,
8 and operations include the meeting of Fall X2.

9 Under Alternative 6A, over the long term, average annual delta exports are anticipated to decrease
10 by 1,386 TAF relative to Existing Conditions, and by 682 TAF relative to the No Action Alternative.
11 All of the exported water will be from the new north Delta intakes, and none of the diversions would
12 be from the existing south Delta intakes (see Chapter 5, *Water Supply*, for more information). The
13 result of this is greatly increased San Joaquin River water influence throughout the south, west, and
14 interior Delta, and a corresponding decrease in Sacramento River water influence. This can be seen,
15 for example, in Appendix 8D, ALT 6–Old River at Rock Slough for ALL years (1976–1991), which
16 shows increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC)
17 percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

18 Under Alternative 6A, long-term average annual Delta outflow is anticipated to increase 1,383 TAF
19 relative to Existing Conditions, due to both changes in operations (including north Delta intake
20 capacity of 15,000 cfs and numerous other components of Operational Scenario D) and climate
21 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this would
22 be decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
23 Delta under Alternative 6A would be greater relative to Existing Conditions because Existing
24 Conditions do not include operations to meet Fall X2, whereas the No Action Alternative and
25 Alternative 6A do. Long-term average annual Delta outflow is anticipated to increase under
26 Alternative 6A by 633 TAF relative to the No Action Alternative, due only to changes in operations.
27 The decreases in sea water intrusion (represented by an decrease in San Francisco Bay (BAY)
28 percentage) can be seen, for example, in Appendix 8D, ALT 6A–Sacramento River at Mallard Island
29 for ALL years (1976–1991).

30 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 31 **Maintenance (CM1)**

32 ***Upstream of the Delta***

33 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
34 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
35 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
36 concentrations that could occur in the water bodies of the affected environment located upstream of
37 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
38 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
39 ammonia.

40 ***Delta***

41 Assessment of effects of ammonia under Alternative 6A is the same as discussed under Alternative
42 1A, except that because flows in the Sacramento River at Freeport are different between the two

1 alternatives, estimated monthly average and long term annual average predicted ammonia-N
2 concentrations in the Sacramento River downstream of Freeport are different.

3 As Table 8-69 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
4 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 6A and the
5 No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations
6 would occur during January through April, and July through December, and remaining months
7 would be unchanged. A minor increase in the annual average concentration would occur under
8 Alternative 6A, compared to the No Action Alternative. Moreover, the estimated concentrations
9 downstream of Freeport under Alternative 6A would be similar to existing source water
10 concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source
11 water fraction anticipated under Alternative 6A, relative to the No Action Alternative, are not
12 expected to substantially increase ammonia concentrations at any Delta locations.

13 **Table 8-69. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
14 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative**
15 **6A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 6A	0.075	0.086	0.070	0.061	0.058	0.061	0.059	0.064	0.067	0.062	0.068	0.066	0.066

16
17 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
18 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
19 beneficial uses or substantially degrade the water quality at these locations, with regards to
20 ammonia.

21 ***SWP/CVP Export Service Areas***

22 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
23 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
24 Alternative 1A, under Alternative 6A for areas of the Delta that are influenced by Sacramento River
25 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
26 decrease, relative to Existing Conditions (in association with diversion of water not influenced by
27 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
28 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
29 quality of exported water, with regards to ammonia.

30 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
31 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
32 under Alternative 6A, relative to No Action Alternative. Any negligible increases in ammonia-N
33 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
34 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
35 degrade the water quality at these locations, with regards to ammonia.

36 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
37 of CM1 are considered to be not adverse.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 3 purpose of making the CEQA impact determination for this constituent. For additional details on the
 4 effects assessment findings that support this CEQA impact determination, see the effects assessment
 5 discussion that immediately precedes this conclusion.

6 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 7 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 8 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 9 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 10 any modified reservoir operations and subsequent changes in river flows under Alternative 6A,
 11 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 12 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 13 of the Delta in the San Joaquin River watershed.

14 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 15 substantially lower under Alternative 6A, relative to Existing Conditions, due to upgrades to the
 16 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 17 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 18 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 19 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 20 either of these concentrations.

21 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 22 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 23 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 24 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 6A,
 25 relative to Existing Conditions.

26 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 27 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 28 CVP and SWP service areas under Alternative 6A relative to Existing Conditions. As such, this
 29 alternative is not expected to cause additional exceedance of applicable water quality objectives/
 30 criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any
 31 beneficial uses of waters in the affected environment. Because ammonia concentrations are not
 32 expected to increase substantially, no long-term water quality degradation is expected to occur and,
 33 thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 34 affected environment and thus any minor increases that could occur in some areas would not make
 35 any existing ammonia-related impairment measurably worse because no such impairments
 36 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 37 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 38 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 39 significant. No mitigation is required.

40 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2-** 41 **CM21**

42 **NEPA Effects:** Effects of CM2–CM21 on ammonia under Alternative 6A would be the same as those
 43 discussed for Alternative 1A and are considered to be not adverse.

1 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 2 measures proposed under Alternative 1A. As such, effects on ammonia resulting from the
 3 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 4 This impact is considered to be less than significant. No mitigation is required.

5 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 Effects of CM1 on boron under Alternative 6A in areas upstream of the Delta would be very similar
 9 to the effects discussed for Alternative 1A. There would be no expected change to the sources of
 10 boron in the Sacramento and eastside tributary watersheds, and resultant changes in flows from
 11 altered system-wide operations would have negligible, if any, effects on the concentration of boron
 12 in the rivers and reservoirs of these watersheds. The modeled long-term annual average lower San
 13 Joaquin River flow at Vernalis would decrease slightly compared to Existing Conditions (in
 14 association with project operations, climate change, and increased water demands) and would be
 15 similar compared to the No Action Alternative considering only changes due to Alternative 6A
 16 operations. The reduced flow would result in possible increases in long-term average boron
 17 concentrations of up to about 3% relative to Existing Conditions (Appendix 8F, *Boron*, Table Bo-32).
 18 The increased boron concentrations would not increase the frequency of exceedances of any
 19 applicable objectives or criteria and would not be expected to cause further degradation at
 20 measurable levels in the lower San Joaquin River, and thus would not cause the existing impairment
 21 there to be discernibly worse. Consequently, Alternative 6A would not be expected to cause
 22 exceedance of boron objectives/criteria or substantially degrade water quality with respect to
 23 boron, and thus would not adversely affect any beneficial uses of the Sacramento River, the eastside
 24 tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

25 ***Delta***

26 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 27 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 28 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 29 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 30 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 31 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 32 information.

33 Relative to the Existing Conditions and No Action Alternative, Alternative 6A would result in
 34 generally widespread increased long-term average boron concentrations for the 16-year period
 35 modeled at the interior and western Delta locations (by as much as 14% at the SF Mokelumne River
 36 at Staten Island, 4% at the San Joaquin River at Buckley Cove, 43% at Franks Tract, and 74% at Old
 37 River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-16). The comparison to Existing Conditions
 38 reflects changes due to both Alternative 6A operations (including north Delta intake capacity of
 39 15,000 cfs and numerous other components of Operational Scenario D) and climate change/sea
 40 level rise. The comparison to the No Action Alternative reflects changes due only to operations.

41 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
 42 concentrations at western Delta assessment locations (more discussion of this phenomenon is
 43 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural

1 diversions which occur primarily at interior Delta locations. The long-term annual average and
 2 monthly average boron concentrations, for either the 16-year period or drought period modeled,
 3 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
 4 agricultural objective at any of the eleven Delta assessment locations, which represents no change
 5 from the Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-3A). The
 6 increased concentrations at interior Delta locations would result in moderate reductions in the long-
 7 term average assimilative capacity of up to 21% at Franks Tract and up to 43% at Old River at Rock
 8 Slough locations (Appendix 8F, *Boron*, Table Bo-17). However, because the absolute boron
 9 concentrations would still be well below the lowest 500 µg/L objective for the protection of the
 10 agricultural beneficial use under Alternative 6A, the levels of boron degradation would not be of
 11 sufficient magnitude to substantially increase the risk of exceeding objectives or cause adverse
 12 effects to municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the
 13 Delta (Appendix 8F, Figure Bo-4).

14 ***SWP/CVP Export Service Areas***

15 Effects of CM1 on boron under Alternative 6A in the Delta would be similar to the effects discussed
 16 for Alternative 1A. Under Alternative 6A, long-term average boron concentrations would decrease
 17 by as much as 56% at the Banks Pumping Plant and by as much 63% at Jones Pumping Plant relative
 18 to Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-16) as a result of
 19 export of a greater proportion of low-boron Sacramento River water. Commensurate with the
 20 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
 21 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
 22 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
 23 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
 24 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
 25 Joaquin River and associated TMDL actions for reducing boron loading.

26 Maintenance of SWP and CVP facilities under Alternative 6A would not be expected to create new
 27 sources of boron or contribute towards a substantial change in existing sources of boron in the
 28 affected environment. Maintenance activities would not be expected to cause any substantial
 29 increases in boron concentrations or degradation with respect to boron such that objectives would
 30 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
 31 affected environment.

32 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 6 would
 33 result in relatively small long-term average increases in boron levels in the San Joaquin River and
 34 moderate increases in the interior and western Delta locations Delta. However, the predicted
 35 changes in the Delta would not be expected to result in exceedances of applicable objectives or
 36 further water quality degradation such that objectives would likely be exceeded or there would be
 37 substantially increased risk of adverse effects on water quality.

38 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 39 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 40 purpose of making the CEQA impact determination for this constituent. For additional details on the
 41 effects assessment findings that support this CEQA impact determination, see the effects assessment
 42 discussion that immediately precedes this conclusion.

43 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
 44 river flow rate and reservoir storage reductions that would occur under the Alternative 6, relative to

1 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
 2 Additionally, relative to Existing Conditions, Alternative 6A would not result in reductions in river
 3 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
 4 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

5 Moderate increased boron levels (i.e., up to 75% increased concentration) and degradation
 6 predicted for interior and western Delta locations in response to a shift in the Delta source water
 7 percentages and tidal habitat restoration under this alternative would not be expected to cause
 8 exceedances of objectives. Alternative 6A maintenance also would not result in any substantial
 9 increases in boron concentrations in the affected environment. Boron concentrations would be
 10 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
 11 potential improvement to boron loading in the lower San Joaquin River.

12 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 6A
 13 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 14 Existing Conditions, Alternative 6A would not result in substantially increased boron concentrations
 15 such that frequency of exceedances of municipal and agricultural water supply objectives would
 16 increase. The levels of boron degradation that may occur under Alternative 6A, while widespread in
 17 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
 18 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
 19 environment. Long-term average boron concentrations would decrease in Delta water exports to the
 20 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
 21 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 6A would not
 22 be expected to cause any substantial increases in boron concentrations or degradation with respect
 23 to boron such that objectives would be exceeded more frequently, or any beneficial uses would be
 24 adversely affected anywhere in the affected environment. Based on these findings, this impact is
 25 determined to be less than significant. No mitigation is required.

26 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

27 **NEPA Effects:** Effects of CM2–CM21 on boron under Alternative 6A would be the same as those
 28 discussed for Alternative 1A and are determined to be not adverse.

29 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 30 measures proposed under Alternative 1A. As such, effects on boron resulting from the
 31 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 32 This impact is considered to be less than significant. No mitigation is required.

33 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 34 **Maintenance (CM1)**

35 ***Upstream of the Delta***

36 Under Alternative 6A there would be no expected change to the sources of bromide in the
 37 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
 38 unchanged and resultant changes in flows from altered system-wide operations under Alternative
 39 6A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
 40 of these watersheds. Consequently, Alternative 6A would not be expected to adversely affect the
 41 MUN beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or
 42 their associated reservoirs upstream of the Delta.

1 Under Alternative 6A, modeling indicates that long-term annual average flows on the San Joaquin
 2 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
 3 relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 4 *Technical Appendix*). These decreases in flow would result in possible increases in long-term average
 5 bromide concentrations of about 3%, relative to Existing Conditions and less than <1% relative to
 6 the No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower San
 7 Joaquin River bromide levels that could occur under Alternative 6A, relative to existing and the No
 8 Action Alternative conditions would not be expected to adversely affect the MUN beneficial use, or
 9 any other beneficial uses, of the lower San Joaquin River.

10 **Delta**

11 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 12 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 13 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 14 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 15 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 16 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 17 information.

18 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
 19 Conditions, Alternative 6A would result in increases in long-term average bromide concentrations at
 20 Staten Island and Barker Slough, while long-term average concentrations would decrease at the
 21 other assessment locations (Appendix 8E, *Bromide*, Table 14). At Barker Slough, predicted long-term
 22 average bromide concentrations would increase from 51 µg/L to 61 µg/L (19% relative increase)
 23 for the modeled 16-year hydrologic period and would increase from 54 µg/L to 92 µg/L (73%
 24 relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L
 25 exceedance frequency would decrease from 49% under Existing Conditions to 38% under
 26 Alternative 6A, but would increase from 55% to 63% during the drought period. At Barker Slough,
 27 the predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to
 28 17% under Alternative 6A, and would increase from 0% to 37% during the drought period. At
 29 Staten Island, predicted long-term average bromide concentrations would increase from 50 µg/L to
 30 70 µg/L (41% relative increase) for the modeled 16-year hydrologic period and would increase
 31 from 51 µg/L to 70 µg/L (37% relative increase) for the modeled drought period. At Staten Island,
 32 increases in average bromide concentrations would correspond to an increased frequency of 50 µg/L
 33 threshold exceedance, from 47% under Existing Conditions to 85% under Alternative 6A (52% to
 34 88% for the modeled drought period), and an increase from 1% to 10% (0% to 5% for the modeled
 35 drought period) for the 100 µg/L threshold. Changes in exceedance frequency of the 50 µg/L and
 36 100 µg/L concentration thresholds at other assessment locations would be less considerable. This
 37 comparison to Existing Conditions reflects changes in bromide due to both Alternative 6A
 38 operations (including north Delta intake capacity of 15,000 cfs and numerous other components of
 39 Operational Scenario D) and climate change/sea level rise.

40 Due to the relatively small differences between modeled Existing Conditions and No Action
 41 baselines, changes in long-term average bromide concentrations and changes in exceedance
 42 frequencies relative to the No Action Alternative would be generally of similar magnitude to those
 43 previously described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 14).
 44 Modeled long-term average bromide concentration increases at Barker Slough are predicted to
 45 increase by 22% (72% for the modeled drought period) relative to the No Action Alternative.

1 Modeled long-term average bromide concentration increases at Staten Island are predicted to
2 increase by 45% (41% for the modeled drought period) relative to the No Action Alternative.
3 However, unlike the Existing Conditions comparison, long-term average bromide concentrations at
4 Buckley Cove would increase relative to the No Action Alternative, although the increases would be
5 relatively small ($\leq 4\%$). Unlike the comparison to Existing Conditions, this comparison to the No
6 Action Alternative reflects changes in bromide due only to Alternative 6A operations.

7 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
8 conditions are very similar (Appendix 8E, *Bromide*, Table 14). Such similarity demonstrates that the
9 modeled Alternative 6A change in bromide is almost entirely due to Alternative 6A operations, and
10 not climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide
11 at Barker Slough, regardless whether Alternative 6A is compared to Existing Conditions, or
12 compared to the No Action Alternative.

13 Results of the modeling approach which used relationships between EC and chloride and between
14 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
15 mass-balance approach (see Appendix 8E, *Bromide*, Table 15). For most locations, the frequency of
16 exceedance of the 50 $\mu\text{g/L}$ and 100 $\mu\text{g/L}$ were similar. The greatest difference between the methods
17 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 $\mu\text{g/L}$
18 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
19 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
20 that presented above from the mass-balance modeling approach. However, there were still
21 substantial increases, resulting in 6% exceedance over the modeled period under Alternative 6A, as
22 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
23 period, exceedance frequency increased from 0% under Existing Conditions and the No Action
24 Alternative, to 17% under Alternative 6A. Because the mass-balance approach predicts a greater
25 level of impact at Barker Slough, determination of impacts was based on the mass-balance results.

26 The increase in long-term average bromide concentrations predicted at Barker Slough, principally
27 the relative increase in 100 $\mu\text{g/L}$ exceedance frequency, would result in a substantial change in
28 source water quality for existing drinking water treatment plants drawing water from the North Bay
29 Aqueduct. As discussed for Alternative 1A, drinking water treatment plants obtaining water via the
30 North Bay Aqueduct utilize a variety of conventional and enhanced treatment technologies in order
31 to achieve DBP drinking water criteria. While the implications of such a modeled change in bromide
32 at Barker Slough are difficult to predict, the substantial modeled increases could lead to adverse
33 changes in the formation of disinfection byproducts such that considerable treatment plant
34 upgrades may be necessary in order to achieve equivalent levels of health protection. Increases at
35 Staten Island are also considerable, although there are no existing or foreseeable municipal intakes
36 in the immediate vicinity. Because many of the other modeled locations already frequently exceed
37 the 100 $\mu\text{g/L}$ threshold under Existing Conditions and the No Action Alternative, these locations
38 likely already require treatment plant technologies to achieve equivalent levels of health protection,
39 and thus no additional treatment technologies would be triggered by the small increases in the
40 frequency of exceeding the 100 $\mu\text{g/L}$ threshold. Hence, no further impact on the drinking water
41 beneficial use would be expected at these locations.

42 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
43 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
44 locations is in excess of 3,000 $\mu\text{g/L}$, but during seasonal periods of high Delta outflow can be <300
45 $\mu\text{g/L}$. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard

1 Slough and City of Antioch under Alternative 6A would experience a period average increase in
2 bromide during the months when these intakes would most likely be utilized. For those wet and
3 above normal water year types where mass balance modeling would predict water quality typically
4 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 162
5 µg/L (58% increase) at City of Antioch and would increase from 150 µg/L to 199 µg/L (33%
6 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
7 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
8 to chloride and chloride to bromide relationships show increases during these months, but the
9 relative magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of
10 the differences in the data between the two modeling approaches, the decisions surrounding the use
11 of these seasonal intakes is largely driven by acceptable water quality, and thus have historically
12 been opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
13 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
14 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

15 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
16 conditions, Alternative 6A would lead to predicted improvements in long-term average bromide
17 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
18 Jones (discussed below). At these locations, long-term average bromide concentrations would be
19 predicted to decrease by as much as 41–61%, depending on baseline comparison. Modeling results
20 using the EC to chloride and chloride to bromide relationships generally do not show similar
21 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
22 the small magnitude of increases predicted, these increases would not adversely affect beneficial
23 uses at those locations.

24 Important to the results presented above is the assumed habitat restoration footprint on both the
25 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
26 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
27 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
28 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
29 deviations from modeled habitat restoration and implementation schedule will lead to different
30 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
31 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
32 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
33 management changes to BDCP restoration activities, including location, magnitude, and timing of
34 restoration, the estimates are not predictive of the bromide levels that would actually occur in
35 Barker Slough or elsewhere in the Delta.

36 ***SWP/CVP Export Service Areas***

37 Under Alternative 6A, improvement in long-term average bromide concentrations would occur at
38 the Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled
39 16-year hydrologic period at these locations would decrease by as much as 96% relative to Existing
40 Conditions and the No Action Alternative (Appendix 8E, *Bromide*, Table 14). As a result, exceedances
41 of the 50 µg/L and 100 µg/L assessment thresholds would be completely eliminated, resulting in
42 considerable overall improvement in Export Service Areas water quality respective to bromide.
43 Commensurate with the decrease in exported bromide, an improvement in lower San Joaquin River
44 bromide would also be observed since bromide in the lower San Joaquin River is principally related
45 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San

1 Joaquin River improvement in bromide is difficult to predict, the relative decrease in overall loading
2 of bromide to the Export Service Areas would likely alleviate or lessen any expected increase in
3 bromide concentrations at Vernalis (see discussion of Upstream of the Delta) as well as locations in
4 the Delta receiving a large fraction of San Joaquin River water, such as much of the south Delta.

5 The discussion above is based on results of the mass-balance modeling approach. Results of the
6 modeling approach which used relationships between EC and chloride and between chloride and
7 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
8 using these data results in the same conclusions as are presented above for the mass-balance
9 approach (see Appendix 8E, *Bromide*, Table 15).

10 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
11 facilities under Alternative 6A would not be expected to create new sources of bromide or
12 contribute towards a substantial change in existing sources of bromide in the affected environment.
13 Maintenance activities would not be expected to cause any substantial change in bromide such that
14 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
15 affected environment.

16 **NEPA Effects:** In summary, Alternative 6A operations and maintenance, relative to the No Action
17 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
18 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
19 However, Alternative 6A operation and maintenance activities would cause substantial degradation
20 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
21 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
22 changes in water treatment plant operations or require treatment plant upgrades in order to
23 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
24 Measure WQ-5 is available to reduce these effects. Implementation of this measure along with a
25 separate other commitment as set forth in Appendix 3B, *Environmental Commitments, AMMs, and*
26 *CMs*, relating to the potential increased treatment costs associated with bromide-related changes
27 would reduce these effects.

28 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
29 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
30 purpose of making the CEQA impact determination for this constituent. For additional details on the
31 effects assessment findings that support this CEQA impact determination, see the effects assessment
32 discussion that immediately precedes this conclusion.

33 Under Alternative 6A there would be no expected change to the sources of bromide in the
34 Sacramento and eastside tributary watersheds. Bromide loading in these watersheds would remain
35 unchanged and resultant changes in flows from altered system-wide operations under Alternative
36 6A would have negligible, if any, effects on the concentration of bromide in the rivers and reservoirs
37 of these watersheds. However, south of the Delta, the San Joaquin River is a substantial source of
38 bromide, primarily due to the use of irrigation water imported from the southern Delta.
39 Concentrations of bromide at Vernalis are inversely correlated to net river flow. Under Alternative
40 6A, long-term average flows at Vernalis would decrease only slightly, resulting in less than
41 substantial predicted increases in long-term average bromide of about 3% relative to Existing
42 Conditions.

43 Relative to Existing Conditions, Alternative 6A would result in substantial increases in long-term
44 average bromide concentration at Barker Slough and Staten Island. There are no existing or

1 foreseeable municipal drinking water intakes in the vicinity of Staten Island, but Barker Slough is
2 the source of the North Bay Aqueduct. The increase in long-term average bromide concentrations
3 predicted for Barker Slough would result in a substantial change in source water quality to existing
4 drinking water treatment plants drawing water from the North Bay Aqueduct. These modeled
5 increases in bromide at Barker Slough could lead to adverse changes in the formation of disinfection
6 byproducts at drinking water treatment plants such that considerable water treatment plant
7 upgrades would be necessary in order to achieve equivalent levels of drinking water health
8 protection.

9 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
10 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 6A,
11 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
12 long-term average bromide concentrations are predicted to decrease by as much as 96% relative to
13 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
14 in the SWP/CVP Export Service Areas.

15 Based on the above, Alternative 6A operation and maintenance would not result in any substantial
16 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
17 Alternative 6A, water exported from the Delta to the SWP/CVP service area would be substantially
18 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
19 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
20 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 6A
21 operation and maintenance activities would not cause substantial long-term degradation to water
22 quality respective to bromide with the exception of water quality at Barker Slough and at Staten
23 Island in the eastern Delta. There are no existing or foreseeable municipal intakes in the vicinity of
24 Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At Barker Slough, modeled
25 long-term annual average concentrations of bromide would increase by 19%, and 73% during the
26 modeled drought period. For the modeled 16-year hydrologic period the frequency of predicted
27 bromide concentrations exceeding 100 µg/L would increase from 0% under Existing Conditions to
28 17% under Alternative 6A, while for the modeled drought period, the frequency would increase
29 from 0% to 37%. Substantial changes in long-term average bromide could necessitate changes in
30 treatment plant operation or require treatment plant upgrades in order to maintain DBP
31 compliance. The model predicted change at Barker Slough is substantial and, therefore, would
32 represent a substantially increased risk for adverse effects on existing MUN beneficial uses should
33 treatment upgrades not be undertaken. The impact is considered significant.

34 Implementation of Mitigation Measure WQ-5 along with a separate other commitment relating to
35 the potential increased treatment costs associated with bromide-related changes would reduce
36 these effects. While mitigation measures to reduce these water quality effects in affected water
37 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
38 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
39 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
40 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
41 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
42 discussion of Alternative 1A.

43 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
44 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
45 separate other commitment to address the potential increased water treatment costs that could

1 result from bromide-related concentration effects on municipal water purveyor operations.
 2 Potential options for making use of this financial commitment include funding or providing other
 3 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
 4 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
 5 water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that
 6 could be taken pursuant to this commitment in order to reduce the water quality treatment costs
 7 associated with water quality effects relating to chloride, electrical conductivity, and bromide.

8 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 9 **Conditions**

10 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

11 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 12 **CM21**

13 **NEPA Effects:** CM2–CM21 proposed under Alternative 6A would be the same as those proposed
 14 under Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–CM21 would not
 15 present new or substantially changed sources of bromide to the study area. Some conservation
 16 measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement
 17 or substitution is not expected to substantially increase or present new sources of bromide. CM2–
 18 CM21 would not be expected to cause any substantial change in bromide such that MUN beneficial
 19 uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

20 In summary, implementation of CM2–CM21 under Alternative 6A, relative to the No Action
 21 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 22 from implementing CM2–CM21 are determined to not be adverse.

23 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 24 measures proposed under Alternative 1A. As such, effects on bromide resulting from the
 25 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 26 This impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 Under Alternative 6A there would be no expected change to the sources of chloride in the
 31 Sacramento and eastside tributary watersheds. Chloride loading in these watersheds would remain
 32 unchanged and resultant changes in flows from altered system-wide operations would have
 33 negligible, if any, effects on the concentration of chloride in the rivers and reservoirs of these
 34 watersheds. The modeled long-term annual average flows on the lower San Joaquin River at Vernalis
 35 would decrease slightly compared to Existing Conditions and be similar compared to the No Action
 36 Alternative (as a result of climate change). The reduced flow would result in possible increases in
 37 long-term average chloride concentrations of about 2%, relative to the Existing Conditions and no
 38 change relative to No Action Alternative (Appendix 8G, *Chloride*, Table CI-62). Consequently,
 39 Alternative 6A would not be expected to cause exceedance of chloride objectives/criteria or
 40 substantially degrade water quality with respect to chloride, and thus would not adversely affect

1 any beneficial uses of the Sacramento River, the eastside tributaries, associated reservoirs upstream
2 of the Delta, or the San Joaquin River.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
9 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
10 information.

11 Relative to the Existing Conditions and No Action Alternative, the predicted long-term average
12 chloride concentrations under Alternative 6A for the 16-year period modeled would be substantially
13 reduced at most of the assessment locations (Appendix 8G, *Chloride*, Table Cl-37 and Table Cl-38).
14 Moreover, the direction and magnitude of predicted changes for Alternative 6A are similar between
15 the alternatives, thus, the effects relative to Existing Conditions and the No Action Alternative are
16 discussed together. Depending on the modeling approach (see Section 8.3.1.3), the average chloride
17 concentrations would be increased at the North Bay Aqueduct at Barker Slough (i.e., $\leq 15\%$) and SF
18 Mokelumne at Staten Island (i.e., $\leq 37\%$). Additionally, implementation of tidal habitat restoration
19 under CM4 would increase the tidal exchange volume in the Delta, and thus may contribute to
20 increased chloride concentrations in the Bay source water as a result of increased salinity intrusion.
21 More discussion of this phenomenon is included in Section 8.3.1.3. Consequently, while uncertain,
22 the magnitude of chloride increases may be greater than indicated herein and would affect the
23 western Delta assessment locations the most which are influenced to the greatest extent by the Bay
24 source water. The comparison to Existing Conditions reflects changes in chloride due to both
25 Alternative 6A operations (including north Delta intake capacity of 15,000 cfs and numerous other
26 components of Operational Scenario D) and climate change/sea level rise. The comparison to the No
27 Action Alternative reflects changes in chloride due only to operations. The following outlines the
28 modeled chloride changes relative to the applicable objectives and beneficial uses of Delta waters.

29 *Municipal Beneficial Uses*

30 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
31 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
32 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
33 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
34 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
35 Pumping Plant #1 locations. For Alternative 6A, the modeled frequency of objective exceedance
36 would remain unchanged at 7% of years under Existing Conditions and Alternative 6A (Appendix
37 8G, *Chloride*, Table Cl-64). The modeled frequency of objective exceedance would increase from 0%
38 of years under the No Action Alternative to 7% under Alternative 6A. However, the increase was due
39 to a single year, 1977, which fell just short of the required number of days (i.e., was within 9 days
40 minimum number of required days < 150 mg/L). Given the uncertainty in the chloride modeling
41 approach, it is likely that real time operations of the SWP and CVP could achieve compliance with
42 this objective (see Section 8.3.1.1 for a discussion of chloride compliance modeling uncertainties and
43 a description of real time operations of the SWP and CVP).

1 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
2 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
3 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
4 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
5 year period. For Alternative 6A, the modeled frequency of objective exceedance would be
6 eliminated, from 6% of modeled days under Existing Conditions and 5% under the No Action
7 Alternative to 0% of modeled days under Alternative 6A (Appendix 8G, *Chloride*, Table Cl-63).

8 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
9 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
10 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
11 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
12 approach to model monthly average chloride concentrations for the 16-year period, the predicted
13 frequency of exceeding the 250 mg/L objective would be eliminated at the Contra Costa Canal at
14 Pumping Plant #1 (24% for Existing Conditions to 0% for Alternative 6A), thus indicating complete
15 compliance with this objective would be achieved (Appendix 8G, *Chloride*, Table Cl-39 and Figure Cl-
16 9). The frequency of exceedances at the San Joaquin River at Antioch also would decrease compared
17 to all of the alternative scenarios (i.e., 9% from 66% for Existing Conditions to 57%) with no
18 substantial change predicted for Mallard Island (i.e., maximum increase of 1%) (Appendix 8G, Table
19 Cl-39). However, available assimilative capacity would be reduced relative to Existing Conditions in
20 April (i.e., up to 21%) (Appendix 8G, Table Cl-41) reflecting substantial degradation during a month
21 when average concentrations would be near, or exceed, the objective.

22 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
23 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
24 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, *Chloride*, Table
25 Cl-40 and Table Cl-42). Specifically, while the model predicted exceedance frequency would
26 decrease at the Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of
27 assimilative capacity would increase substantially for the months of February through June. (i.e.,
28 maximum of 81% in March for the modeled drought period). Due to such seasonal long-term
29 average water quality degradation at these locations, the potential exists for substantial adverse
30 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
31 water with acceptable chloride levels.

32 *303(d) Listed Water Bodies*

33 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
34 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
35 nearest DSM2-modeled location to Tom Paine in the south Delta, would generally be similar
36 compared to Existing Conditions and No Action Alternative, and thus, would not be further degraded
37 on a long-term basis (Appendix 8G, Figure Cl-10).

38 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
39 modeled would generally increase compared to Existing Conditions and No Action Alternative in
40 some months during October through May at the Sacramento River at Collinsville (Appendix 8G,
41 Figure Cl-11), Mallard Island (Appendix 8G, Figure Cl-9), and increase substantially at Montezuma
42 Slough at Beldon's Landing (i.e., over a doubling of concentration in December through February)
43 (Appendix 8G, Figure Cl-12). Although modeling of Alternative 6A assumed no operation of the
44 Montezuma Slough Salinity Control Gates, the project description assumes continued operation of

1 the Salinity Control Gates, consistent with assumptions included in the No Action Alternative. A
 2 sensitivity analysis modeling run conducted for Alternative 4 with the gates operational consistent
 3 with the No Action Alternative resulted in substantially lower EC levels than indicated in the original
 4 Alternative 4 modeling results for Suisun Marsh, but EC levels were still somewhat higher than EC
 5 levels under Existing Conditions for several locations and months. Although chloride was not
 6 specifically modeled in this sensitivity analysis, it is expected that chloride concentrations would be
 7 nearly proportional to EC levels in Suisun Marsh. Another modeling run with the gates operational
 8 and restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions,
 9 indicating that design and siting of restoration areas has notable bearing on EC levels at different
 10 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
 11 sensitivity analyses). These analyses also indicate that increases in salinity are related primarily to
 12 the hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity
 13 analyses, optimizing the design and siting of restoration areas may limit the magnitude of long-term
 14 chloride increases in the Marsh. However, the chloride concentration increases at certain locations
 15 could be substantial, depending on siting and design of restoration areas. Thus, these increased
 16 chloride levels in Suisun Marsh are considered to contribute to additional, measureable long-term
 17 degradation that potentially would adversely affect the necessary actions to reduce chloride loading
 18 for any TMDL that is developed.

19 ***SWP/CVP Export Service Areas***

20 Under Alternative 6A, long-term average chloride concentrations based on the mass balance
 21 analysis of modeling results for the 16-year period modeled at the Banks and Jones pumping plants
 22 would decrease by approximately 95% relative to Existing Conditions and No Action Alternative
 23 (Appendix 8G, *Chloride*, Table Cl-37). The modeled low-frequency exceedances of objectives present
 24 under the Existing Conditions and No Action Alternative would be eliminated under Alternative 6A
 25 (Appendix 8G, *Chloride*, Table Cl-39). Consequently, water exported into the SWP/CVP service area
 26 would generally be improved with regards to chloride relative to Existing Conditions and No Action
 27 Alternative conditions.

28 Results of the modeling approach which used relationships between EC and chloride (see Section
 29 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
 30 results in the same conclusions as are presented above for the mass-balance approach (Appendix
 31 8G, *Chloride*, Table Cl-38 and Table Cl-40).

32 Commensurate with the reduced chloride concentrations in water exported to the service area,
 33 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
 34 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
 35 San Joaquin River flows (see discussion of Upstream of the Delta).

36 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
 37 contribute towards a substantial change in existing sources of chloride in the affected environment.
 38 Maintenance activities would not be expected to cause any substantial change in chloride such that
 39 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
 40 affected anywhere in the affected environment.

41 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 6A would
 42 result in substantial seasonal use of assimilative capacity at Contra Costa Pumping Plant #1, Antioch,
 43 and Rock Slough, and could result in increased concentrations with respect to the 303(d)
 44 impairment in Suisun Marsh. The predicted chloride increases constitute an adverse effect on water

1 quality (see Mitigation Measure WQ-7; implementation of this measure along with a separate other
2 commitment relating to the potential increased chloride treatment costs would reduce these
3 effects). Additionally, the predicted changes relative to the No Action Alternative conditions indicate
4 that in addition to the effects of climate change/sea level rise, implementation of CM1 and CM4
5 under Alternative 6A would contribute substantially to the adverse water quality effects.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
8 purpose of making the CEQA impact determination for this constituent. For additional details on the
9 effects assessment findings that support this CEQA impact determination, see the effects assessment
10 discussion that immediately precedes this conclusion.

11 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
12 thus river flow rate and reservoir storage reductions that would occur under the Alternative 6A,
13 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
14 chloride levels. Additionally, relative to Existing Conditions, the Alternative 6A would not result in
15 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
16 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
17 watershed.

18 Relative to Existing Conditions, Alternative 6A operations would result in substantially reduced
19 chloride concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP
20 objective at the San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless,
21 due to the substantial seasonal use of assimilative capacity at Contra Costa Pumping Plant #1 and
22 Rock Slough, the potential exists for adverse effects on the municipal and industrial beneficial uses
23 at these locations (see Mitigation Measure WQ-7 below; implementation of this measure along with
24 a separate other commitment relating to the potential increased chloride treatment costs would
25 reduce these effects). Moreover, the modeled increased chloride concentrations and degradation in
26 the western Delta could still occur and further contribute, at measurable levels, to the existing
27 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish and wildlife.
28 Based on these findings, this impact is determined to be significant due to increased degradation
29 relative to the 250 mg/L objective in the western Delta as well as potential increased degradation
30 relative to the 303(d) listing in Suisun Marsh.

31 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
32 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
33 River.

34 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
35 6A would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
36 Alternative 6A maintenance would not result in any substantial changes in chloride concentration
37 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
38 this impact is determined to be significant due to increased chloride concentrations and degradation
39 in Suisun Marsh and its effects on fish and wildlife beneficial uses.

40 While mitigation measures to reduce these water quality effects in affected water bodies to less-
41 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
42 recommended to attempt to reduce the effect that increased chloride concentrations may have on
43 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
44 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain

1 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
2 discussion of Alternative 1A.

3 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
4 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
5 separate other commitment to address the potential increased water treatment costs that could
6 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
7 operations. Potential options for making use of this financial commitment include funding or
8 providing other assistance towards acquiring alternative water supplies or towards modifying
9 existing operations when chloride concentrations at a particular location reduce opportunities to
10 operate existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
11 potential actions that could be taken pursuant to this commitment in order to reduce the water
12 quality treatment costs associated with water quality effects relating to chloride, electrical
13 conductivity, and bromide.

14 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
15 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

16 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

17 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
18 **CM21**

19 **NEPA Effects:** Under Alternative 6A, the types and geographic extent of effects on chloride
20 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
21 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
22 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
23 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
24 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
25 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
26 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
27 discharges of agricultural field drainage with elevated chloride concentrations, which would be
28 considered an improvement compared to No Action Alternative conditions.

29 In summary, based on the discussion above, the effects on chloride from implementing CM2–CM21
30 are considered to be not adverse.

31 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 6A would not present new or
32 substantially changed sources of chloride to the affected environment upstream of the Delta, within
33 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
34 with habitat restoration conservation measures may result in some reduction in discharge of
35 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
36 quality conditions. Based on these findings, this impact is considered to be less than significant. No
37 mitigation is required.

38 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
39 **Maintenance (CM1)**

40 **NEPA Effects:** Effects of CM1 on DO under Alternative 6A would be the same as those discussed for
41 Alternative 1A and are considered to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 6A would be similar to those discussed
 2 for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 3 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 4 constituent. For additional details on the effects assessment findings that support this CEQA impact
 5 determination, see the effects assessment discussion under the Alternative 1A.

6 Reservoir storage reductions that would occur under Alternative 6A, relative to Existing Conditions,
 7 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
 8 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
 9 Similarly, river flow rate reductions that would occur would not be expected to result in a
 10 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
 11 flows would remain within the ranges historically seen under Existing Conditions and the affected
 12 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
 13 water temperature would not be expected to cause DO levels to be outside of the range seen
 14 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
 15 change sufficiently to affect DO levels.

16 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 17 Delta source water percentages under this alternative or substantial degradation of these water
 18 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 19 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 20 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 21 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 22 the reaeration of Delta waters would not be expected to change substantially.

23 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 24 Export Service Areas waters under Alternative 6A, relative to Existing Conditions. Because the
 25 biochemical oxygen demand of the exported water would not be expected to substantially differ
 26 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 27 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 28 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 29 downstream reservoirs.

30 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 31 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 32 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 33 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 34 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 35 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 36 related impairment of these areas would not be expected. This impact would be less than significant.
 37 No mitigation is required.

38 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

39 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 6A would be the same as those
 40 discussed for Alternative 1A and are considered to not be adverse.

41 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 42 measures proposed under Alternative 1A. As such, effects on DO resulting from the implementation

1 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 4 **Operations and Maintenance (CM1)**

5 *Upstream of the Delta*

6 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
7 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
8 the San Joaquin River upstream of the Delta under Alternative 6A are not expected to be outside the
9 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
10 minor changes in EC levels that could occur under Alternative 6A in water bodies upstream of the
11 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
12 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

13 *Delta*

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
19 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
20 information.

21 Relative to Existing Conditions, Alternative 6A would result in an increase in the number of days the
22 Bay-Delta WQCP EC objectives for fish and wildlife protection (which apply during April and May in
23 all but critical water year types) would be exceeded in the San Joaquin River at Jersey Point and
24 Prisoners Point (Appendix 8H, *Electrical Conductivity*, Table EC-6), and an increase in exceedance of
25 the agricultural EC objective for the Sacramento River at Emmaton.

26 The percentage of days the fish and wildlife EC objective would be exceeded at Jersey Point for the
27 entire period modeled (1976–1991) would increase from 0% under Existing Conditions to 3%
28 under Alternative 6A, and the percentage of days out of compliance with the EC objective would
29 increase from 0% under Existing Conditions to 5% under Alternative 6A. The percentage of days the
30 EC objective would be exceeded at Prisoners Point for the entire period modeled would increase
31 from 6% under Existing Conditions to 40% under Alternative 6A, and the percentage of days out of
32 compliance with the EC objective would increase from 10% under Existing Conditions to 40% under
33 Alternative 6A. Sensitivity analyses conducted for Alternative 4 Scenario H3 indicated that removing
34 all tidal restoration areas would reduce the number of exceedances, but there would still be
35 substantially more exceedances than under Existing Conditions or the No Action Alternative. Results
36 of the sensitivity analyses indicate that the exceedances are partially a function of the operations of
37 the alternative itself, perhaps due to Head of Old River Barrier assumptions and south Delta export
38 differences (see Appendix 8H, Attachment 1, for more discussion of these sensitivity analyses). Due
39 to similarities in the nature of the exceedances between alternatives, the findings from these
40 analyses can be extended to this alternative as well. Appendix 8H, Attachment 2, contains a more
41 detailed assessment of the likelihood of these exceedances impacting aquatic life beneficial uses.
42 Specifically, Appendix 8H, Attachment 2, discusses whether these exceedances might have indirect

1 effects on striped bass spawning in the Delta, and concludes that the high level of uncertainty
2 precludes making a definitive determination.

3 At Emmaton, the percentage of days the EC objective would be exceeded would increase from 6%
4 under Existing Conditions to 32% under Alternative 6A, and the percentage of days out of
5 compliance would increase from 11% under Existing Conditions to 44% under Alternative 6A.

6 Average EC levels at the western and southern Delta compliance locations and San Joaquin River at
7 San Andreas Landing (an interior Delta location) would decrease from 2–56% for the entire period
8 modeled and 3–52% during the drought period modeled (1987–1991) (Appendix 8H, *Electrical*
9 *Conductivity*, Table EC-17). In the S. Fork Mokelumne River at Terminous, average EC would
10 increase 7% for the entire period modeled and 6% during the drought period modeled. Average EC
11 in the S. Fork Mokelumne River at Terminous (an interior Delta location) would increase during all
12 months (Appendix 8H, Table EC-17). The western Delta is Clean Water Act section 303(d) listed as
13 impaired due to elevated EC and there would be an increased exceedance of the EC objective at
14 Emmaton. Thus, relative to Existing Conditions, Alternative 6A could contribute to additional
15 impairment of section 303(d) listed waters. The comparison to Existing Conditions reflects changes
16 in EC due to both Alternative 6A operations (including north Delta intake capacity of 15,000 cfs and
17 numerous other components of Operational Scenario D) and climate change/sea level rise.

18 Relative to the No Action Alternative, the change in percentage compliance with Bay-Delta WQCP EC
19 objectives under Alternative 6A would be similar to that described above relative to Existing
20 Conditions for the Sacramento River at Emmaton, and the San Joaquin River at Jersey Point and
21 Prisoners Point. In addition, there would also be a slight increase (<1%) in the percentage of days
22 the EC objective would be exceeded in Old River at Tracy Bridge for the entire period modeled. For
23 the entire period modeled, average EC levels would increase at: S. Fork Mokelumne River at
24 Terminous; San Joaquin River at Brandt Bridge and Prisoners Point; and Old River at Tracy Bridge.
25 The greatest average EC increase would occur in the S. Fork Mokelumne River at Terminous (8%);
26 the average EC increase at the other locations would be <1–3% (Appendix 8H, *Electrical*
27 *Conductivity*, Table EC-17). During the drought period modeled, average EC would increase at the
28 same locations, except San Joaquin River at Prisoners Point. The greatest average EC increase during
29 the drought period modeled would occur in the S. Fork Mokelumne River at Terminous (7%); the
30 increase at the other locations would be 1–2% (Appendix 8H, Table EC-17). Given that the western
31 Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC, the increase in the
32 incidence of exceedance of EC objectives at Emmaton, relative to the No Action Alternative, has the
33 potential to contribute to additional impairment and potentially adversely affect beneficial uses. The
34 comparison to the No Action Alternative reflects changes in EC due only to Alternative 6A
35 operations (including north Delta intake capacity of 15,000 cfs and numerous other components of
36 Operational Scenario D).

37 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
38 fish and wildlife apply. Long-term average EC would increase under Alternative 6A, relative to
39 Existing Conditions, during the months of April and May by 0.2–0.4 mS/cm in the Sacramento River
40 at Collinsville (Appendix 8H, *Electrical Conductivity*, Table EC-21). Long-term average EC would
41 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
42 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon Landing, with
43 long-term average EC levels increasing by 0.8–2.2 mS/cm, depending on the month, nearly doubling
44 during some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table
45 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases

1 during February–May of 0.4–1.7 mS/cm (Appendix 8H, Tables EC-24 and EC-25). Modeling of this
 2 alternative assumed no operation of the Montezuma Slough Salinity Control Gates, but the project
 3 description assumes continued operation of the Salinity Control Gates, consistent with assumptions
 4 included in the No Action Alternative. A sensitivity analysis modeling run conducted for Alternative
 5 4 Scenario H3 with the gates operational consistent with the No Action Alternative resulted in
 6 substantially lower EC levels than indicated in the original Alternative 4 modeling results, but EC
 7 levels were still somewhat higher than EC levels under Existing Conditions and the No Action
 8 Alternative for several locations and months. Another modeling run with the gates operational and
 9 restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions and the No
 10 Action Alternative, indicating that design and siting of restoration areas has notable bearing on EC
 11 levels at different locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more
 12 information on these sensitivity analyses). These analyses also indicate that increases are related
 13 primarily to the hydrodynamic effects of CM4, not operational components of CM1. Based on the
 14 sensitivity analyses, optimizing the design and siting of restoration areas may limit the magnitude of
 15 long-term EC increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the
 16 EC increases between alternatives, the findings from these analyses can be extended to this
 17 alternative as well.

18 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
 19 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
 20 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
 21 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
 22 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
 23 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
 24 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
 25 certain locations could be substantial, depending on siting and design of restoration areas, and it is
 26 uncertain the degree to which current management plans for the Suisun Marsh would be able to
 27 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
 28 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
 29 Long-term average EC increases in Suisun Marsh under Alternative 6A relative to the No Action
 30 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh also is
 31 section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
 32 average EC concentrations could contribute to additional impairment.

33 ***SWP/CVP Export Service Areas***

34 At the Banks and Jones pumping plants, Alternative 6A would result in no exceedances of the Bay-
 35 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, *Electrical*
 36 *Conductivity*, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
 37 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 6A.

38 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 6A
 39 would decrease substantially on average: 67% for the entire period modeled and 73% during the
 40 drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by
 41 64% for the entire period modeled and 71% during the drought period modeled. (Appendix 8H,
 42 Table EC-17)

43 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 6A
 44 would also decrease substantially: 68% for the entire period modeled and 74% during the drought

1 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 67% for
2 the entire period modeled and 73% during the drought period modeled. (Appendix 8H, Table EC-17)

3 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
4 pumping plants, Alternative 6A would not cause degradation of water quality with respect to EC in
5 the SWP/CVP Export Service Areas; rather, Alternative 6A would improve long-term average EC
6 conditions in the SWP/CVP Export Service Areas.

7 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
8 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
9 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
10 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
11 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
12 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
13 impact discussion under the No Action Alternative).

14 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
15 elevated EC. Alternative 6A would result in lower average EC levels relative to Existing Conditions
16 and the No Action Alternative and, thus, would not contribute to additional beneficial use
17 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

18 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives in the western
19 Delta under Alternative 6A, relative to the No Action Alternative, would contribute to adverse effects
20 on the agricultural beneficial uses. In addition, the increased frequency of exceedance of the San
21 Joaquin River at Prisoners Point and Jersey Point EC objectives and long-term and drought period
22 average EC at Prisoners Point could contribute to adverse effects on fish and wildlife beneficial uses
23 (specifically, indirect adverse effects on striped bass spawning), though there is a high degree of
24 uncertainty associated with this impact. The western and southern Delta are CWA section 303(d)
25 listed as impaired due to elevated EC, and the increase in incidence of exceedance of EC objectives in
26 the western portion of the Delta have the potential to contribute to additional beneficial use
27 impairment. The increases in long-term average EC levels that could occur in Suisun Marsh would
28 further degrade existing EC levels and could contribute to adverse effects on the fish and wildlife
29 beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to elevated EC, and the
30 potential increases in long-term average EC levels could contribute to additional beneficial use
31 impairment. These increases in EC constitute an adverse effect on water quality. Mitigation Measure
32 WQ-11 would be available to reduce these effects. Implementation of this measure along with a
33 separate other commitment as set forth in Appendix 3B, *Environmental Commitments, AMMs, and*
34 *CMs*, relating to the potential EC-related changes would reduce these effects.

35 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
36 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
37 purpose of making the CEQA impact determination for this constituent. For additional details on the
38 effects assessment findings that support this CEQA impact determination, see the effects assessment
39 discussion that immediately precedes this conclusion.

40 River flow rate and reservoir storage reductions that would occur under Alternative 6A, relative to
41 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
42 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
43 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
44 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected

1 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
2 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
3 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
4 Delta.

5 Relative to Existing Conditions, Alternative 6A would not result in any substantial increases in long-
6 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
7 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
8 would decrease at both plants and, thus, this alternative would not contribute to additional
9 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
10 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
11 relative to Existing Conditions.

12 Alternative 6A would result in an increase in the frequency with which Bay-Delta WQCP EC
13 objectives for fish and wildlife protection are exceeded in the San Joaquin River at Jersey Point (from
14 0% under Existing Conditions to 3% under Alternative 6A) and Prisoners Point (from 6% under
15 Existing Conditions to 40% under Alternative 6A), and an increase in the EC agricultural objectives
16 at Emmaton for the entire period modeled (1976–1991). Because EC is not bioaccumulative, the
17 increases in long-term average EC levels would not directly cause bioaccumulative problems in
18 aquatic life or humans. Portions of the Delta on the Clean Water Act section 303(d) list as impaired
19 due to elevated EC would not have increased long-term average EC levels relative to Existing
20 Conditions, However, at Emmaton, which is in the western Delta, there would be an increased
21 frequency of exceedance of the EC objective. Thus, Alternative 6A could contribute to additional
22 impairment of section 303(d) listed waters. The increased frequency of exceedance of fish and
23 wildlife EC objectives at Prisoners Point and Jersey Point could adversely affect aquatic life
24 beneficial uses specifically, indirect adverse effects on striped bass spawning), though there is a high
25 degree of uncertainty associated with this impact. This impact is considered to be significant.

26 Further, relative to Existing Conditions, Alternative 6A could result in substantial increases in long-
27 term average EC during the months of October through May in Suisun Marsh. The increases in long-
28 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
29 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
30 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
31 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
32 elevated EC and the increases in long-term average EC that would occur in the marsh could make
33 beneficial use impairment measurably worse. This impact is considered to be significant.

34 Implementation of Mitigation Measure WQ-11 along with a separate other commitment relating to
35 the potential increased costs associated with EC-related changes would reduce these effects. While
36 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
37 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
38 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
39 However, because the effectiveness of this mitigation measure to result in feasible measures for
40 reducing water quality effects is uncertain, this impact is considered to remain significant and
41 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
42 Alternative 1A.

43 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
44 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,

1 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
 2 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 3 purveyor operations. Potential options for making use of this financial commitment include funding
 4 or providing other assistance towards acquiring alternative water supplies or towards modifying
 5 existing operations when EC concentrations at a particular location reduce opportunities to operate
 6 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
 7 actions that could be taken pursuant to this commitment in order to reduce the water quality
 8 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
 9 bromide.

10 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 11 **Quality Conditions**

12 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

13 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2-**
 14 **CM21**

15 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 6A would be the same as those
 16 discussed for Alternative 1A and are considered not to be adverse.

17 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 18 measures proposed under Alternative 1A. As such, effects on EC resulting from the implementation
 19 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 20 considered to be less than significant. No mitigation is required.

21 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 22 **Maintenance (CM1)**

23 ***Upstream of the Delta***

24 Under the Alternative 6A, the magnitude and timing of reservoir releases and river flows upstream
 25 of the Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 26 Existing Conditions and the No Action Alternative.

27 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 28 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 29 relationships for mercury and methylmercury. No significant, predictive regression relationships
 30 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 31 (monthly or annual) (Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
 32 total mercury and flow is to be expected based on the association of mercury with suspended
 33 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 34 Sacramento River under Alternative 6A relative to Existing Conditions and the No Action Alternative
 35 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
 36 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
 37 In addition, even though it may be flow-affected, total mercury concentrations remain well below
 38 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
 39 the water bodies of the affected environment located upstream of the Delta would not be of
 40 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 41 substantially degrade the quality of these water bodies as related to mercury. Both waterborne

1 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
2 remain above guidance levels at upstream of Delta locations, but will not change substantially
3 relative to Existing Conditions or the No Action Alternative due to changes in flows under
4 Alternative 6A.

5 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
6 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
7 Mercury Control Program. These projects will target specific sources of mercury and methylation
8 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
9 The implementation of these projects could help to ensure that upstream of Delta environments will
10 not be substantially degraded for water quality with respect to mercury or methylmercury.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
16 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
17 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
18 information.

19 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
20 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
21 change in assimilative capacity of waterborne total mercury of Alternative 6A relative to the 25 ng/L
22 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease to be
23 9.2% at the Contra Costa Pumping Plant, 9.1% at the Contra Costa Pumping Plant relative to the No
24 Action Alternative (Figures 8-53a and 8-54a). These changes are not expected to result in adverse
25 effects to beneficial use. Similarly, changes in methylmercury concentration are expected to be
26 relatively small. The greatest annual average methylmercury concentration for drought conditions
27 was 0.165 ng/L for the San Joaquin River at Buckley Cove which was slightly higher than Existing
28 Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (0.167 ng/L) (Appendix
29 8I, Table I-6). All modeled input concentrations exceeded the methylmercury TMDL guidance
30 objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not evaluated for
31 methylmercury.

32 Fish tissue estimates show substantial percentage increases in concentration and exceedance
33 quotients for mercury at some Delta locations. The greatest increases in exceedance quotients
34 (ranging from 33 to 64%) are expected for Franks Tract and Old River at Rock Slough relative to
35 Existing Conditions and the No Action Alternative (Figure 8-55a and 8-55b; Appendix 8I, Table I-
36 13b). Because these increases are substantial, and it is evident that substantive increases are
37 expected at numerous locations throughout the Delta, these changes may be measurable in the
38 environment. See Appendix 8I for a discussion of the uncertainty associated with the fish tissue
39 estimates.

40 ***SWP/CVP Export Service Areas***

41 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
42 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
43 methylmercury concentrations for Alternative 6A are projected to be lower than Existing Conditions

1 and the No Action Alternative (Appendix 8I, *Mercury*, Figures I-4 and I-5). Therefore, mercury shows
2 an increased assimilative capacity at these locations (Figures 8-53a and 8-54a).

3 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
4 Alternative 6A, relative to Existing Conditions and the No Action Alternative at any location within
5 the Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 41%
6 improvement relative to Existing Conditions, 43% relative to the No Action Alternative) (Figures 8-
7 55a and 8-55b; Appendix 8I, *Mercury*, Table I-13b).

8 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
9 comparison of Alternative 6A to the No Action Alternative (as waterborne and bioaccumulated
10 forms) are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
13 purpose of making the CEQA impact determination for this constituent. For additional details on the
14 effects assessment findings that support this CEQA impact determination, see the effects assessment
15 discussion that immediately precedes this conclusion.

16 Under Alternative 6A, greater water demands and climate change would alter the magnitude and
17 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
18 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
19 methylmercury upstream of the Delta will not be substantially different relative to Existing
20 Conditions due to the lack of important relationships between mercury/methylmercury
21 concentrations and flow for the major rivers.

22 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
23 capacity exists. Monthly average waterborne concentrations of total and methylmercury, over the
24 period of record, are very similar to Existing Conditions, but showed notable increases at some
25 locations. Estimates of fish tissue mercury concentrations show substantial increases would occur
26 for several sites for Alternative 6A as compared to Existing Conditions for Delta sites.

27 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
28 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
29 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
30 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 6A as
31 compared to Existing Conditions.

32 As such, this alternative is not expected to cause additional exceedance of applicable water quality
33 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
34 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
35 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
36 make existing mercury-related impairment in the Delta measurably worse. In comparison to
37 Existing Conditions, Alternative 6A would increase levels of mercury by frequency, magnitude, and
38 geographic extent such that the affected environment would be expected to have measurably higher
39 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
40 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
41 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
42 unknown. General mercury management measures through CM12, or actions taken by other entities
43 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury

1 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
 2 reduced to a level that would be less than significant as a result of CM12 or other future actions.
 3 Therefore, the impact would be significant and unavoidable.

4 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2–**
 5 **CM21**

6 **NEPA Effects:** Some habitat restoration activities under Alternative 6A would occur on lands in the
 7 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 8 Alternative 6A have the potential to increase water residence times and increase accumulation of
 9 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 10 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 11 possible but uncertain depending on the specific restoration design implemented at a particular
 12 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 13 not currently available. However, DSM2 modeling for Alternative 6A operations does incorporate
 14 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 15 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 16 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 17 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 18 potential for increased mercury and methylmercury concentrations under Alternative 6A.

19 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 20 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 21 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 22 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 23 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 24 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 25 ● Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 26 better inform restoration design,
- 27 ● Sequestering methylmercury at restoration sites using low intensity chemical dosing
 28 techniques,
- 29 ● Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 30 organic material at a restoration site,
- 31 ● Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 32 biologically unavailable, inorganic form of mercury,
- 33 ● Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 34 ● Considering capping mercury laden sediments, where possible to reduce methylation potential
 35 at a site.

36 Because of the uncertainties associated with site-specific estimates of methylmercury
 37 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 38 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 39 need to be evaluated separately for each restoration effort, as part of design and implementation.
 40 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 41 potential effect of implementing CM2–CM21 is considered adverse.

1 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 2 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 3 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 4 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 5 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 6 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 7 measurable increase in methylmercury concentrations would make existing mercury-related
 8 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 9 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 10 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 11 Design of restoration sites under Alternative 6A would be guided by CM12 which requires
 12 development of site specific mercury management plans as restoration actions are implemented.
 13 The effectiveness of minimization and mitigation actions implemented according to the mercury
 14 management plans is not known at this time although the potential to reduce methylmercury
 15 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 16 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 17 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 18 impact being considered significant. No mitigation measures would be available until specific
 19 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 20 unavoidable.

21 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and**
 22 **Maintenance (CM1)**

23 ***Upstream of the Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
 25 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 26 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

27 Under Alternative 6A, modeling indicates that long-term annual average flows on the San Joaquin
 28 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 29 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
 30 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 31 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 32 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 33 affected, if at all, by changes in flow rates under Alternative 6A.

34 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 35 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 36 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 37 water bodies, with regards to nitrate.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 42 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 43 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to

1 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
2 information.

3 Results of the mixing calculations indicate that under Alternative 6A, relative to Existing Conditions
4 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
5 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 22 and 23). Long-
6 term average nitrate concentrations are anticipated to increase at most locations in the Delta. The
7 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
8 Plant #1 (all >100% increase). Long-term average concentrations were estimated to increase to
9 0.78, 1.23 and 1.33 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
10 Plant #1, respectively, due primarily to increased San Joaquin River water percentage at these
11 locations (see Appendix 8D, *Source Water Fingerprinting Results*). Although changes at specific Delta
12 locations and for specific months may be substantial on a relative basis, the absolute concentration
13 of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of
14 10 mg/L-N, as well as all other thresholds identified in Table 8-50. No additional exceedances of the
15 MCL are anticipated at any location (Appendix 8J, Table 22). On a monthly average basis and on a
16 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
17 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
18 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 14% at Old River at Rock
19 Slough and Contra Costa Pumping Plant #1, and averaged approximately 8–9% on a long-term
20 average basis (Appendix 8J, Table 24). Similarly, the use of available assimilative capacity at Franks
21 Tract was up to approximately 7%, and averaged 3–4% over the long term. The concentrations
22 estimated for these locations would not increase the likelihood of exceeding the 10 mg/L-N MCL,
23 nor would they increase the risk for adverse effects to beneficial uses. At all other locations, use of
24 assimilative capacity was negligible (<5%), except San Joaquin River at Buckley Cove in August,
25 which showed a 7.3% use of the assimilative capacity that was available under the No Action
26 Alternative, for the drought period (1987–1991) (Appendix 8J, Table 24).

27 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
28 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
29 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
30 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
31 the modeling.

- 32 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
33 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
34 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
35 the increase becoming greater with increasing distance downstream. However, the increase in
36 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
37 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
38 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board
39 2010a:32).
- 40 • Under Alternative 6A, the planned upgrades to the SRWTP, which include nitrification/partial
41 denitrification, would substantially decrease ammonia concentrations in the discharge, but
42 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
43 higher than under Existing Conditions.
- 44 • Overall, under Alternative 6A, the nitrogen load from the SRWTP discharge is expected to
45 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial

1 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
2 of the facility are expected to be higher than modeling results indicate for both Existing
3 Conditions and Alternative 6A, the increase is expected to be greater under Existing Conditions
4 than for Alternative 6A due to the upgrades that are assumed under Alternative 6A.

5 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
6 immediately downstream of other wastewater treatment plants that practice nitrification, but not
7 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
8 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
9 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
10 State has determined that no beneficial uses are adversely affected by the discharge, and that the
11 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
12 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
13 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
14 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
15 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
16 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
17 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

18 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
19 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
20 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

21 ***SWP/CVP Export Service Areas***

22 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
23 nitrate-N at the Banks and Jones pumping plants.

24 Results of the mixing calculations indicate that under Alternative 6A, relative to Existing Conditions
25 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
26 anticipated to decrease on a long-term average annual basis, and on an average monthly basis for
27 every month of the year (Appendix 8J, *Nitrate*, Tables 22 and 23). No additional exceedances of the
28 MCL are anticipated (Appendix 8J, Table 22). On a monthly average basis and on a long term annual
29 average basis, for all modeled years and for the drought period (1987–1991) only, there was no use
30 of assimilative capacity available under Existing Conditions and the No Action Alternative, relative
31 to the 10 mg/L-N MCL, for both Banks and Jones pumping plants (Appendix 8J, Table 24).

32 Therefore, implementation of this alternative is not expected to result in adverse effects to beneficial
33 uses or substantially degrade the quality of exported water, with regards to nitrate.

34 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
35 CM1 are considered to be not adverse.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
37 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
38 purpose of making the CEQA impact determination for this constituent. For additional details on the
39 effects assessment findings that support this CEQA impact determination, see the effects assessment
40 discussion that immediately precedes this conclusion.

41 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
42 substantial dilution available for point sources and the lack of substantial nonpoint sources of

1 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
2 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
3 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
4 Consequently, any modified reservoir operations and subsequent changes in river flows under
5 Alternative 6A, relative to Existing Conditions, are expected to have negligible, if any, effects on
6 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
7 watershed and upstream of the Delta in the San Joaquin River watershed.

8 In the Delta, results of the mixing calculations indicate that under Alternative 6A, relative to Existing
9 Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-
10 N) relative to adopted objectives. No additional exceedances of the MCL are anticipated at any
11 location, and use of assimilative capacity available under Existing Conditions, relative to the
12 drinking water MCL of 10 mg/L-N, was not of sufficient magnitude to increase the risk of
13 substantially effecting beneficial uses.

14 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
15 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
16 indicate that under Alternative 6A, relative to Existing Conditions, long-term average nitrate
17 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
18 exceedances of the MCL are anticipated, and there was no use of assimilative capacity available
19 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants for all
20 months.

21 Based on the above, this alternative is not expected to cause additional exceedance of applicable
22 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
23 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
24 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
25 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
26 the affected environment and thus any increases that may occur in some areas and months would
27 not make any existing nitrate-related impairment measurably worse because no such impairments
28 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
29 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
30 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
31 significant. No mitigation is required.

32 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2- 33 CM21**

34 **NEPA Effects:** Effects of CM2-CM21 on nitrate under Alternative 6A would be the same as those
35 discussed for Alternative 1A and are considered not to be adverse.

36 **CEQA Conclusion:** CM2-CM21 proposed under Alternative 6A would be similar to conservation
37 measures proposed under Alternative 1A. As such, effects on nitrate resulting from the
38 implementation of CM2-CM21 would be similar to those previously discussed for Alternative 1A.
39 This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 6A, there would be no substantial change to the sources of DOC within the
 5 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 6 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 7 system operations and resulting reservoir storage levels and river flows would not be expected to
 8 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 9 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 10 6A, relative to Existing Conditions and the No Action Alternative, would not be of sufficient
 11 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 12 substantially degrade the quality of these water bodies, with regards to DOC.

13 ***Delta***

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 19 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 20 information.

21 Under Alternative 6A, the geographic extent of effects pertaining to long-term average DOC
 22 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 23 although the magnitude of predicted long-term increase and relative frequency of concentration
 24 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
 25 Tract, Rock Slough, and Contra Costa PP No. 1, where for the 16-year hydrologic period and the
 26 modeled drought period, long-term average concentration increases ranging from 1.0–1.6 mg/L
 27 would be predicted ($\leq 46\%$ net increase) resulting in long-term average DOC concentrations greater
 28 than 4 mg/L at all three Delta interior locations (Appendix 8K, *Organic Carbon*, DOC Table 7). Long-
 29 term average increases of 0.2–0.6 mg/L ($\leq 20\%$ net increase) would also occur at Staten Island,
 30 Emmaton, Antioch and Mallard Island. Increases in long-term average concentrations would
 31 correspond to more frequent concentration threshold exceedances, with the greatest change
 32 occurring at Rock Slough and Contra Costa PP No. 1 locations. For Rock Slough, long-term average
 33 DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 100%
 34 under the Alternative 6A (an increase from 47% to 100% for the drought period), and
 35 concentrations exceeding 4 mg/L would increase from 30% to 79% (32% to 95% for the drought
 36 period). For Contra Costa PP No. 1, long-term average DOC concentrations exceeding 3 mg/L would
 37 increase from 52% under Existing Conditions to 100% under Alternative 6A (45% to 100% for the
 38 drought period), and concentrations exceeding 4 mg/L would increase from 32% to 84% (35% to
 39 95% for the drought period). Relative change in frequency of threshold exceedance for other
 40 assessment locations would be similar or less. This comparison to Existing Conditions reflects
 41 changes in DOC due to both Alternative 6A operations (including north Delta intake capacity of
 42 15,000 cfs and numerous other components of Operational Scenario D) and climate change/sea
 43 level rise.

1 In comparison, Alternative 6A relative to the No Action Alternative N would generally result in a
 2 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
 3 increases of 1.0 to 1.5 mg/L DOC (i.e., $\leq 41\%$) would be predicted at Franks Tract, Rock Slough, and
 4 Contra Costa PP No. 1 relative to the No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table
 5 7). Threshold concentration exceedance frequency trends would also be similar to those discussed
 6 for the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance
 7 frequency at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-
 8 term average DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to
 9 30% (42% to 53% for the modeled drought period). Unlike the comparison to Existing Conditions,
 10 this comparison to the No Action Alternative reflects changes in DOC due only to Alternative 6A
 11 operations.

12 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
 13 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
 14 significant changes in drinking water treatment plant design or operations. In particular, assessment
 15 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 16 drinking water treatment plants. Under Alternative 6A, drinking water treatment plants obtaining
 17 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 18 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 19 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 20 such technologies would likely require substantial investment in new or modified infrastructure.

21 Relative to existing and No Action Alternative conditions, Alternative 6A would lead to predicted
 22 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 23 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
 24 Slough would decrease approximately 0.1 mg/L (including the drought period), depending on
 25 baseline conditions comparison and modeling period.

26 ***SWP/CVP Export Service Areas***

27 Under Alternative 6A, modeled long-term average DOC concentrations would decrease at Banks and
 28 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 29 period. Modeled decreases would generally be similar between Existing Conditions and the No
 30 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
 31 would be predicted to decrease by 1.5 mg/L (1.8 mg/L during drought period) (Appendix 8K,
 32 *Organic Carbon*, DOC Table 7). At Jones, long-term average DOC concentrations would be predicted
 33 to decrease by 1.5 mg/L (1.7 mg/L during drought period). Such substantial improvement in long-
 34 term average DOC concentrations would include fewer exceedances of concentration thresholds. At
 35 both Banks and Jones, average DOC concentrations exceeding the 2 mg/L concentration threshold
 36 would decrease from 100% under Existing Conditions and the No Action Alternative to 39% under
 37 Alternative 6A (100% to 33% during the drought period), while concentrations exceeding 4 mg/L
 38 would nearly be eliminated (i.e., $\leq 10\%$ exceedance frequency). Such modeled improvement would
 39 correspond to substantial improvement in Export Service Areas water quality, respective to DOC.

40 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 41 facilities under Alternative 6A would not be expected to create new sources of DOC or contribute
 42 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
 43 would not be expected to cause any substantial change in long-term average DOC concentrations
 44 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

1 **NEPA Effects:** In summary, Alternative 6A, relative to the No Action Alternative, would not cause a
2 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
3 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
4 decrease by as much as 1.9 mg/L, while long-term average DOC concentrations for some Delta
5 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
6 increase by as much as 1.5 mg/L. Resultant substantial changes in long-term average DOC at these
7 Delta interior locations could necessitate changes in water treatment plant operations or require
8 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
9 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
10 reduce these effects.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
12 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
13 purpose of making the CEQA impact determination for this constituent. For additional details on the
14 effects assessment findings that support this CEQA impact determination, see the effects assessment
15 discussion that immediately precedes this conclusion.

16 While greater water demands under the Alternative 6A would alter the magnitude and timing of
17 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
18 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
19 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
20 flows would not be expected to cause a substantial long-term change in DOC concentrations
21 upstream of the Delta.

22 Relative to Existing Conditions, Alternative 6A would result in substantial increases (i.e., 1.0–1.6
23 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
24 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
25 changes in DOC would substantially increase the frequency with which long-term average
26 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
27 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
28 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
29 magnitude change in long-term average DOC concentrations would represent a substantially
30 increased risk for adverse effects on existing MUN beneficial.

31 The assessment of Alternative 6A effects on DOC in the SWP/CVP Export Service Areas is based on
32 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
33 Existing Conditions, long-term average DOC concentrations would decrease by as much as 1.8 mg/L
34 at Banks and Jones pumping plants. The frequency with which long-term average DOC
35 concentrations would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted
36 exceedances of >4 mg/L would be nearly eliminated (i.e., ≤10% exceedance frequency). As a result,
37 substantial improvement in DOC-related water quality would be predicted in the SWP/CVP Export
38 Service Areas.

39 Based on the above, Alternative 6A operation and maintenance would not result in any substantial
40 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
41 Alternative 6A, water exported from the Delta to the SWP/CVP service area would be substantially
42 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
43 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
44 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified

1 conveyance facilities proposed under Alternative 6A would result in a substantial increase in long-
 2 term average DOC concentrations (i.e., 1.0–1.6 mg/L, equivalent to $\leq 46\%$ relative increase) at
 3 Franks Tract, Rock Slough, and Contra Costa PP No.1. In particular, under Alternative 6A, model
 4 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
 5 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
 6 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
 7 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
 8 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
 9 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
 10 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
 11 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
 12 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
 13 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
 14 uncertain and therefore implementation would not necessarily reduce the identified impact to a
 15 level that would be less than significant, and therefore it is significant and unavoidable.

16 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
 17 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

18 To reduce the effect of CM1 operations on increased DOC concentrations specifically predicted
 19 to occur at municipal water purveyors obtaining raw source water through south Delta intakes
 20 at Rock Slough and those associated with Contra Costa PP No. 1, the BDCP proponents shall
 21 consult with the purveyors (i.e., Contra Costa water district and entities to which they supply
 22 raw water) to identify the means to either avoid, minimize, or offset increases in long-term
 23 average DOC concentrations that affect the beneficial use of the water. The BDCP proponents
 24 shall consult with these entities to determine existing DBP concentrations (as system-wide
 25 running averages), and then implement any combination of measures sufficient to maintaining
 26 these concentrations at existing levels in treated drinking water of affected water purveyors.
 27 Such actions may include, but not be limited to: 1) upgrading and maintaining adequate drinking
 28 water treatment systems, 2) developing or obtaining replacement surface water supplies from
 29 other water rights holders, 3) developing replacement groundwater supplies, or 4) physically
 30 routing a portion of the water diverted from the Sacramento River through the associated new
 31 conveyance pipelines/tunnel to affected purveyors.

32 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 33 **Implementation of CM2–CM21**

34 **NEPA Effects:** CM2–CM21 proposed under Alternative 6A would be the same as those proposed
 35 under Alternative 1A. As such, effects on DOC resulting from the implementation of CM2–CM21
 36 would be similar to those previously discussed for Alternative 1A, although the isolated conveyance
 37 facilities of Alternative 6A would effectively isolate SWP and CVP export facilities in the southern
 38 Delta from the influence of potential new or modified sources of DOC relative to CM4–CM7 and
 39 CM10. However, the potential for CM4–CM7 and CM10 to contribute substantial amounts of DOC to
 40 raw drinking water supplies to the other Delta municipal intakes would remain, and could possibly
 41 be measurably worse in actual comparison to the dual conveyance project alternatives. With
 42 relatively less low DOC Sacramento River water in the Delta, there effectively would be less dilution
 43 of interior Delta DOC sources, leading to effectively higher long-term average DOC concentrations.
 44 Substantially increased long-term average DOC in raw water supplies could lead to a need for

1 treatment plant upgrades in order to appropriately manage DBP formation in treated drinking
 2 water. This potential for future DOC increases would lead to substantially greater associated risk of
 3 long-term adverse effects on the MUN beneficial use.

4 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 6A would
 5 present new localized sources of DOC to the study area, and in some circumstances would substitute
 6 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 7 proximity to municipal drinking water intakes, such restoration activities could contribute
 8 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 9 DOC could necessitate changes in water treatment plant operations or require treatment plant
 10 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 11 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

12 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 6A would be similar,
 13 and possibly greater, to those discussed for Alternative 1A, except that SWP and CVP export facilities
 14 would be isolated from these effects by Alternative 6A design. Similar to the discussion for
 15 Alternative 1A, this impact is considered to be significant and mitigation is required. It is uncertain
 16 whether implementation of Mitigation Measure WQ-18 would reduce identified impacts to a less-
 17 than-significant level. Hence, this impact remains significant and unavoidable.

18 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 19 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 20 *AMMs*, and *CMs*, a separate other commitment to address the potential increased water treatment
 21 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 22 operations. Potential options for making use of this financial commitment include funding or
 23 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 24 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 25 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 26 water quality effects relating to DOC.

27 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 28 **Effects on Municipal Intakes**

29 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

30 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 31 **(CM1)**

32 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 6A would be the same as those
 33 discussed for Alternative 1A and are considered to not be adverse.

34 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 6A would be the same as those
 35 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 36 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 37 this constituent. For additional details on the effects assessment findings that support this CEQA
 38 impact determination, see the effects assessment discussion under Alternative 1A.

39 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 40 (water facilities and operations) under Alternative 6A, relative to Existing Conditions, would not be
 41 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 42 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the

1 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 2 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 3 related regulations.

4 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 5 a shift in the Delta source water percentages under this alternative or substantial degradation of
 6 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
 7 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 8 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 9 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 10 and livestock-related uses, would continue under this alternative.

11 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
 12 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
 13 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
 14 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
 15 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
 16 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
 17 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

18 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 19 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 20 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 21 expected to increase substantially, no long-term water quality degradation for pathogens is
 22 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 23 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
 24 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 25 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 26 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 27 considered to be less than significant. No mitigation is required.

28 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

29 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 6A would be the same as those
 30 discussed for Alternative 1A and are considered to not be adverse.

31 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 32 measures proposed under Alternative 1A. As such, effects on pathogens resulting from the
 33 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 34 This impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 36 **Maintenance (CM1)**

37 ***Upstream of the Delta***

38 For the same reasons stated for the No Action Alternative, under Alternative 6A no specific
 39 operations or maintenance activity of the SWP or CVP would substantially drive a change in
 40 pesticide use, and thus pesticide sources would remain unaffected upstream of the Delta.
 41 Nevertheless, changes in the timing and magnitude of reservoir releases could have an effect on

1 available dilution capacity along river segments such as the Sacramento, Feather, American, and San
2 Joaquin Rivers.

3 Under Alternative 6A, winter (November–March) and summer (April–October) season average flow
4 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
5 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
6 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 6% during
7 the summer and 3% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River,
8 average flow rates would decrease no more than 7% during the summer, but would increase by as
9 much as 9% in the winter. American River average flow rates would decrease by as much as 17% in
10 the summer but would increase by as much as 7% in the winter. Seasonal average flow rates on the
11 San Joaquin River would decrease by as much as 12% in the summer, but increase by as much as 1%
12 in the winter. For the same reasons stated for the No Action Alternative, decreased seasonal average
13 flow of $\leq 17\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
14 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
15 affect other beneficial uses of water bodies upstream of the Delta.

16 **Delta**

17 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
18 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
19 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

20 Under Alternative 6A, the distribution and mixing of Delta source waters would change. Percentage
21 change in monthly average source water fraction was evaluated for the modeled 16-year (1976–
22 1991) hydrologic period and a representative drought period (1987–1991), with special attention
23 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
24 fractions. Relative to Existing Conditions, under Alternative 6A modeled San Joaquin River fractions
25 would increase greater than 10% at Buckley Cove (drought period only), Franks Tract, Rock Slough,
26 Contra Costa PP No. 1, and the San Joaquin River at Antioch (Appendix 8D, *Source Water*
27 *Fingerprinting Results*). At Buckley Cove, San Joaquin River source water fractions when modeled for
28 the drought period would increase by 13% in July and 19% in August. At Antioch, San Joaquin River
29 source water fractions when modeled for the 16-year hydrologic period would increase by 11–19%
30 from October through June (11% for January through March of the modeled drought period). While
31 these changes at Buckley Cove and Antioch are not considered substantial, changes in San Joaquin
32 River source water fraction in the Delta interior would be considerable. At Franks Tract, modeled
33 San Joaquin River source water fractions would increase between 14–34% for the entire calendar
34 year of January through December (12–28% for October through June of the modeled drought
35 period). Changes at Rock Slough and Contra Costa PP No. 1 would be very similar, where modeled
36 San Joaquin River source water fractions would increase from 26–76% (11–74% for the modeled
37 drought period) for the entire calendar year. Relative to Existing Conditions, there would be no
38 modeled increases in Sacramento River fractions greater than 14% (with exception to Banks and
39 Jones which are discussed below) and Delta agricultural fractions greater than 19%. Increases in
40 San Joaquin River source water fraction at Franks Tract, Rock Slough, and Contra Costa PP No. 1
41 would primarily balance through decreases in Sacramento River water, and as a result the San
42 Joaquin River would account for greater than 50% of the total source water volume at Franks Tract
43 between March through May (<50% for all months during the modeled drought period), and would
44 be 50%, and as much as 80% during October through May at Rock Slough and Contra Costa PP No. 1
45 for both the modeled drought and 16-year hydrologic periods. While the source water and potential

1 pesticide related toxicity co-occurrence predictions do not mean adverse effects would occur, such
2 considerable modeled increases in early summer source water fraction at Franks Tract and winter
3 and summer source water fractions at Rock Slough and Contra Costa PP No. 1 could substantially
4 alter the long-term risk of pesticide-related toxicity to aquatic life, given the apparent greater
5 incidence of pesticides in the San Joaquin River.

6 When compared to the No Action Alternative, changes in source water fractions would be similar in
7 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
8 to Buckley Cove. Relative to the No Action Alternative, on a source water basis Buckley Cove is
9 comprised predominantly of water of San Joaquin River origin (i.e., typically >80% San Joaquin
10 River) for all months of the year but July and August. In July and August, the combined operational
11 effects on Delta hydrodynamics of the Delta Cross Channel being open, the absence of a barrier at
12 Head of Old River, and seasonally high exports from south Delta pumps results in substantially
13 lower San Joaquin River source water fraction at Buckley Cove relative to all other months of the
14 year. Under Alternative 6A, however, modeled July and August San Joaquin River fractions at
15 Buckley Cove would increase relative to the No Action Alternative, with increases of 20% in July
16 (36% for the modeled drought period) and 27% in August (52% for the modeled drought period)
17 (Appendix 8D, *Source Water Fingerprinting Results*). Despite these San Joaquin River increases, the
18 resulting net San Joaquin River source water fraction for July and August would remain less than all
19 other months. Although these modeled changes in the source water fractions at Buckley Cover are
20 not of sufficient magnitude to substantially alter the long-term risk of pesticide-related toxicity to
21 aquatic life, relative to the No Action Alternative, changes in source water fractions at Rock Slough,
22 Contra Costa PP No. 1 and Franks Tract could substantially alter the long-term risk of pesticide-
23 related toxicity to aquatic life, given the apparent greater incidence of pesticides in the San Joaquin
24 River.

25 These predicted adverse effects on pesticides at Delta interior locations relative to Existing
26 Conditions and the No Action Alternative fundamentally assume that the present pattern of
27 pesticide incidence in surface water will occur at similar levels into the future. In reality, however,
28 the makeup and character of the pesticide use market in the late long-term (i.e., the year 2060) will
29 not be exactly as it is today. Current use of chlorpyrifos and diazinon is on the decline with their
30 replacement by pyrethroids on the rise, yet in this assessment it is the apparent greater incidence of
31 diazinon and chlorpyrifos on the San Joaquin River that serves as the basis for concluding that
32 substantially increased San Joaquin River source water fraction would correspond to an increased
33 risk of pesticide-related toxicity to aquatic life. By 2060, however, alternative pesticides, such as
34 neonicotinoids and biologicals, will likely be a more substantial contributing part of the existing mix
35 of pesticides, and perhaps more prominent. The trend in the development of future-use pesticides is
36 towards reduced risk pesticides, including more biopesticides, with greater targeted specificity,
37 fewer residues, and lower overall non-target toxicity. By 2060 existing chlorpyrifos and diazinon
38 TMDLs for the Sacramento and San Joaquin Rivers will have been in effect for more than 50 years.
39 Moreover, it is reasonable to expect that CWA section 303(d) listings and future additional listings
40 will have developed TMDLs by 2060. To the extent these existing and future TMDL's address current
41 and future-use pesticides, a greater degree of pesticide related source control can be anticipated.
42 Nevertheless, forecasting whether these various efforts will ultimately be successful at resolving
43 current pesticide related impairments requires considerable speculation. While the fundamental
44 assumptions that have guided this assessment of pesticides may be somewhat altered by 2060,
45 these assumptions are informed by actual studies and monitoring data collected from the recent
46 past and, therefore, judging project alternative effects in the future remain most accurate through

1 use of these informed assumptions rather than based on assumptions founded upon future
2 speculative conditions.

3 ***SWP/CVP Export Service Areas***

4 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
5 the Banks and Jones pumping plants. Under Alternative 6A, Sacramento River source water fractions
6 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
7 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
8 pumping plant, Sacramento source water fractions would generally increase from 19–79% for the
9 entire period of January through December (12–56% for January through December of the modeled
10 drought period) and at Jones pumping plant Sacramento source water fractions would generally
11 increase from 33–96% for the entire period of January through December (17–89% for January
12 through December of the modeled drought period). These increases in Sacramento source water
13 fraction would primarily balance through equivalent decreases in San Joaquin River water. Based on
14 the general observation that San Joaquin River, in comparison to the Sacramento River, is a greater
15 contributor of OP insecticides in terms of greater frequency of incidence and presence at
16 concentrations exceeding water quality benchmarks, modeled increases in Sacramento River
17 fraction at Banks and Jones would generally represent an improvement in export water quality
18 respective to pesticides.

19 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
20 American, and San Joaquin Rivers, under Alternative 6A relative to the No Action Alternative, are of
21 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
22 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
23 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
24 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
25 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
26 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

27 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
28 provided above are summarized here, and are then compared to the CEQA thresholds of significance
29 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
30 constituent. For additional details on the effects assessment findings that support this CEQA impact
31 determination, see the effects assessment discussion that immediately precedes this conclusion.

32 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
33 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
34 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
35 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
36 substantially increase the long-term risk of pesticide-related water quality degradation and related
37 toxicity to aquatic life in these water bodies upstream of the Delta.

38 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
39 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
40 and maintenance activities would not affect these sources, changes in Delta source water fraction
41 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
42 Alternative 6A, modeled long-term average San Joaquin River source water fractions at Franks
43 Tract, Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some

1 months such that the long-term risk of pesticide-related toxicity to aquatic life could substantially
2 increase.

3 The assessment of Alternative 6A effects on pesticides in the SWP/CVP Export Service Areas is
4 based on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River
5 source water fractions would increase substantially at both Banks and Jones pumping plants and
6 would generally represent an improvement in export water quality respective to pesticides.

7 Based on the above, Alternative 6A would not result in any substantial change in long-term average
8 pesticide concentration or result in substantial increase in the anticipated frequency with which
9 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
10 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
11 pesticides are currently used throughout the affected environment, and while some of these
12 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
13 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
14 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
15 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
16 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
17 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
18 flows and Delta source water fractions would not be expected to make any of these beneficial use
19 impairments measurably worse, with principal exception to locations in the Delta that would receive
20 a substantially greater fraction San Joaquin River water under Alternative 6A. Long-term average
21 San Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
22 locations would change considerably for some months such that the long-term risk of pesticide-
23 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
24 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
25 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
26 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
27 feasible mitigation available to reduce the effect of this significant impact.

28 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 29 **CM21**

30 **NEPA Effects:** CM2–CM21 proposed under Alternative 6A would be the same as those proposed
31 under Alternative 1A. As such, effects on pesticides resulting from the implementation of CM2–
32 CM21 would be similar to those previously discussed for Alternative 1A. In summary, CM13
33 proposes the use of herbicides to control invasive aquatic vegetation around habitat restoration
34 sites. Herbicides directly applied to water could include adverse effects on non-target aquatic life,
35 such as aquatic invertebrates and beneficial aquatic plants. As such, aquatic life toxicity objectives
36 could be exceeded with sufficient frequency and magnitude such that beneficial uses would be
37 impacted, thus constituting an adverse effect on water quality.

38 In summary, based on the discussion above, the effects on pesticides from implementing CM2–CM21
39 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
40 effect.

41 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 6A are similar to those
42 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
43 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially

1 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
2 that would be less than significant.

3 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
4 **Strategies**

5 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

6 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
7 **and Maintenance (CM1)**

8 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
9 of the affected environment under Alternative 6A would be very similar (i.e., nearly the same) to
10 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
11 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
12 6A, which are considered to be not adverse.

13 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
14 provided above are summarized here, and are then compared to the CEQA thresholds of significance
15 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
16 constituent. For additional details on the effects assessment findings that support this CEQA impact
17 determination, see the effects assessment discussion that immediately precedes this conclusion.

18 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
19 because changes in flows do not necessarily result in changes in concentrations or loading of
20 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
21 Delta are not anticipated for Alternative 6A, relative to Existing Conditions.

22 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
23 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
24 long term-average basis under Alternative 6A, relative to Existing Conditions. Algal growth rates are
25 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
26 that may occur at some locations and times within the Delta would be expected to have little effect
27 on primary productivity in the Delta.

28 The assessment of effects of phosphorus under Alternative 6A in the SWP and CVP Export Service
29 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
30 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
31 anticipated to change substantially on a long term-average basis.

32 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
33 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
34 CVP and SWP service areas under Alternative 6A relative to Existing Conditions. As such, this
35 alternative is not expected to cause additional exceedance of applicable water quality
36 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
37 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
38 are not expected to increase substantially, no long-term water quality degradation is expected to
39 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
40 within the affected environment and thus any minor increases that may occur in some areas would
41 not make any existing phosphorus-related impairment measurably worse because no such
42 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may

1 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
2 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
3 than significant. No mitigation is required.

4 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 5 **CM2–CM21**

6 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
7 environment under Alternative 6A would be very similar (i.e., nearly the same) to those discussed
8 for Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
9 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
10 effects of these same actions under Alternative 6A, which are considered to be not adverse.

11 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
12 measures proposed under Alternative 1A. As such, effects on phosphorus resulting from the
13 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
14 This impact is considered to be less than significant. No mitigation is required.

15 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 16 **Maintenance (CM1)**

17 ***Upstream of the Delta***

18 For the same reasons stated for the No Action Alternative, Alternative 6A would have negligible, if
19 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
20 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
21 concentrations that could occur in the water bodies of the affected environment located upstream of
22 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
23 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
24 selenium.

25 ***Delta***

26 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
27 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
28 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
29 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
30 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
31 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
32 information.

33 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
34 locations under Alternative 5, relative to Existing Conditions and the No Action Alternative, are
35 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-16 and M-26 for most biota
36 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
37 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
38 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
39 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
40 water at each modeled assessment location for all years. Appendix 8M, Figure M-23 provides more

1 detail in the form of monthly patterns of selenium concentrations in water during the modeling
2 period.

3 Alternative 6A would result in small to moderate changes in average selenium concentrations in
4 water at all modeled Delta assessment locations relative to Existing Conditions and the No Action
5 Alternative (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at interior and
6 western Delta locations would increase by 0.01–0.17 µg/L for the entire period modeled (1976–
7 1991). These increases in selenium concentrations in water would result in reductions in available
8 assimilative capacity of 1–16%, relative to the 1.3 µg/L USEPA draft water quality criterion (Figures
9 8-59a and 8-60a). The long-term average selenium concentrations in water for Alternative 6A
10 (range 0.09–0.40 µg/L) would be similar to Existing Conditions (range 0.09–0.41 µg/L) and the No
11 Action Alternative (range 0.09–0.38 µg/L), and all would be below the USEPA draft water quality
12 criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

13 Relative to Existing Conditions and the No Action Alternative, Alternative 6A would generally result
14 in small increases (less than 4%) in estimated selenium concentrations in most biota (whole-body
15 fish (excluding sturgeon), bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets)
16 throughout the Delta, with little difference among locations (Figures 8-61a through 8-64b; Appendix
17 8M, *Selenium*, Table M-26). Despite the small increases in selenium concentrations in biota, Level of
18 Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for
19 selenium concentrations in those biota for all years and for drought years are less than 1.0
20 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
21 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
22 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
23 predicted to increase by about 41% relative to Existing Conditions and 42% relative to the No
24 Action Alternative in all years (from about 4.7 to 6.6 mg/kg dry weight). Likewise, those for
25 sturgeon in the Sacramento River at Mallard Island are predicted to increase by about 24% in all
26 years (from about 4.4 to 5.5 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31). Selenium
27 concentrations in sturgeon during drought years are expected to increase by about 14% and 28% at
28 those locations. Detection of small changes in whole-body sturgeon such as those estimated for the
29 western Delta may require large sample sizes because of the inherent variability in fish tissue
30 selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium concentrations
31 in sturgeon in the western Delta would exceed 1.0 for drought years at both locations (as they do for
32 Existing Conditions and the No Action Alternative) and for all years at both locations, whereas
33 Existing Conditions and the No Action Alternative do not (quotients increase from 0.94 to 1.3 at San
34 Joaquin at Antioch, and from 0.88 to 1.1 at Sacramento River at Mallard Island (Appendix 8M, Table
35 M-32). High Toxicity Threshold Exceedance Quotients for selenium concentrations in sturgeon in
36 the western Delta would exceed 1.0 for drought years in the San Joaquin River at Antioch, whereas
37 Existing Conditions and the No Action Alternative do not (quotient increases from 0.85–0.86 to 1.1)
38 (Appendix 8M, Table M-32).

39 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
40 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
41 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
42 from waterborne selenium concentrations (expressed as the K_a , which is the ratio of selenium
43 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
44 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
45 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
46 the two western Delta locations and used literature-derived uptake factors and trophic transfer

1 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
2 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
3 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
4 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
5 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
6 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
7 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
8 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
9 waterborne selenium concentration at the two locations in different time periods.

10 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
11 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
12 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
13 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
14 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
15 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
16 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
17 most areas of the Delta.

18 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
19 Alternative 6A would be greater in the South Delta and East Delta than in other sub-regions. Relative
20 to Existing Conditions, annual average residence times for Alternative 6A in the South Delta are
21 expected to increase by more than 53 days (Table 8-60a). and in the East Delta increase by more
22 than 32 days. Increases in residence times for other sub-regions would be smaller, especially as
23 compared to Existing Conditions and the No Action Alternative (which are longer than those
24 modeled for the South Delta). As mentioned above, these results incorporate hydrodynamic effects
25 of both CM1 and CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of
26 CM2 and CM4. However, it is expected that CM2 and CM4 are substantial drivers of the increased
27 residence time.

28 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
29 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
30 concentrations in particulates, as the lowest level of the food chain, relative to the water-borne
31 concentration], and associated tissue concentrations [especially in clams and their consumers, such
32 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
33 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
34 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
35 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
36 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

37 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
38 as related to residence time, but the effects of residence time are incorporated in the
39 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
40 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
41 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
42 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
43 concentrations are currently low and not approaching thresholds of concern (which, as discussed
44 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
45 residence time alone would not be expected to cause them to then approach or exceed thresholds of

1 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
 2 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
 3 sparse, the most likely area in which biota tissues would be at levels high enough that additional
 4 bioaccumulation due to increased residence time from restoration areas would be a concern is the
 5 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
 6 increase in residence time estimated in the western Delta is 6 days relative to Existing Conditions,
 7 and 4 days relative to the No Action Alternative. Given the available information, these increases are
 8 small enough that they are not expected to substantially affect selenium bioaccumulation in the
 9 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
 10 residence times, further discussion is included in Impact WQ-26 below.

11 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 6A would
 12 result in small increases in selenium concentrations throughout the Delta for most biota (less than
 13 4%), although larger increases in selenium concentrations are predicted for sturgeon in the western
 14 Delta. The Low Toxicity Threshold Exceedance Quotient for selenium concentrations in sturgeon for
 15 all years in the San Joaquin River at Antioch would increase from 0.94 for Existing Conditions and
 16 the No Action Alternative to 1.3, and from 0.88 to 1.1 at Sacramento River at Mallard Island. The
 17 High Toxicity Threshold Exceedance Quotient for selenium concentrations for sturgeon at Antioch in
 18 drought years would increase from 0.85 for Existing Conditions and 0.86 for the No Action
 19 Alternative to 1.1, indicating a high potential for effects. The modeling of bioaccumulation for
 20 sturgeon is less calibrated to site-specific conditions than that for other biota, which was calibrated
 21 on a robust dataset for modeling of bioaccumulation in largemouth bass as a representative species
 22 for the Delta. Overall, the predicted increases for Alternative 6A are high enough that they may
 23 represent a measurable increase in body burdens of sturgeon, which would constitute an adverse
 24 impact.

25 ***SWP/CVP Export Service Areas***

26 Alternative 6A would result in moderate (0.12–0.19 µg/L) decreases in long-term average selenium
 27 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
 28 the No Action Alternative, for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a).
 29 These decreases in long-term average selenium concentrations in water would result in increases in
 30 available assimilative capacity for selenium at these pumping plants of 11–20%, relative to the 1.3
 31 µg/L USEPA draft water quality criterion (Figures 8-59a and 8-60a). Furthermore the modeled
 32 selenium concentrations in water for Alternative 6A (0.09 µg/L) would be below the USEPA draft
 33 water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

34 Relative to Existing Conditions and the No Action Alternative, Alternative 6A would result in small
 35 changes (less than 5%) in estimated selenium concentrations in biota (whole-body fish, bird eggs
 36 [invertebrate diet], bird eggs [fish diet], and fish fillets) at export service areas (Figures 8-61a
 37 through 8-64b; Appendix 8M, *Selenium*, Table M-26). Concentrations in biota would not exceed any
 38 selenium benchmarks for Alternative 6A (Figures 8-61a through 8-64b).

39 ***NEPA Effects:*** Based on the discussion above, the effects on selenium from Alternative 6A are
 40 considered to be adverse. This determination is reached because selenium concentrations in whole-
 41 body sturgeon modeled at two western Delta locations would increase by an average of 27%, which
 42 may represent a measurable increase in the environment. Because both low and high toxicity
 43 benchmarks would be exceeded, these potentially measurable increases represent an adverse
 44 impact.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for selenium. For additional details on the effects
4 assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
7 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
8 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
9 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
10 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
11 Valley Regional Water Quality Control Board 2010d; State Water Resources Control Board 2010b,
12 2010c) that are expected to result in decreasing discharges of selenium from the San Joaquin River
13 to the Delta. Consequently, any modified reservoir operations and subsequent changes in river flows
14 under Alternative 6A, relative to Existing Conditions, are expected to cause negligible changes in
15 selenium concentrations in water. Any negligible changes in selenium concentrations that may occur
16 in the water bodies of the affected environment located upstream of the Delta would not be of
17 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
18 substantially degrade the quality of these water bodies as related to selenium.

19 Relative to Existing Conditions, modeling estimates indicate that Alternative 6A would result in
20 small changes in selenium concentrations in water or most biota throughout the Delta, with no
21 exceedances of benchmarks for biological effects. Relative to Existing Conditions, modeling
22 estimates indicate that Alternative 6A would increase selenium concentrations in whole-body
23 sturgeon modeled at two western Delta locations by an average of 27%, which may represent a
24 measurable increase in the environment. Because both low and high toxicity benchmarks are
25 already exceeded under Existing Conditions, these potentially measurable increases represent a
26 potential adverse impact on fish and wildlife beneficial uses.

27 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
28 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
29 Alternative 6A would cause no increase in the frequency with which applicable benchmarks would
30 be exceeded and would improve the quality of water in selenium concentrations at the Banks and
31 Jones pumping plants locations.

32 Based on the above, although waterborne selenium concentrations would not exceed applicable
33 water quality objectives/criteria; however, significant impacts on some beneficial uses of waters in
34 the Delta could occur because high toxicity benchmarks may be exceeded (where they are not under
35 Existing Conditions), and uptake of selenium from water to biota may measurably increase. In
36 comparison to Existing Conditions, water quality conditions under this alternative would increase
37 levels of selenium (a bioaccumulative pollutant) by frequency, magnitude, and geographic extent
38 such that the affected environment may have measurably higher body burdens of selenium in
39 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish);
40 however, impacts to humans consuming those organisms are not expected to occur. Water quality
41 conditions under this alternative with respect to selenium would cause long-term degradation of
42 water quality in the western Delta. Except in the vicinity of the western Delta for sturgeon, water
43 quality conditions under this alternative would not increase levels of selenium by frequency,
44 magnitude, and geographic extent such that the affected environment would be expected to have
45 measurably higher body burdens of selenium in aquatic organisms. The greater level of selenium

1 bioaccumulation in the western Delta would further degrade water quality by measurable levels, on
 2 a long-term basis, for selenium and, thus, cause the CWA 303(d)-listed impairment of beneficial use
 3 to be made discernibly worse. This impact is considered significant. *AMM27 Selenium Management*,
 4 which affords for site-specific measures to reduce effects, would be available to reduce BDCP-
 5 related effects associated with selenium. The effectiveness of AMM27 is uncertain and, therefore
 6 implementation may not reduce the identified impact to a level that would be less than significant,
 7 and therefore it is significant and unavoidable.

8 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2-
 9 CM21**

10 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 6A would be the same as those
 11 discussed for Alternative 1A and are considered not to be adverse.

12 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 13 measures proposed under Alternative 1A. As such, effects on selenium resulting from the
 14 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 15 This impact is considered to be less than significant. No mitigation is required.

16 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations
 17 and Maintenance (CM1)**

18 ***Upstream of the Delta***

19 For the same reasons stated for the No Action Alternative, Alternative 6A would result in negligible,
 20 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
 21 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 22 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 23 annual and long-term average basis. As such, Alternative 6A would not be expected to substantially
 24 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
 25 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
 26 degrade the quality of these water bodies, with regard to trace metals.

27 ***Delta***

28 For the same reasons stated for the No Action Alternative, Alternative 6A would not result in
 29 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
 30 the No Action Alternative. However, substantial changes in source water fraction would occur in the
 31 south Delta (Appendix 8D, *Source Water Fingerprinting Results*). Throughout much of the south
 32 Delta, San Joaquin River water would replace Sacramento River water, with the future trace metals
 33 profile largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative,
 34 trace metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar
 35 and currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
 36 concentrations in the south Delta would likely be measurable, Alternative 6A would not be expected
 37 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
 38 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
 39 trace metals.

1 **SWP/CVP Export Service Areas**

2 For the same reasons stated for the No Action Alternative, Alternative 6A would not result in
3 substantial increases in trace metal concentrations in SWP/CVP export service area waters under
4 Alternative 6A, relative to Existing Conditions and the No Action Alternative. Unlike current
5 conditions, however, water delivered to the SWP and CVP export service area would be entirely
6 sourced to the Sacramento River, and thus the future trace metals profile would reflect that of the
7 Sacramento River. While the change in trace metal concentrations in SWP and CVP export service
8 area would likely be measurable, Alternative 6A would not be expected to substantially increase the
9 frequency with which applicable Basin Plan objectives or CTR criteria would be exceeded in the
10 water bodies of the affected environment in the SWP/CVP service area or substantially degrade the
11 quality of these water bodies, with regard to trace metals.

12 **NEPA Effects:** In summary, Alternative 6A, relative to the No Action Alternative, would not cause a
13 substantial increase in long-term average trace metals concentrations within the affected
14 environment, nor would it cause an increased frequency of water quality objective/criteria
15 exceedances within the affected environment. The effect on trace metals is determined not to be
16 adverse.

17 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 6A would be similar to those
18 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
19 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
20 this constituent. For additional details on the effects assessment findings that support this CEQA
21 impact determination, see the effects assessment discussion under Alternative 1A.

22 While greater water demands under the Alternative 6A would alter the magnitude and timing of
23 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
24 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
25 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
26 therefore, changes in river flows would not be expected to cause a substantial long-term change in
27 trace metal concentrations upstream of the Delta.

28 Average and 95th percentile trace metal concentrations are very similar across the primary source
29 waters to the Delta. Given this similarity, very large changes in source water fraction would be
30 necessary to effect a relatively small change in trace metal concentration at a particular Delta
31 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
32 waters are all below their respective water quality criteria, including those that are hardness-based
33 without a WER adjustment. No mixing of these three source waters could result in a metal
34 concentration greater than the highest source water concentration, and given that trace metals do
35 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
36 not be expected to occur under the Alternative 6A.

37 The assessment of the Alternative 6A effects on trace metals in the SWP/CVP Export Service Areas is
38 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
39 As just discussed regarding similarities in Delta source water trace metal concentrations, the
40 Alternative 6A is not expected to result in substantial changes in trace metal concentrations in Delta
41 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
42 in the SWP/CVP Export Service Area are expected to be negligible.

1 Based on the above, there would be no substantial long-term increase in trace metal concentrations
2 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
3 service area waters under Alternative 6A relative to Existing Conditions. As such, this alternative is
4 not expected to cause additional exceedance of applicable water quality objectives by frequency,
5 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
6 in the affected environment. Because trace metal concentrations are not expected to increase
7 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
8 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
9 trace metal concentrations that may occur in water bodies of the affected environment would not be
10 expected to make any existing beneficial use impairments measurably worse. The trace metals
11 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
12 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
13 significant. No mitigation is required.

14 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 15 **CM2–CM21**

16 **NEPA Effects:** CM2–CM21 proposed under Alternative 6A would be the same as those proposed
17 under Alternative 1A. As such, effects on trace metals resulting from the implementation of CM2–
18 CM21 would be similar to those previously discussed for Alternative 1A. As they pertain to trace
19 metals, implementation of CM2–CM21 would not be expected to adversely affect beneficial uses of
20 the affected environment or substantially degrade water quality with respect to trace metals.

21 In summary, implementation of CM2–CM21 under Alternative 6A, relative to the No Action
22 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
23 metals from implementing CM2–CM21 is determined not to be adverse.

24 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 6A would not cause substantial
25 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
26 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
27 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
28 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
29 environment. Because trace metal concentrations are not expected to increase substantially, no
30 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
31 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
32 concentrations that may occur throughout the affected environment would not be expected to make
33 any existing beneficial use impairments measurably worse. The trace metals discussed in this
34 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
35 problems in aquatic life or humans. This impact is considered to be less than significant. No
36 mitigation is required.

37 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 38 **Maintenance (CM1)**

39 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 6A would be the same as those
40 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
41 to not be adverse.

42 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 6A would be similar to
43 those discussed for Alternative 1A, and are summarized here, then compared to the CEQA

1 thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact
 2 determination for this constituent. For additional details on the effects assessment findings that
 3 support this CEQA impact determination, see the effects assessment discussion under Alternative
 4 1A.

5 Changes river flow rate and reservoir storage that would occur under Alternative 6A, relative to
 6 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
 7 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 8 suspended sediment concentrations are more affected by season than flow. Site-specific and
 9 temporal exceptions may occur due to localized temporary construction activities, dredging
 10 activities, development, or other land use changes would be site-specific and temporal, which would
 11 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 12 than substantial levels.

13 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 14 usually gradual, occurring over years, and high storm event inflows would not be substantially
 15 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 16 would not be substantially different from the levels under Existing Conditions. Consequently, this
 17 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 18 region, relative to Existing Conditions.

19 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 20 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 6A, relative to
 21 Existing Conditions, because as stated above, this alternative is not expected to result in substantial
 22 changes in TSS concentrations and turbidity levels at the south Delta export pumps, relative to
 23 Existing Conditions.

24 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 25 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 26 concentrations and turbidity levels are not expected to be substantially different, long-term water
 27 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 28 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
 29 listed constituents. This impact is considered to be less than significant. No mitigation is required.

30 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

31 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 6A would be the same as
 32 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
 33 is determined to not be adverse.

34 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 6A would be similar to conservation
 35 measures proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
 36 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 37 This impact is considered to be less than significant. No mitigation is required.

38 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 39 **(CM1–CM21)**

40 The conveyance features for CM1 under Alternative 6A would be very similar to those discussed for
 41 Alternative 1A. The primary difference between Alternative 6A and Alternative 1A is that under
 42 Alternative 6A, there would be additional features constructed to create the isolated conveyance

1 system. As such, construction techniques and locations of major features of the conveyance system
 2 within the Delta would be similar. The remainder of the facilities constructed under Alternative 6A,
 3 including CM2–CM21, would be very similar to, or the same as, those to be constructed for
 4 Alternative 1A.

5 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
 6 associated with implementation of CM1–CM21 under Alternative 6A would be very similar to the
 7 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM21
 8 would be essentially identical. Nevertheless, the construction of CM1, and any individual
 9 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
 10 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, and other agency permitted
 11 construction requirements would result in the potential water quality effects being largely avoided
 12 and minimized. The specific environmental commitments that would be implemented under
 13 Alternative 6A would be similar to those described for Alternative 1A (refer to Chapter 3,
 14 *Description of Alternatives*, and Appendix 3B for additional information regarding the environmental
 15 commitments and environmental permits). Consequently, relative to Existing Conditions,
 16 Alternative 6A would not be expected to cause exceedance of applicable water quality
 17 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
 18 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
 19 SWP and CVP service area.

20 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 21 construction-related water quality effects are considered to be not adverse.

22 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 23 6A for construction-related activities along with agency-issued permits that also contain
 24 construction requirements to protect water quality, the construction-related effects, relative to
 25 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
 26 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
 27 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
 28 degrade water quality with respect to the constituents of concern on a long-term average basis, and
 29 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 30 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
 31 would be temporary and intermittent in nature, the construction would involve negligible
 32 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
 33 environment. As such, construction activities would not contribute measurably to bioaccumulation
 34 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
 35 Based on these findings, this impact is determined to be less than significant. No mitigation is
 36 required.

37 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 38 **and Maintenance (CM1)**

39 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
 40 concentrations, in water bodies of the affected environment under Alternative 6A would be very
 41 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
 42 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
 43 Services Areas under Alternative 1A would similarly change under Alternative 6A, relative to
 44 Existing Conditions and the No Action Alternative. For the Delta in particular, there are differences

1 in the direction and magnitude of water residence time changes during the *Microcystis* bloom period
2 among the six Delta sub-regions under Alternative 6A compared to Alternative 1A, relative to
3 Existing Conditions and No Action Alternative. However, under Alternative 6A, relative to Existing
4 Conditions and No Action Alternative, water residence times during the *Microcystis* bloom period in
5 various Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A,
6 lead to an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms
7 throughout the Delta. Water exported from the Delta under Alternative 1A will be a mixture of
8 *Microcystis*-affected water from the existing south Delta intake and unaffected Sacramento River
9 water from the north Delta intake, which contrasts to Alternative 6, under which water exported to
10 the SWP/CVP Export Service Areas consist entirely of water from the Sacramento River from the
11 north Delta that is unaffected by *Microcystis*. Because of this, the effects of *Microcystis* on and the
12 microcystin concentrations of water exported to the SWP/CVP Export Service Areas could decrease
13 under Alternative 6A, relative to Existing Conditions.

14 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
15 would occur in the Delta under Alternative 6A, which could lead to earlier occurrences of *Microcystis*
16 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
17 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
18 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
19 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative
20 6A may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
21 because water temperatures will increase in the Export Service Areas due to the expected increase
22 in ambient air temperatures resulting from climate change.

23 **NEPA Effects:** Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
24 affected environment under Alternative 6A would be very similar to (i.e., nearly the same) to those
25 discussed for Alternative 1A. In summary, Alternative 6A operations and maintenance, relative to
26 the No Action Alternative, would result in long-term increases in hydraulic residence time of various
27 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
28 increased residence time could result in a concurrent increase in the frequency, magnitude, and
29 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
30 As a result, Alternative 6A operation and maintenance activities would cause further degradation to
31 water quality with respect to *Microcystis* in the Delta. Under Alternative 6A, relative to No Action
32 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
33 affected source water from the south Delta intakes and unaffected source water from the
34 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
35 and maintenance under Alternative 6A will result in increased or decreased levels of *Microcystis* and
36 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
37 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
38 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
39 *Microcystis* from implementing CM1 is determined to be adverse.

40 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
41 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
42 purpose of making the CEQA impact determination for this constituent. For additional details on the
43 effects assessment findings that support this CEQA impact determination, see the effects assessment
44 discussion that immediately precedes this conclusion.

1 Under Alternative 6A, additional impacts from *Microcystis* in the reservoirs and watersheds
2 upstream of the Delta are not expected, relative to Existing Conditions. Operations and maintenance
3 occurring under Alternative 6A is not expected to change nutrient levels in upstream reservoirs or
4 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
5 conducive to *Microcystis* production.

6 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
7 expected to increase under Alternative 6A, resulting in an increase in the frequency, magnitude and
8 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
9 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
10 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
11 throughout the Delta during the summer and fall bloom period, due in small part to climate change
12 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
13 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
14 production expected within any Delta sub-region is unknown because conditions will vary across
15 the complex networks of intertwining channels, shallow back water areas, and submerged islands
16 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
17 to Alternative 6A. Consequently, it is possible that increases in the frequency, magnitude, and
18 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
19 maintenance of Alternative 6A and the hydrodynamic impacts of restoration (CM2 and CM4).

20 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
21 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
22 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
23 Under Alternative 6A, relative to Existing Conditions, the potential for *Microcystis* to occur in the
24 Export Service Area is expected to increase due to increasing water temperature, but this impact is
25 driven entirely by climate change and not Alternative 6A. Water exported from the Delta to the
26 Export Service Area will consist entirely of Sacramento River water from the north Delta which is
27 unaffected by *Microcystis*. Operations and maintenance (CM1) under Alternative 6A, relative to
28 existing conditions, is not expected to result in increased levels of *Microcystis* and microcystins in
29 the mixture of source waters exported from Banks and Jones pumping plants.

30 Based on the above, this alternative would not be expected to cause additional exceedance of
31 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
32 would cause significant impacts on any beneficial uses of waters in the affected environment.
33 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
34 increases that could occur in some areas would not make any existing *Microcystis* impairment
35 measurably worse because no such impairments currently exist. However, because it is possible that
36 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
37 occur due to the operations and maintenance of Alternative 6A and the hydrodynamic impacts of
38 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
39 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
40 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
41 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
42 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
43 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
44 the effects on *Microcystis* from implementing CM1 is determined to be significant.

1 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
 2 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
 3 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
 4 remain significant and unavoidable.

5 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 6 ***Microcystis* Blooms**

7 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

8 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 9 **Water Residence Time**

10 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

11 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 12 **Measures (CM2–CM21)**

13 The effects of CM2–CM21 on *Microcystis* under Alternative 6A would be the same as those discussed
 14 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
 15 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
 16 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters.
 17 Because the hydrodynamic effects associated with implementing CM2 and CM4 were incorporated
 18 into the modeling used to assess CM1, a detailed assessment of the effects of implementing CM2 and
 19 CM4 on *Microcystis* blooms in the Delta via their effects on Delta water residence time is provided
 20 under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation
 21 of Mitigation Measures WQ-32a. The effectiveness of the mitigation measure to result in feasible
 22 measures for reducing water quality effects is uncertain. CM3 and CM5–CM21 would not result in an
 23 increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta.

24 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 6A would be the same as those
 25 discussed for Alternative 1A and are considered to be adverse.

26 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
 27 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 28 extent that would cause significant impacts on any beneficial uses of waters in the affected
 29 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 30 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 31 impairment measurably worse because no such impairments currently exist. However, microcystin
 32 is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 33 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 34 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 35 would, in turn, pose health risks to fish, wildlife or humans. Because restoration actions
 36 implemented under CM2 and CM4 will increase residence time throughout the Delta and create local
 37 areas of warmer water during the bloom season, it is possible that increases in the frequency,
 38 magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water quality
 39 degradation and significant impacts on beneficial uses, could occur. Although there is considerable
 40 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 41 determined to be significant.

1 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 2 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 3 measures for reducing water quality effects is uncertain, this impact is considered to remain
 4 significant and unavoidable.

5 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 6 ***Microcystis* Blooms**

7 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

8 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 9 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

10 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 11 that Alternative 6A would have a less than significant impact/no adverse effect on the following
 12 constituents in the Delta:

- 13 • Boron
- 14 • DO
- 15 • Pathogens
- 16 • Pesticides
- 17 • Trace Metals
- 18 • Turbidity and TSS

19 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 20 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 21 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 22 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 23 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 24 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 25 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 26 quality of the of San Francisco Bay.

27 The effects of Alternative 6A on bromide, chloride, and DOC, in the Delta were determined to be
 28 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 29 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 30 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 31 adversely effect any beneficial uses of San Francisco Bay.

32 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
 33 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
 34 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
 35 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
 36 which would be the primary driver of salinity changes, would be two to three orders of magnitude
 37 lower than (and thus minimal compared to) the Bay's tidal flow.

38 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
 39 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because

1 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
2 Suisun Bay.

3 While effects of Alternative 6A on the nutrients ammonia, nitrate, and phosphorus were determined
4 to be less than significant/not adverse, these constituents are addressed further below because the
5 response of the seaward bays to changed nutrient concentrations/loading may differ from the
6 response of the Delta. Selenium and mercury are discussed further, because they are
7 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
8 and exports are of concern.

9 **Nutrients: Ammonia, Nitrate, and Phosphorus**

10 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 6A would be
11 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
12 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
13 decrease by 5%, relative to Existing Conditions, and increase by 40%, relative to the No Action
14 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
15 Suisun and San Pablo Bays under Alternative 6A would not adversely impact primary productivity
16 in these embayments because light limitation and grazing currently limit algal production in these
17 embayments. To the extent that algal growth increases in relation to a change in ammonia
18 concentration, this would have net positive benefits, because current algal levels in these
19 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
20 cyanobacteria levels in the North Bay.

21 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 6A is
22 estimated to increase by 9%, relative to Existing Conditions, and increase by 4% relative to the No
23 Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus
24 loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary
25 productivity. However, there is uncertainty regarding the impact of nutrient ratios on
26 phytoplankton community composition and abundance. Any effect on phytoplankton community
27 composition would likely be small compared to the effects of grazing from introduced clams and
28 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
29 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
30 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
31 would result in adverse effects to beneficial uses.

32 **Mercury**

33 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
34 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
35 are estimated to change relatively little due to changes in source water fractions and net Delta
36 outflow that would occur under Alternative 6A. Mercury load to the Bay is estimated to increase by
37 12 kg/year (5%), relative to Existing Conditions, and 9 kg/year (3%), relative to the No Action
38 Alternative. Methylmercury load is estimated to increase by 0.37 kg/year (10%), relative to Existing
39 Conditions, and increase by 0.28 kg/year (7%) relative to the No Action Alternative. The estimated
40 total mercury load to the Bay is 272 kg/year, which would be less than the San Francisco Bay
41 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
42 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
43 term average net Delta outflow and the long-term average mercury and methylmercury
44 concentrations in Delta source waters. The estimated changes in mercury load under the alternative

1 would also be substantially less than the considerable differences among estimates in the current
2 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
3 David et al. 2009).

4 Given that the estimated incremental increases of mercury and methylmercury loading to San
5 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
6 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
7 Francisco Bay due to Alternative 6A are not expected to result in adverse effects to beneficial uses or
8 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
9 303(d) impairment measurably worse.

10 **Selenium**

11 Changes in source water fraction and net Delta outflow under Alternative 6A, relative to Existing
12 Conditions, are projected to cause the total selenium load to the North Bay to increase by 24%,
13 relative to Existing Conditions, and increase by 20%, relative to the No Action Alternative (Appendix
14 80, Table O-3). Changes in long-term average selenium concentrations of the North Bay are assumed
15 to be proportional to changes in North Bay selenium loads. Under Alternative 6A, the long-term
16 average total selenium concentration of the North Bay is estimated to be 0.16 µg/L and the dissolved
17 selenium concentration is estimated to be 0.14 µg/L, which would be a 0.03 µg/L increase relative to
18 Existing Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved selenium
19 concentration would be below the target of 0.202 µg/L developed by Presser or Luoma (2013) to
20 coincide with a white sturgeon whole-body fish tissue selenium concentration not greater than 8
21 mg/kg in the North Bay.

22 The incremental increase in dissolved selenium concentrations projected to occur under Alternative
23 6A, relative to Existing Conditions and the No Action Alternative, would be higher than under
24 Alternatives 1A–5, but still low (0.03 µg/L). The increased dissolved selenium concentration would
25 be within the overall uncertainty of the analytical methods used to measure selenium in water
26 column samples; however, it also would be within the uncertainty associated with estimating
27 numeric water column selenium thresholds (Presser and Luoma 2013). As described in Section
28 8.3.1.8, there have been improvements in selenium concentrations in the tissue of diving ducks and
29 muscle of white sturgeon since the initial CWA Section 303(d) listing of the North Bay for selenium
30 impairments, and selenium concentrations in white sturgeon muscle have also generally been below
31 the USEPA's draft recommended fish muscle tissue concentration of 11.8 mg/kg dry weight (San
32 Francisco Estuary Institute 2014). However, as described under Impact WQ-25, though there is
33 some uncertainty in the estimate of sturgeon concentrations at western Delta locations, the
34 predicted increases for Alternative 6A are high enough that they may represent measurably higher
35 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
36 wildlife (including fish). Because the projected incremental increases in dissolved selenium could
37 cause measurable changes in water column concentrations, and these incremental increases would
38 be within the uncertainty in the target water column threshold for dissolved selenium for protection
39 against adverse bioaccumulative effects in the North Bay ecosystem, and modeling predicts
40 concentrations in the western Delta may represent a measurable increase in body burdens of
41 sturgeon, there is potential that the incremental increase in dissolved selenium concentration
42 projected to occur in the North Bay under Alternative 6A could result in adverse effects beneficial
43 uses.

1 **NEPA Effects:** Based on the discussion above, Alternative 6A, relative to the No Action Alternative,
2 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
3 DOC, EC, mercury, pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or
4 turbidity and TSS in the San Francisco Bay. Further, changes in these constituent concentrations in
5 Delta outflow would not be expected to cause changes in Bay concentrations of frequency,
6 magnitude, and geographic extent that would adversely affect any beneficial uses. In summary,
7 based on the discussion above, effects on the San Francisco Bay from implementation of CM1–CM21
8 are considered to be not adverse with respect to boron, bromide, chloride, DO, DOC, EC, mercury,
9 pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS.
10 However, Alternative 6A could result in increases in selenium concentrations in the North San
11 Francisco Bay that could result in adverse effects to fish and wildlife beneficial uses. This effect is
12 considered to be adverse.

13 **CEQA Conclusion:** Based on the above, Alternative 6A would not be expected to cause long-term
14 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
15 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
16 would result in substantially increased risk for adverse effects to one or more beneficial uses with
17 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
18 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Further, based on the above, this
19 alternative would not be expected to cause additional exceedance of applicable water quality
20 objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent that
21 would cause significant impacts on any beneficial uses of waters in the affected environment with
22 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
23 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Any changes in boron, bromide,
24 chloride, and DOC in the San Francisco Bay would not adversely affect beneficial uses, because the
25 uses most affected by changes in these parameters, MUN and AGR, are not beneficial uses of the Bay.
26 Further, no substantial changes in DO, pathogens, pesticides, trace metals or turbidity or TSS are
27 anticipated in the Delta, relative to Existing Conditions, therefore, no substantial changes these
28 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
29 measurable changes in Bay salinity, as the change in Delta outflow would two to three orders of
30 magnitude lower than (and thus minimal compared to) the Bay's tidal flow. Adverse changes in
31 *Microcystis* levels that could occur in the Delta would not cause adverse *Microcystis* blooms in the
32 Bay, because *Microcystis* are intolerant of the Bay's high salinity and, thus not have not been
33 detected downstream of Suisun Bay. The 5% decrease in total nitrogen load and 40% increase in
34 phosphorus load, relative to Existing Conditions, are expected to have minimal effect on water
35 quality degradation, primary productivity, or phytoplankton community composition. The estimated
36 increase in mercury load (9 kg/year; 3%) and methylmercury load (0.37 kg/year; 10%), relative to
37 Existing Conditions, is within the level of uncertainty in the mass load estimate and not expected to
38 contribute to water quality degradation, make the CWA section 303(d) mercury impairment
39 measurably worse or cause mercury/methylmercury to bioaccumulate to greater levels in aquatic
40 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans.

41 In regard to selenium, the estimated increase in selenium load would be 24% and the estimated
42 increase in dissolved selenium concentrations would be 0.03 µg/L. Though there is some
43 uncertainty in the estimate of sturgeon concentrations at western Delta locations, the predicted
44 increases are high enough that they may represent measurably higher body burdens of selenium in
45 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish). Thus,
46 the increase in selenium load may make the CWA section 303(d) selenium impairment measurably

1 worse and cause selenium to bioaccumulate to greater levels in aquatic organisms that would, in
 2 turn, pose substantial health risks to fish and wildlife. This impact is considered to be significant.
 3 *AMM27 Selenium Management*, which affords for site-specific measures to reduce effects, would be
 4 available to reduce BDCP-related effects associated with selenium. The effectiveness of AMM27 is
 5 uncertain and, therefore implementation may not reduce the identified impact to a level that would
 6 be less than significant, and therefore it is significant and unavoidable.

7 **8.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and** 8 **Intakes 1–5 (15,000 cfs; Operational Scenario D)**

9 Alternative 6B would comprise physical/structural components similar to those under Alternative
 10 1B with the principal exception that Alternative 6B would be an “isolated” conveyance, no longer
 11 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 12 Forebay and Jones Pumping Plant. Alternative 6B would utilize five screened intakes (i.e., Intakes 1
 13 through 5) to convey up to 15,000 cfs of water from the north Delta to the south Delta through a
 14 canal along the east side of the Delta. An intermediate pumping plant north of the town of Holt
 15 would be constructed as well as a new 600-acre Byron Tract Forebay located adjacent to Clifton
 16 Court Forebay. Water supply and conveyance operations would follow the guidelines described as
 17 Scenario D, which includes Fall X2. CM2–CM21 would be implemented under this alternative, and
 18 these conservation measures would be the same as those under Alternative 1A. See Chapter 3,
 19 *Description of Alternatives*, Section 3.5.12, for additional details on Alternative 6B.

20 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

21 Alternative 6B has the same diversion and conveyance operations as Alternative 6A. The primary
 22 difference between the two alternatives is that conveyance under Alternative 6B would be in a lined
 23 or unlined canal, instead of pipeline. Because there would be no difference in conveyance capacity or
 24 operations, there would be no differences between these two alternatives in upstream of Delta river
 25 flows or reservoir operations, Delta inflow, source fractions to various Delta locations, and
 26 hydrodynamics in the Delta. Conveyance of water in an open channel instead of a pipeline may
 27 result in differing physical properties (e.g., DO, pH, temperature) of the water upon reaching the
 28 south Delta export pumps than if the water was conveyed in a pipeline. However, the physical
 29 properties of water arriving at the south Delta export pumps would continue to change and would
 30 equilibrate to similar levels as Alternative 6A as it is conveyed throughout the SWP/CVP Export
 31 Service Areas. Because no substantial differences in water quality effects are anticipated anywhere
 32 in the affected environment under Alternative 6B compared to those described in detail for
 33 Alternative 6A, the water quality effects described for Alternative 6A also appropriately characterize
 34 effects under Alternative 6B.

35 **Water Quality Effects Resulting from Implementation of CM2–CM21**

36 Alternative 6B has the same conservation measures as Alternative 6A. Because no substantial
 37 differences in water quality effects are anticipated anywhere in the affected environment under
 38 Alternative 6B compared to those described in detail for Alternative 6A, the water quality effects
 39 described for Alternative 6A also appropriately characterize effects under Alternative 6B.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities**
 2 **(CM1–CM21)**

3 **NEPA Effects:** The primary difference between Alternative 6B and Alternative 1A is that under
 4 Alternative 6B, a canal would be constructed for conservation measure CM1 along the eastern side
 5 of the Delta to convey the Sacramento River water south, rather than the tunnel/pipeline features.
 6 As such, construction techniques and locations of major features of the conveyance system within
 7 the Delta would be different (see Chapter 3, *Description of Alternatives*, Section 3.5.12). The
 8 remainder of the facilities constructed under Alternative 6B, including CM2–CM21, would be very
 9 similar to, or the same as, those to be constructed for Alternative 1A.

10 The types of potential construction-related water quality effects associated with implementation of
 11 CM1 under Alternative 6B would be very similar to the effects discussed for Alternative 1A, and the
 12 effects anticipated with implementation of CM2–CM21 would be essentially identical. However,
 13 given the substantial differences in the conveyance features under CM1 with construction of a canal,
 14 there could be differences in the location, magnitude, duration, and frequency of construction
 15 activities and related water quality effects. In particular, relative to the Existing Conditions and No
 16 Action Alternative conditions, construction of the major intakes and canal features for CM1 under
 17 Alternative 6B would involve extensive general construction activities, material
 18 handling/storage/placement activities, surface soil grading/excavation/disposal and associated
 19 exposure of disturbed sites to erosion and runoff, and construction site dewatering operations.
 20 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
 21 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 22 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements would result
 23 in the potential water quality effects being largely avoided and minimized. The specific
 24 environmental commitments that would be implemented under Alternative 6B would be similar to
 25 those described for Alternative 1A with the exception that Category “B” BMPs for RTM dewatering
 26 basin construction and operations, if necessary at all, would be much reduced. Consequently,
 27 relative to Existing Conditions, Alternative 6B would not be expected to cause exceedance of
 28 applicable water quality objectives/criteria or substantial water quality degradation with respect to
 29 constituents of concern, and thus would not adversely affect any beneficial uses upstream of the
 30 Delta, in the Delta, or in the SWP and CVP service area.

31 In summary, with implementation of environmental commitments in Appendix 3B, the potential
 32 construction-related water quality effects are considered to be not adverse.

33 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
 34 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
 35 listed constituents to water bodies of the affected environment. As such, construction activities
 36 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
 37 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
 38 implemented under Alternative 6B for construction-related activities along with agency-issued
 39 permits that also contain construction related mitigation requirements to protect water quality, the
 40 construction-related effects, relative to Existing Conditions, would not be expected to cause or
 41 contribute to substantial alteration of existing drainage patterns which would result in substantial
 42 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
 43 objectives/criteria, or substantially degrade water quality with respect to the constituents of
 44 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in

1 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
 2 these findings, this impact is determined to be less than significant. No mitigation is required.

3 **8.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and** 4 **Intakes W1–W5 (15,000 cfs; Operational Scenario D)**

5 Alternative 6C would comprise physical/structural components similar to those under Alternative
 6 1C with the principal exception that Alternative 6B would be an “isolated” conveyance, no longer
 7 involving operation of the existing SWP and CVP south Delta export facilities for Clifton Court
 8 Forebay and Jones Pumping Plant. Alternative 6C would utilize five screened intakes (i.e., Intakes 1
 9 through 5) to convey up to 15,000 cfs of water from the north Delta to the south Delta through a
 10 series of canals and tunnels along the west side of the Delta. An intermediate pumping plant would
 11 be utilized and a new 600-acre forebay at Byron Tract would be constructed adjacent Clifton Court
 12 Forebay. There would be no intermediate forebay. Water supply and conveyance operations would
 13 follow the guidelines described as Scenario D, which includes Fall X2. CM2–CM21 would be
 14 implemented under this alternative, and these conservation measures would be the same as those
 15 under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.13, for additional details
 16 on Alternative 6C.

17 **Water Quality Effects Resulting from Facilities Operations and Maintenance (CM1)**

18 Alternative 6C has the same diversion and conveyance operations as Alternative 6A. The primary
 19 differences between the two alternatives are that conveyance under Alternative 6C would be in a
 20 lined or unlined canal, instead of pipeline, and the alignment of the canal would be along the
 21 western side of the Delta, rather than the eastern side. Because there would be no difference in
 22 conveyance capacity or operations, there would be no differences between these two alternatives in
 23 upstream of Delta river flows or reservoir operations, Delta inflow, source fractions to various Delta
 24 locations, and hydrodynamics in the Delta. Conveyance of water in an open channel instead of a
 25 pipeline may result in differing physical properties (e.g., DO, pH, temperature) of the water upon
 26 reaching the south Delta export pumps than if the water was conveyed in a pipeline. However, the
 27 physical properties of water arriving at the south Delta export pumps would continue to change and
 28 would equilibrate to similar levels as Alternative 6A as it is conveyed throughout the SWP/CVP
 29 Export Service Areas. Because no substantial differences in water quality effects are anticipated
 30 anywhere in the affected environment under Alternative 6C compared to those described in detail
 31 for Alternative 6A, the water quality effects described for Alternative 6A also appropriately
 32 characterize effects under Alternative 6C.

33 **Water Quality Effects Resulting from Implementation of CM2–CM21**

34 Alternative 6C has the same conservation measures as Alternative 6A. Because no substantial
 35 differences in water quality effects are anticipated anywhere in the affected environment under
 36 Alternative 6C compared to those described in detail for Alternative 6A, the water quality effects
 37 described for Alternative 6A also appropriately characterize effects under Alternative 6C.

1 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities**
2 **(CM1–CM21)**

3 **NEPA Effects:** The primary difference between Alternative 6C and Alternative 1A is that under
4 Alternative 6C, a canal would be constructed for CM1 along the western side of the Delta to convey
5 the Sacramento River water south, in addition to the tunnel/pipeline features. As such, construction
6 techniques and locations of major features of the conveyance system within the Delta would be
7 different (see Chapter 3, *Description of Alternatives*, Section 3.5.13). The remainder of the facilities
8 constructed under Alternative 6C, including CM2–CM21, would be very similar to, or the same as,
9 those to be constructed for Alternative 1A.

10 The types of potential construction-related water quality effects associated with implementation of
11 CM1 under Alternative 6C would be very similar to the effects discussed for Alternative 1A, and the
12 effects anticipated with implementation of CM2–CM21 would be essentially identical. Given the
13 substantial differences in the conveyance features under CM1 with construction of a canal in
14 addition to the tunnel/pipeline features, there could be differences in the location, magnitude,
15 duration, and frequency of construction activities and related water quality effects. In particular,
16 relative to the Existing Conditions and No Action Alternative conditions, construction of the major
17 intakes and canal features for CM1 under Alternative 6C would involve extensive general
18 construction activities, material handling/storage/placement activities, surface soil
19 grading/excavation/disposal and associated exposure of disturbed sites to erosion and runoff, and
20 construction site dewatering operations. Nevertheless, the construction of CM1, and any individual
21 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
22 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, and other agency permitted
23 construction requirements would result in the potential water quality effects being largely avoided
24 and minimized. The specific environmental commitments that would be implemented under
25 Alternative 6C would be similar to those described for Alternative 1A. However, this alternative
26 would involve environmental commitments associated with both tunnel/pipeline and canal
27 construction activities. Consequently, relative to Existing Conditions, Alternative 6C would not be
28 expected to cause exceedance of applicable water quality objectives/criteria or substantial water
29 quality degradation with respect to constituents of concern, and thus would not adversely affect any
30 beneficial uses upstream of the Delta, in the Delta, or in the SWP and CVP service area.

31 In summary, with implementation of environmental commitments in Appendix 3B, the potential
32 construction-related water quality effects are considered to be not adverse.

33 **CEQA Conclusion:** Construction-related contaminant discharges would be temporary and
34 intermittent in nature and would involve negligible, if any, discharges of bioaccumulative or 303(d)
35 listed constituents to water bodies of the affected environment. As such, construction activities
36 would not contribute measurably to bioaccumulation of contaminants in organisms or humans or
37 cause 303(d) impairments to be discernibly worse. Because environmental commitments would be
38 implemented under Alternative 6C for construction-related activities along with agency-issued
39 permits that also contain construction related mitigation requirements to protect water quality, the
40 construction-related effects, relative to Existing Conditions, would not be expected to cause or
41 contribute to substantial alteration of existing drainage patterns which would result in substantial
42 erosion or siltation on- or off-site, substantial increased frequency of exceedances of water quality
43 objectives/criteria, or substantially degrade water quality with respect to the constituents of
44 concern on a long-term average basis, and thus would not adversely affect any beneficial uses in

1 water bodies upstream of the Delta, within the Delta, or in the SWP and CVP service area. Based on
2 these findings, this impact is determined to be less than significant. No mitigation is required.

3 **8.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, 4 and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational 5 Scenario E)**

6 Alternative 7 would comprise physical/structural components similar to those under Alternative 1A
7 with the principal exception that Alternative 7 would construct only three intakes and intake
8 pumping plants (i.e., Intakes 2, 3, and 5). Alternative 7 would convey up to 9,000 cfs of water from
9 the north Delta to the south Delta through pipelines/tunnels from three screened intakes on the east
10 bank of the Sacramento River between Clarksburg and Walnut Grove. A 750-acre intermediate
11 forebay and pumping plant would be constructed near Hood. A new 600-acre Byron Tract Forebay,
12 adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to
13 the south Delta pumping plants. Water supply and conveyance operations would follow the
14 guidelines described as Scenario E, which includes Fall X2. The modifications under this enhanced
15 aquatic alternative are intended to further improve fish and wildlife habitat, especially along the San
16 Joaquin River. CM2–CM21 (CM2–CM21) would be implemented under this alternative, and would be
17 the same as those under Alternative 1A, except that 40 linear miles rather than 20 linear miles of
18 channel margin habitat would be enhanced, and 20,000 acres rather than 10,000 acres of seasonally
19 inundated floodplain would be restored. See Chapter 3, *Description of Alternatives*, Section 3.5.14, for
20 additional details on Alternative 7.

21 **Effects of the Alternative on Delta Hydrodynamics**

22 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
23 substantially affect water quality within the Delta:

- 24 ● Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
25 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
26 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
27 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
28 decreased exports of San Joaquin River water (due to increased Sacramento River water
29 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
30 also can affect water residence time and many related physical, chemical, and biological
31 variables.
- 32 ● Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
33 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
34 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
35 and above normal water years) will decrease levels of these constituents, particularly in the
36 west Delta.

37 Under Alternative 7, over the long term, average annual delta exports are anticipated to decrease by
38 1,389 TAF relative to Existing Conditions, and by 682 TAF relative to the No Action Alternative.
39 Since, over the long-term, approximately 62% of the exported water will be from the new north
40 Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of
41 the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more
42 information). The result of this is greatly increased San Joaquin River water influence throughout
43 the south, west, and interior Delta, and a corresponding decrease in Sacramento River water

1 influence. This can be seen, for example, in Appendix 8D, ALT 7–Old River at Rock Slough for ALL
 2 years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased
 3 Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No
 4 Action Alternative.

5 Under Alternative 7, long-term average annual Delta outflow is anticipated to increase 1,383 TAF
 6 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 7 capacity of 9,000 cfs and numerous other components of Operational Scenario E) and climate
 8 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this would
 9 be decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
 10 Delta under Alternative 7 would be greater relative to the Existing Conditions because Existing
 11 Conditions do not include operations to meet Fall X2, whereas the No Action Alternative and
 12 Alternative 7 do. Long-term average annual Delta outflow is anticipated to increase under
 13 Alternative 7 by 683 TAF relative to the No Action Alternative, due only to changes in operations.
 14 The decreases in sea water intrusion (represented by an decrease in San Francisco Bay (BAY)
 15 percentage) can be seen, for example, in Appendix 8D, ALT 7–Sacramento River at Mallard Island for
 16 ALL years (1976–1991).

17 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 18 **Maintenance (CM1)**

19 ***Upstream of the Delta***

20 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
 21 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 22 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 23 concentrations that could occur in the water bodies of the affected environment located upstream of
 24 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 25 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 26 ammonia.

27 ***Delta***

28 Assessment of effects of ammonia under Alternative 7 is the same as discussed under Alternative
 29 1A, except that because flows in the Sacramento River at Freeport are different between the two
 30 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 31 concentrations in the Sacramento River downstream of Freeport are different.

32 As Table 8-70 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 33 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 7 and the No
 34 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
 35 occur during January through March, July through September, November, and December, and
 36 remaining months would be unchanged or have a minor decrease. A minor increase in the annual
 37 average concentration would occur under Alternative 7, compared to the No Action Alternative.
 38 Moreover, the estimated concentrations downstream of Freeport under Alternative 7 would be
 39 similar to existing source water concentrations for the San Francisco Bay and San Joaquin River.
 40 Consequently, changes in source water fraction anticipated under Alternative 7, relative to the No
 41 Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta
 42 locations.

1 **Table 8-70. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 2 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 7**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 7	0.073	0.086	0.070	0.061	0.058	0.061	0.058	0.064	0.065	0.061	0.069	0.066	0.066

3

4 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 5 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 6 beneficial uses or substantially degrade the water quality at these locations, with regards to
 7 ammonia.

8 ***SWP/CVP Export Service Areas***

9 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 10 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 11 Alternative 1A, under Alternative 7 for areas of the Delta that are influenced by Sacramento River
 12 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
 13 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 14 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 15 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
 16 quality of exported water, with regards to ammonia.

17 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
 18 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
 19 under Alternative 7, relative to No Action Alternative. Any negligible increases in ammonia-N
 20 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
 21 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 22 degrade the water quality at these locations, with regards to ammonia.

23 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
 24 of CM1 are considered to be not adverse.

25 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 27 purpose of making the CEQA impact determination for this constituent. For additional details on the
 28 effects assessment findings that support this CEQA impact determination, see the effects assessment
 29 discussion that immediately precedes this conclusion.

30 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 31 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 32 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 33 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 34 any modified reservoir operations and subsequent changes in river flows under Alternative 7,
 35 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 36 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 37 of the Delta in the San Joaquin River watershed.

1 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 2 substantially lower under Alternative 7, relative to Existing Conditions, due to upgrades to the
 3 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 4 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 5 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 6 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 7 either of these concentrations.

8 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 9 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 10 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 11 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 7,
 12 relative to Existing Conditions.

13 There would be no substantial, long-term increase in ammonia-N concentrations in the rivers and
 14 reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the CVP and SWP
 15 service areas under Alternative 7 relative to Existing Conditions. As such, this alternative is not
 16 expected to cause additional exceedance of applicable water quality objectives/criteria by
 17 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
 18 of waters in the affected environment. Because ammonia concentrations are not expected to
 19 increase substantially, no long-term water quality degradation is expected to occur and, thus, no
 20 adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the affected
 21 environment and thus any minor increases that could occur in some areas would not make any
 22 existing ammonia-related impairment measurably worse because no such impairments currently
 23 exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in some areas
 24 would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial
 25 health risks to fish, wildlife, or humans. This impact is considered to be less than significant. No
 26 mitigation is required.

27 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 28 CM21**

29 **NEPA Effects:** Effects of CM2-CM21 on ammonia under Alternative 7 would be the same as those
 30 discussed for Alternative 1A and are considered to be not adverse.

31 **CEQA Conclusion:** CM2-CM21 proposed under Alternative 7 would be similar to conservation
 32 measures proposed under Alternative 1A. As such, effects on ammonia resulting from the
 33 implementation of CM2-CM21 would be similar to those previously discussed for Alternative 1A.
 34 This impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and 36 Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Effects of CM1 on boron under Alternative 7 in areas upstream of the Delta would be very similar to
 39 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 40 in the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 41 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 42 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin

1 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
2 project operations, climate change, and increased water demands) and would be similar compared
3 to the No Action Alternative considering only changes due to Alternative 7 operations. The reduced
4 flow would result in possible increases in long-term average boron concentrations of up to about
5 3% relative to the Existing Conditions (Appendix 8F, *Boron*, Table Bo-32). The increased boron
6 concentrations would not increase the frequency of exceedances of any applicable objectives or
7 criteria and would not be expected to cause further degradation at measurable levels in the lower
8 San Joaquin River, and thus would not cause the existing impairment there to be discernibly worse.
9 Consequently, Alternative 7 would not be expected to cause exceedance of boron objectives/criteria
10 or substantially degrade water quality with respect to boron, and thus would not adversely affect
11 any beneficial uses of the Sacramento River, the eastside tributaries, associated reservoirs upstream
12 of the Delta, or the San Joaquin River.

13 ***Delta***

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
19 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
20 information.

21 Effects of CM1 on boron under Alternative 7 in the Delta would be similar to the effects discussed for
22 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 7 would
23 result in increased long-term average boron concentrations for the 16-year period modeled at
24 interior and western Delta locations (by as much as 10% at the SF Mokelumne River at Staten Island,
25 33% at Franks Tract, and 56% at Old River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-18). The
26 comparison to Existing Conditions reflects changes due to both Alternative 7 operations (including
27 north Delta intake capacity of 9,000 cfs and numerous other components of Operational Scenario E)
28 and climate change/sea level rise. The comparison to the No Action Alternative reflects changes due
29 only to operations.

30 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
31 concentrations at western Delta assessment locations (more discussion of this phenomenon is
32 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
33 diversions which occur primarily at interior Delta locations. The long-term annual average and
34 monthly average boron concentrations, for either the 16-year period or drought period modeled,
35 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
36 agricultural objective at any of the eleven Delta assessment locations, which represents no change
37 from the Existing Conditions and the No Action Alternative (Appendix 8F, *Boron*, Table Bo-3A). The
38 increased concentrations at interior Delta locations would result in moderate reductions in the long-
39 term average assimilative capacity of up to 33% at Franks Tract and up to 56% at Old River at Rock
40 Slough locations (Appendix 8F, Table Bo-19). However, because the absolute boron concentrations
41 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
42 beneficial use under Alternative 7, the levels of boron degradation would not be of sufficient
43 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
44 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
45 (Appendix 8F, Figure Bo-5).

1 **SWP/CVP Export Service Areas**

2 Effects of CM1 on boron under Alternative 7 in the Delta would be similar to the effects discussed for
3 Alternative 1A. Under Alternative 7, long-term average boron concentrations would decrease by as
4 much as 41% at the Banks Pumping Plant and by as much as 48% at Jones Pumping Plant relative to
5 Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-18) as a result of
6 export of a greater proportion of low-boron Sacramento River water. Commensurate with the
7 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
8 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
9 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
10 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
11 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
12 Joaquin River and associated TMDL actions for reducing boron loading.

13 Maintenance of SWP and CVP facilities under Alternative 7 would not be expected to create new
14 sources of boron or contribute towards a substantial change in existing sources of boron in the
15 affected environment. Maintenance activities would not be expected to cause any substantial
16 increases in boron concentrations or degradation with respect to boron such that objectives would
17 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 7 would
20 result in relatively small long-term average increases in boron levels in the San Joaquin River and
21 moderate increases in the interior and western Delta locations Delta. However, the predicted
22 changes in the Delta would not be expected to result in exceedances of applicable objectives or
23 further water quality degradation such that objectives would likely be exceeded or there would be
24 substantially increased risk of adverse effects on water quality.

25 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
31 river flow rate and reservoir storage reductions that would occur under the Alternative 7, relative to
32 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
33 Additionally, relative to Existing Conditions, Alternative 7 would not result in reductions in river
34 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
35 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

36 Moderate increased boron levels (i.e., up to 56% increased concentration) and degradation
37 predicted for interior and western Delta locations in response to a shift in the Delta source water
38 percentages and tidal habitat restoration under this alternative would not be expected to cause
39 exceedances of objectives. Alternative 7 maintenance also would not result in any substantial
40 increases in boron concentrations in the affected environment. Boron concentrations would be
41 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
42 potential improvement to boron loading in the lower San Joaquin River.

1 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 7
 2 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 3 Existing Conditions, Alternative 7 would not result in substantially increased boron concentrations
 4 such that frequency of exceedances of municipal and agricultural water supply objectives would
 5 increase. The levels of boron degradation that may occur under Alternative 7, while widespread in
 6 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
 7 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
 8 environment. Long-term average boron concentrations would decrease in Delta water exports to the
 9 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
 10 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 7 would not be
 11 expected to cause any substantial increases in boron concentrations or degradation with respect to
 12 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
 13 adversely affected anywhere in the affected environment. Based on these findings, this impact is
 14 determined to be less than significant. No mitigation is required.

15 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

16 **NEPA Effects:** Effects of CM2–CM21 on boron under Alternative 7 would be the same as those
 17 discussed for Alternative 1A and are determined to be not adverse.

18 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 19 measures proposed under Alternative 1A. As such, effects on boron resulting from the
 20 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 21 This impact is considered to be less than significant. No mitigation is required.

22 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 23 **Maintenance (CM1)**

24 ***Upstream of the Delta***

25 Under Alternative 7 there would be no expected change to the sources of bromide in the Sacramento
 26 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
 27 and resultant changes in flows from altered system-wide operations under Alternative 7 would have
 28 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
 29 watersheds. Consequently, Alternative 7 would not be expected to adversely affect the MUN
 30 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 31 associated reservoirs upstream of the Delta.

32 Under Alternative 7, modeling indicates that long-term annual average flows on the San Joaquin
 33 River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same
 34 relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 35 *Technical Appendix*). Similar to the No Action Alternative, these decreases in flow would result in
 36 possible increases in long-term average bromide concentrations of about 3%, relative to Existing
 37 Conditions and less than <1% relative to No Action Alternative (Appendix 8E, *Bromide*, Table 24).
 38 The small increases in lower San Joaquin River bromide levels that could occur under Alternative 7,
 39 relative to existing and the No Action Alternative conditions would not be expected to adversely
 40 affect the MUN beneficial use, or any other beneficial uses, of the lower San Joaquin River.

Delta

Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter hydrodynamics within the Delta region, which affects mixing of source waters, these effects are included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more information.

Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing Conditions, Alternative 7 would result in increases in long-term average bromide concentrations at Staten Island and Barker Slough (for the modeled drought period only), while long-term average concentrations would decrease at the other assessment locations (Appendix 8E, *Bromide*, Table 16). At Barker Slough, predicted long-term average bromide concentrations would decrease from 51 µg/L to 50 µg/L (2% relative decrease) for the modeled 16-year hydrologic period, but would increase from 54 µg/L to 72 µg/L (34% relative increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L exceedance frequency would decrease from 49% under Existing Conditions to 29% under Alternative 7, but would increase slightly from 55% to 57% during the drought period. At Barker Slough, the predicted 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to 8% under Alternative 7, and would increase from 0% to 22% during the drought period. At Staten Island, predicted long-term average bromide concentrations would increase from 50 µg/L to 63 µg/L (27% relative increase) for the modeled 16-year hydrologic period and would increase from 51 µg/L to 64 µg/L (25% relative increase) for the modeled drought period. At Staten Island, increases in average bromide concentrations would correspond to an increased frequency of 50 µg/l threshold exceedance, from 47% under Existing Conditions to 80% under Alternative 7 (52% to 88% for the modeled drought period), and an increase from 1% to 2% (0% to 0% for the modeled drought period) for the 100 µg/L threshold. Changes in exceedance frequency of the 50 µg/L and 100 µg/L concentration thresholds at other assessment locations would be less considerable, with exception to Franks Tract. Although long-term average bromide concentrations were modeled to decrease at Franks Tract, exceedances of the 100 µg/L threshold would increase slightly, from 82% under Existing Conditions to 99% under Alternative 7 (78% to 97% for the modeled drought period). This comparison to Existing Conditions reflects changes in bromide due to both Alternative 7 operations (including north Delta intake capacity of 9,000 cfs and numerous other components of Operational Scenario E) and climate change/sea level rise.

Due to the relatively small differences between modeled Existing Conditions and No Action baselines, changes in long-term average bromide concentrations and changes in exceedance frequencies relative to the No Action Alternative would be generally of similar magnitude to those previously described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 16). Modeled long-term average bromide concentration at Barker Slough is predicted to increase by 1% (34% for the modeled drought period) relative to the No Action Alternative. Modeled long-term average bromide concentration increases at Staten Island are predicted to increase by 31% (29% for the modeled drought period) relative to the No Action Alternative. However, unlike the Existing Conditions comparison, long-term average bromide concentrations at Buckley Cove would increase relative to the No Action Alternative, although the increases would be relatively small ($\leq 9\%$). Unlike the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes in bromide due only to Alternative 7 operations.

1 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
2 conditions are very similar (Appendix 8E, *Bromide*, Table 16). Such similarity demonstrates that the
3 modeled Alternative 7 change in bromide is almost entirely due to Alternative 7 operations, and not
4 climate change/sea level rise. Therefore, operations are the primary driver of effects on bromide at
5 Barker Slough, regardless whether Alternative 7 is compared to Existing Conditions, or compared to
6 the No Action Alternative.

7 Results of the modeling approach which used relationships between EC and chloride and between
8 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
9 mass-balance approach (see Appendix 8E, *Bromide*, Table 17). For most locations, the frequency of
10 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
11 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
12 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
13 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
14 that presented above from the mass-balance modeling approach. Results indicate 2% exceedance
15 over the modeled period under Alternative 7, as compared to 1% under Existing Conditions and 2%
16 under the No Action Alternative. For the drought period, exceedance frequency increased from 0%
17 under Existing Conditions and the No Action Alternative, to 7% under Alternative 7. Because the
18 mass-balance approach predicts a greater level of impact at Barker Slough, determination of impacts
19 was based on the mass-balance results.

20 While the increase in long-term average bromide concentrations at Barker Slough are relatively
21 small when modeled over a representative 16-year hydrologic period, increases during the modeled
22 drought period, principally the relative increase in 100 µg/L exceedance frequency, would represent
23 a substantial change in source water quality during a season of drought. As discussed for Alternative
24 1A, drinking water treatment plants obtaining water via the North Bay Aqueduct utilize a variety of
25 conventional and enhanced treatment technologies in order to achieve DBP drinking water criteria.
26 While the implications of such a modeled drought period change in bromide concentrations at
27 Barker Slough is difficult to predict, the substantial modeled increases could lead to adverse changes
28 in the formation of disinfection byproducts such that considerable treatment plant upgrades may be
29 necessary in order to achieve equivalent levels of health protection during seasons of drought.
30 Increases at Staten Island are also considerable, although there are no existing or foreseeable
31 municipal intakes in the immediate vicinity. Because many of the other modeled locations already
32 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,
33 these locations likely already require treatment plant technologies to achieve equivalent levels of
34 health protection, and thus no additional treatment technologies would be triggered by the small
35 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
36 drinking water beneficial use would be expected at these locations.

37 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
38 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
39 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
40 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
41 Slough and City of Antioch under Alternative 7 would experience a period average increase in
42 bromide during the months when these intakes would most likely be utilized. For those wet and
43 above normal water year types where mass balance modeling would predict water quality typically
44 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 152
45 µg/L (48% increase) at City of Antioch and would increase from 150 µg/L to 204 µg/L (36%
46 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).

1 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
2 to chloride and chloride to bromide relationships show increases during these months, but the
3 relative magnitude of the increases is much lower (Appendix 8E, Table 26). Regardless of the
4 differences in the data between the two modeling approaches, the decisions surrounding the use of
5 these seasonal intakes is largely driven by acceptable water quality, and thus have historically been
6 opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
7 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
8 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

9 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
10 conditions, Alternative 7 would lead to predicted improvements in long-term average bromide
11 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
12 Jones (discussed below). At these locations, long-term average bromide concentrations would be
13 predicted to decrease by as much as 16–32%, depending on baseline comparison. Modeling results
14 using the EC to chloride and chloride to bromide relationships generally do not show similar
15 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
16 the small magnitude of increases predicted, these increases would not adversely affect beneficial
17 uses at those locations.

18 Important to the results presented above is the assumed habitat restoration footprint on both the
19 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
20 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
21 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
22 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
23 deviations from modeled habitat restoration and implementation schedule will lead to different
24 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
25 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
26 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
27 management changes to BDCP restoration activities, including location, magnitude, and timing of
28 restoration, the estimates are not predictive of the bromide levels that would actually occur in
29 Barker Slough or elsewhere in the Delta.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 7, improvement in long-term average bromide concentrations would occur at the
32 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
33 year hydrologic period at these locations would decrease by as much as 71% relative to Existing
34 Conditions and 67% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 16). As a
35 result, exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be substantially
36 reduced, resulting in considerable overall improvement in Export Service Areas water quality
37 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in
38 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
39 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
40 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
41 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
42 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
43 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
44 much of the south Delta.

1 The discussion above is based on results of the mass-balance modeling approach. Results of the
2 modeling approach which used relationships between EC and chloride and between chloride and
3 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
4 using these data results in the same conclusions as are presented above for the mass-balance
5 approach (see Appendix 8E, *Bromide*, Table 17).

6 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
7 facilities under Alternative 7 would not be expected to create new sources of bromide or contribute
8 towards a substantial change in existing sources of bromide in the affected environment.
9 Maintenance activities would not be expected to cause any substantial change in bromide such that
10 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
11 affected environment.

12 **NEPA Effects:** In summary, Alternative 7 operations and maintenance, relative to the No Action
13 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
14 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
15 However, Alternative 7 operation and maintenance activities would cause substantial degradation
16 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
17 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
18 changes in water treatment plant operations or require treatment plant upgrades in order to
19 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
20 Measure WQ-5 is available to reduce these effects. Implementation of this measure along with a
21 separate other commitment as set forth in Appendix 3B, *Environmental Commitments, AMMs, and*
22 *CMs*, relating to the potential increased treatment costs associated with bromide-related changes
23 would reduce these effects.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
26 purpose of making the CEQA impact determination for this constituent. For additional details on the
27 effects assessment findings that support this CEQA impact determination, see the effects assessment
28 discussion that immediately precedes this conclusion.

29 Under Alternative 7 there would be no expected change to the sources of bromide in the Sacramento
30 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
31 and resultant changes in flows from altered system-wide operations under Alternative 7 would have
32 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
33 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
34 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
35 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 7, long-term
36 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
37 increases in long-term average bromide of about 3% relative to Existing Conditions.

38 Relative to Existing Conditions, Alternative 7 would result in substantial increases in long-term
39 average bromide concentration at Staten Island and Barker Slough (for the modeled drought period
40 only). There are no existing or foreseeable municipal drinking water intakes in the vicinity of Staten
41 Island, but Barker Slough is the source of the North Bay Aqueduct. While the increase in long-term
42 average bromide concentrations at Barker Slough are predicted to be relatively small when modeled
43 over a representative 16-year hydrologic period, increases during the modeled drought period
44 would represent a substantial change in source water quality during a season of drought. These

1 predicted drought season related increases in bromide at Barker Slough could lead to adverse
2 changes in the formation of disinfection byproducts at drinking water treatment plants such that
3 considerable water treatment plant upgrades would be necessary in order to achieve equivalent
4 levels of drinking water health protection.

5 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
6 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 7,
7 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
8 long-term average bromide concentrations are predicted to decrease by as much as 71% relative to
9 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
10 in the SWP/CVP Export Service Areas.

11 Based on the above, Alternative 7 operation and maintenance would not result in any substantial
12 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
13 Alternative 7, water exported from the Delta to the SWP/CVP service area would be substantially
14 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
15 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
16 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 7
17 operation and maintenance activities would not cause substantial long-term degradation to water
18 quality respective to bromide with the exception of water quality at Barker Slough (drought period
19 only) and at Staten Island in the eastern Delta. There are no existing or foreseeable municipal
20 intakes in the vicinity of Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At
21 Barker Slough, modeled long-term annual average concentrations of bromide would increase by
22 34% during the modeled drought period. For the modeled 1 drought period the frequency of
23 predicted bromide concentrations exceeding 100 µg/L would increase from 0% under Existing
24 Conditions to 22% under Alternative 7. Substantial changes in long-term average bromide during
25 seasons of drought could necessitate changes in treatment plant operation or require treatment
26 plant upgrades in order to maintain DBP compliance. The model predicted change at Barker Slough
27 during the drought period is substantial and, therefore, would represent a substantially increased
28 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
29 undertaken. The impact is considered significant.

30 Implementation of Mitigation Measure WQ-5 along with a separate other commitment relating to
31 the potential increased treatment costs associated with bromide-related changes would reduce
32 these effects. While mitigation measures to reduce these water quality effects in affected water
33 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
34 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
35 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
36 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
37 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
38 discussion of Alternative 1A.

39 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
40 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
41 separate other commitment to address the potential increased water treatment costs that could
42 result from bromide-related concentration effects on municipal water purveyor operations.
43 Potential options for making use of this financial commitment include funding or providing other
44 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
45 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing

1 water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that
 2 could be taken pursuant to this commitment in order to reduce the water quality treatment costs
 3 associated with water quality effects relating to chloride, electrical conductivity, and bromide.

4 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 5 **Conditions**

6 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

7 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 8 **CM21**

9 **NEPA Effects:** CM2–CM21 under Alternative 7 would be similar to conservation measures under
 10 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
 11 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
 12 restored. As discussed for Alternative 1A, implementation of the CM2–CM21 would not present new
 13 or substantially changed sources of bromide to the study area. Some conservation measures may
 14 replace or substitute for existing irrigated agriculture in the Delta. This replacement or substitution
 15 is not expected to substantially increase or present new sources of bromide. CM2–CM21 would not
 16 be expected to cause any substantial change in bromide such that MUN beneficial uses, or any other
 17 beneficial use, would be adversely affected anywhere in the affected environment.

18 In summary, implementation of CM2–CM21 under Alternative 7, relative to the No Action
 19 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 20 from implementing CM2–CM21 are determined to not be adverse.

21 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 22 measures proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
 23 CM21 would not present new or substantially changed sources of bromide to the study area. As
 24 such, effects on bromide resulting from the implementation of CM2–CM21 would be similar to those
 25 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 26 mitigation is required.

27 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 Under Alternative 7 there would be no expected change to the sources of chloride in the Sacramento
 31 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 32 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 33 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
 34 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
 35 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
 36 result of climate change). The reduced flow would result in possible increases in long-term average
 37 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
 38 Action Alternative (Appendix 8G, *Chloride*, Table CI-62). Consequently, Alternative 7 would not be
 39 expected to cause exceedance of chloride objectives/criteria or substantially degrade water quality
 40 with respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento
 41 River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
7 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
8 information.

9 Relative to the Existing Conditions and No Action Alternative, Alternative 7 would result in similar
10 or reduced long-term average chloride concentrations for the 16-year period modeled at most of the
11 assessment locations, and, depending on modeling approach (see Section 8.3.1.3) increased
12 concentrations at the Contra Costa Canal at Pumping Plant #1 (i.e., up to 29% compared to No
13 Action Alternative), Rock Slough (i.e., up to 22% compared to No Action Alternative), and the SF
14 Mokelumne at Staten Island (i.e., up to 28% compared to Existing Conditions and No Action
15 Alternative) (Appendix 8G, *Chloride*, Table CI-43 and Table CI-44). Moreover, the direction and
16 magnitude of predicted changes for Alternative 7 are similar between the alternatives, thus, the
17 effects relative to Existing Conditions and the No Action Alternative are discussed together.
18 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
19 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
20 Bay source water as a result of increased salinity intrusion. More discussion of this phenomenon is
21 included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may
22 be greater than indicated herein and would affect the western Delta assessment locations the most
23 which are influenced to the greatest extent by the Bay source water. The comparison to Existing
24 Conditions reflects changes in chloride due to both Alternative 7 operations (including north Delta
25 intake capacity of 9,000 cfs and numerous other components of Operational Scenario E) and climate
26 change/sea level rise. The comparison to the No Action Alternative reflects changes in chloride due
27 only to operations. The following outlines the modeled chloride changes relative to the applicable
28 objectives and beneficial uses of Delta waters.

29 *Municipal Beneficial Uses*

30 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
31 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
32 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
33 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
34 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
35 Pumping Plant #1 locations. For Alternative 7, the modeled frequency of objective exceedance
36 would increase from 7% of years under Existing Conditions and 0% under the No Action Alternative
37 to 20% of years under Alternative 7 (Appendix 8G, *Chloride*, Table CI-64).

38 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
39 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
40 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
41 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
42 year period. For Alternative 7, the modeled frequency of objective exceedance would decrease, from
43 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
44 modeled days under Alternative 7 (Appendix 8G, *Chloride*, Table CI-63).

1 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
2 estimation of chloride concentrations through both a mass balance approach and an EC-chloride
3 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
4 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
5 approach to model monthly average chloride concentrations for the 16-year period, the predicted
6 frequency of exceeding the 250 mg/L objective would decrease up to 12% (i.e., 24% for Existing
7 Conditions to 12%) at the Contra Costa Canal at Pumping Plant #1 (Appendix 8G, *Chloride*, Table Cl-
8 45 and Figure Cl-13). The frequency of exceedances would decrease at the San Joaquin River at
9 Antioch (i.e., from 66% under Existing Conditions to 60%) with no substantial change predicted for
10 Mallard Island (i.e., maximum increase of 1%) (Appendix 8G, Table Cl-45) and no substantial long-
11 term degradation (Appendix 8G, Table Cl-47). However, relative to the No Action conditions,
12 available assimilative capacity for chloride at the Contra Costa Canal at Pumping Plant #1 would be
13 substantially reduced in August through October (i.e., reduction ranging from 35% to 74% for the 16
14 year period modeled, and 100% in August and September [i.e., eliminated]) (Appendix 8G, Table Cl-
15 47), thus reflecting substantial degradation when concentrations would be near, or exceed, the
16 objective.

17 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
18 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
19 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, *Chloride*, Table
20 Cl-46 and Table Cl-48). Specifically, while the model predicted exceedance frequency would
21 decrease at the Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of
22 assimilative capacity would increase substantially for the months of February through June as well
23 as September (i.e., maximum of 82% in March for the modeled drought period). Due to such
24 seasonal long-term average water quality degradation at these locations, the potential exists for
25 substantial adverse effects on the municipal and industrial beneficial uses through reduced
26 opportunity for diversion of water with acceptable chloride levels. Moreover, due to the increased
27 frequency of exceeding the 150 mg/L Bay-Delta WQCP objective, the potential exists for adverse
28 effects on the municipal and industrial beneficial uses at Contra Costa Pumping Plant #1 and
29 Antioch.

30 *303(d) Listed Water Bodies*

31 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
32 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
33 nearest DSM2-modeled location to Tom Paine in the south Delta, would generally be similar
34 compared to Existing Conditions and No Action Alternative, and thus, would not be further degraded
35 on a long-term basis (Appendix 8G, Figure Cl-14).

36 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
37 modeled would generally increase compared to Existing Conditions and No Action Alternative in
38 some months during October through May at the Sacramento River at Collinsville (Appendix 8G,
39 Figure Cl-15), Mallard Island (Appendix 8G, Figure Cl-13), and increase substantially at Montezuma
40 Slough at Beldon's Landing (i.e., over a doubling of concentration in December through February)
41 (Appendix 8G, Figure Cl-16). Although modeling of Alternative 7 assumed no operation of the
42 Montezuma Slough Salinity Control Gates, the project description assumes continued operation of
43 the Salinity Control Gates, consistent with assumptions included in the No Action Alternative. A
44 sensitivity analysis modeling run conducted for Alternative 4 with the gates operational consistent
45 with the No Action Alternative resulted in substantially lower EC levels than indicated in the original

1 Alternative 4 modeling results for Suisun Marsh, but EC levels were still somewhat higher than EC
 2 levels under Existing Conditions for several locations and months. Although chloride was not
 3 specifically modeled in this sensitivity analysis, it is expected that chloride concentrations would be
 4 nearly proportional to EC levels in Suisun Marsh. Another modeling run with the gates operational
 5 and restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions,
 6 indicating that design and siting of restoration areas has notable bearing on EC levels at different
 7 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
 8 sensitivity analyses). These analyses also indicate that increases in salinity are related primarily to
 9 the hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity
 10 analyses, optimizing the design and siting of restoration areas may limit the magnitude of long-term
 11 chloride increases in the Marsh. However, the chloride concentration increases at certain locations
 12 could be substantial, depending on siting and design of restoration areas. Thus, these increased
 13 chloride levels in Suisun Marsh are considered to contribute to additional, measureable long-term
 14 degradation that potentially would adversely affect the necessary actions to reduce chloride loading
 15 for any TMDL that is developed.

16 ***SWP/CVP Export Service Areas***

17 Under Alternative 7, long-term average chloride concentrations based on the mass balance analysis
 18 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
 19 decrease by as much as 70% relative to Existing Conditions and 66% compared to No Action
 20 Alternative (Appendix 8G, *Chloride*, Table Cl-43). The modeled frequency of exceedances of
 21 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
 22 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
 23 *Chloride*, Table Cl-45). Consequently, water exported into the SWP/CVP service area would
 24 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
 25 the No Action Alternative conditions.

26 Results of the modeling approach which used relationships between EC and chloride (see Section
 27 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
 28 results in the same conclusions as are presented above for the mass-balance approach (Appendix
 29 8G, *Chloride*, Table Cl-44 and Table Cl-46).

30 Commensurate with the reduced chloride concentrations in water exported to the service area,
 31 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
 32 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
 33 San Joaquin River flows (see discussion of Upstream of the Delta).

34 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
 35 contribute towards a substantial change in existing sources of chloride in the affected environment.
 36 Maintenance activities would not be expected to cause any substantial change in chloride such that
 37 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
 38 affected anywhere in the affected environment.

39 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 7 would
 40 result in substantial increased water quality degradation relative to the 150 mg/L Bay-Delta WCCP
 41 objective at Contra Costa Pumping Plant #1 and Antioch, substantial seasonal use of assimilative
 42 capacity at Contra Costa Pumping Plant #1 and Rock Slough, and potentially measureable water
 43 quality degradation relative to the 303(d) impairment in Suisun Marsh. The predicted chloride
 44 increases constitute an adverse effect on water quality (see Mitigation Measure WQ-7;

1 implementation of this measure along with a separate other commitment relating to the potential
2 increased chloride treatment costs would reduce these effects). Additionally, the predicted changes
3 relative to the No Action Alternative conditions indicate that in addition to the effects of climate
4 change/sea level rise, implementation of CM1 and CM4 under Alternative 7 would contribute
5 substantially to the adverse water quality effects.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
8 purpose of making the CEQA impact determination for this constituent. For additional details on the
9 effects assessment findings that support this CEQA impact determination, see the effects assessment
10 discussion that immediately precedes this conclusion.

11 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
12 thus river flow rate and reservoir storage reductions that would occur under the Alternative 7,
13 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
14 chloride levels. Additionally, relative to Existing Conditions, the Alternative 7 would not result in
15 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
16 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
17 watershed.

18 Relative to Existing Conditions, Alternative 7 operations would result in reduced chloride
19 concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP objective at the
20 San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless, due to the
21 predicted increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at Contra Costa
22 Pumping Plant #1 and Antioch as well as substantial seasonal use of assimilative capacity at Contra
23 Costa Pumping Plant #1 and Rock Slough, the potential exists for adverse effects on the municipal
24 and industrial beneficial uses at Contra Costa Pumping Plant #1 and Antioch (see Mitigation
25 Measure WQ-7; implementation of this measure along with a separate other commitment relating to
26 the potential increased chloride treatment costs would reduce these effects). Moreover, the modeled
27 increased chloride concentrations and degradation in the western Delta could further contribute, at
28 measurable levels, to the existing 303(d) listed impairment due to chloride in Suisun Marsh for the
29 protection of fish and wildlife.

30 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
31 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
32 River.

33 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
34 7 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
35 Alternative 7 maintenance would not result in any substantial changes in chloride concentration
36 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
37 this impact is determined to be significant due to increased chloride concentrations and frequency
38 of objective exceedance in the western Delta, as well as potential adverse effects on aquatic life
39 beneficial uses in the interior Delta and fish and wildlife beneficial uses in Suisun Marsh.

40 While mitigation measures to reduce these water quality effects in affected water bodies to less-
41 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
42 recommended to attempt to reduce the effect that increased chloride concentrations may have on
43 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
44 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain

1 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
2 discussion of Alternative 1A.

3 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
4 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
5 separate other commitment to address the potential increased water treatment costs that could
6 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
7 operations. Potential options for making use of this financial commitment include funding or
8 providing other assistance towards acquiring alternative water supplies or towards modifying
9 existing operations when chloride concentrations at a particular location reduce opportunities to
10 operate existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
11 potential actions that could be taken pursuant to this commitment in order to reduce the water
12 quality treatment costs associated with water quality effects relating to chloride, electrical
13 conductivity, and bromide.

14 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
15 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

16 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

17 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
18 **CM21**

19 **NEPA Effects:** Under Alternative 7, the types and geographic extent of effects on chloride
20 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
21 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
22 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
23 affected environment. Moreover, some habitat restoration conservation measures (CM4–CM10)
24 would occur on lands within the Delta currently used for irrigated agriculture, thus replacing
25 agricultural land uses with restored tidal wetlands, floodplain, and related channel margin and off-
26 channel habitats. The potential reduction in irrigated lands within the Delta may result in reduced
27 discharges of agricultural field drainage with elevated chloride concentrations, which would be
28 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

29 In summary, based on the discussion above, the effects on chloride from implementing CM2–CM21
30 are considered to be not adverse.

31 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 7 would not present new or
32 substantially changed sources of chloride to the affected environment upstream of the Delta, within
33 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
34 with habitat restoration conservation measures may result in some reduction in discharge of
35 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
36 quality conditions. Based on these findings, this impact is considered to be less than significant. No
37 mitigation is required.

38 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
39 **Maintenance (CM1)**

40 **NEPA Effects:** Effects of CM1 on DO under Alternative 7 would be the same as those discussed for
41 Alternative 1A and are considered to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 7 would be similar to those discussed for
 2 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance
 3 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 4 constituent. For additional details on the effects assessment findings that support this CEQA impact
 5 determination, see the effects assessment discussion under Alternative 1A.

6 Reservoir storage reductions that would occur under Alternative 7, relative to Existing Conditions,
 7 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
 8 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
 9 Similarly, river flow rate reductions that would occur would not be expected to result in a
 10 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
 11 flows would remain within the ranges historically seen under Existing Conditions and the affected
 12 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
 13 water temperature would not be expected to cause DO levels to be outside of the range seen
 14 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
 15 change sufficiently to affect DO levels.

16 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 17 Delta source water percentages under this alternative or substantial degradation of these water
 18 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 19 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 20 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 21 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 22 the reaeration of Delta waters would not be expected to change substantially.

23 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 24 Export Service Areas waters under Alternative 7, relative to Existing Conditions. Because the
 25 biochemical oxygen demand of the exported water would not be expected to substantially differ
 26 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 27 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 28 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 29 downstream reservoirs.

30 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 31 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 32 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 33 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 34 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 35 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 36 related impairment of these areas would not be expected. This impact would be less than significant.
 37 No mitigation is required.

38 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

39 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 7 would be the same as those
 40 discussed for Alternative 1A and are considered to not be adverse.

41 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 42 measures proposed under Alternative 1A. As such, effects on DO resulting from the implementation

1 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 4 **Operations and Maintenance (CM1)**

5 ***Upstream of the Delta***

6 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
7 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
8 the San Joaquin River upstream of the Delta under Alternative 7 are not expected to be outside the
9 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
10 minor changes in EC levels that could occur under Alternative 7 in water bodies upstream of the
11 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
12 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

13 ***Delta***

14 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
15 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
16 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
17 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
18 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
19 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
20 information.

21 Relative to Existing Conditions, Alternative 7 would result in an increase in the number of days the
22 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, and the San
23 Joaquin River at San Andreas Landing, Prisoners Point, and Brandt Bridge (Appendix 8H, *Electrical*
24 *Conductivity*, Table EC-7).

25 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
26 (1976–1991) would increase from 6% under Existing Conditions to 19% under Alternative 7, and
27 the percent of days out of compliance would increase from 11% under Existing Conditions to 29%
28 under Alternative 7.

29 The percentage of days the San Andreas Landing EC objective would be exceeded would increase
30 from 1% under Existing Conditions to 4% under Alternative 7, and the percentage of days out of
31 compliance with the EC objective would increase from 1% under Existing Conditions to 7% under
32 Alternative 7. Sensitivity analyses were performed for Alternative 4 Scenario H3, and indicated that
33 many similar exceedances were modeling artifacts, and the small number of remaining exceedances
34 were small in magnitude, lasted only a few days, and could be addressed with real time operations
35 of the SWP and CVP (see Section 8.3.1.1 for a description of real time operations of the SWP and
36 CVP). Due to similarities in the nature of the exceedances between alternatives, the findings from
37 these analyses can be extended to this alternative as well.

38 The percentage of days the Prisoners Point EC objective would be exceeded for the entire period
39 modeled would increase from 6% under Existing Conditions to 40% under Alternative 7, and the
40 percentage of days out of compliance with the EC objective would increase from 10% under Existing
41 Conditions to 40% under Alternative 7. Sensitivity analyses conducted for Alternative 4 Scenario H3
42 indicated that removing all tidal restoration areas would reduce the number of exceedances, but

1 there would still be substantially more exceedances than under Existing Conditions or the No Action
2 Alternative. Results of the sensitivity analyses indicate that the exceedances are partially a function
3 of the operations of the alternative itself, perhaps due to Head of Old River Barrier assumptions and
4 south Delta export differences (see Appendix 8H, *Electrical Conductivity*, Attachment 1, for more
5 discussion of these sensitivity analyses). Due to similarities in the nature of the exceedances
6 between alternatives, the findings from these analyses can be extended to this alternative as well.
7 Appendix 8H, Attachment 2, contains a more detailed assessment of the likelihood of these
8 exceedances impacting aquatic life beneficial uses. Specifically, Appendix 8H, Attachment 2,
9 discusses whether these exceedances might have indirect effects on striped bass spawning in the
10 Delta, and concludes that the high level of uncertainty precludes making a definitive determination.

11 In the San Joaquin River at Brandt Bridge, the percentage of days exceeding the EC objective would
12 increase from 3% under Existing Conditions to 4% under Alternative 7; the percentage of days out
13 of compliance would increase from 8% under Existing Conditions to 9% under Alternative 7. These
14 changes are minimal, and are not considered substantial in light of overall modeling uncertainty.

15 Average EC levels at the western and southern Delta compliance locations and San Joaquin River at
16 San Andreas Landing (an interior Delta location) would decrease from 0–46% for the entire period
17 modeled and 2–45% during the drought period modeled (1987–1991) (Appendix 8H, Table EC-18).
18 In the S. Fork Mokelumne River at Terminous, average EC would increase 6% for the entire period
19 modeled and 5% during the drought period modeled. Average EC in the S. Fork Mokelumne River at
20 Terminous would increase during all months (Appendix 8H, Table EC-18). Average EC in the San
21 Joaquin River at Prisoners Point would increase by 1% during the drought period (Appendix 8H,
22 Table EC-18). Given that the western Delta is Clean Water Act section 303(d) listed as impaired due
23 to elevated EC, the increase in the incidence of exceedance of EC objectives under Alternative 7,
24 relative to Existing Conditions, has the potential to contribute to additional impairment and
25 potentially adversely affect beneficial uses. The comparison to Existing Conditions reflects changes
26 in EC due to both Alternative 7 operations (including north Delta intake capacity of 9,000 cfs and
27 numerous other components of Operational Scenario E) and climate change/sea level rise.

28 Relative to the No Action Alternative, the percentage of days exceeding EC objectives and percentage
29 of days out of compliance would increase at: Sacramento River at Emmaton, San Joaquin River at
30 Jersey Point, San Andreas Landing, Vernalis, Brandt Bridge, and Prisoners Point; and Old River near
31 Middle River and at Tracy Bridge (Appendix 8H, *Electrical Conductivity*, Table EC-7). The increase in
32 percentage of days exceeding the EC objective would be 39% at Prisoners Point and 5% or less at
33 the remaining locations. The increase in percentage of days out of compliance would be 30% at
34 Prisoners Point and 6% or less at the remaining locations. For the entire period modeled, average EC
35 levels would increase at: S. Fork Mokelumne River (6%), Old River at Tracy Bridge (1%), and San
36 Joaquin River at Prisoners Point (10%) (Appendix 8H, Table EC-18). During the drought period
37 modeled, average EC would increase at: S. Fork Mokelumne River (6%), San Joaquin River at Brandt
38 Bridge (1%) and Prisoners Point (8%), and Old River at Tracy Bridge (1%) (Appendix 8H, Table EC-
39 18). Given that the western and southern Delta are Clean Water Act section 303(d) listed as
40 impaired due to elevated EC, the increase in the incidence of exceedance of EC objectives under
41 Alternative 7, relative to the No Action Alternative, has the potential to contribute to additional
42 impairment and potentially adversely affect beneficial uses. The comparison to the No Action
43 Alternative reflects changes in EC due only to Alternative 7 operations (including north Delta intake
44 capacity of 9,000 cfs and numerous other components of Operational Scenario E).

1 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
2 fish and wildlife apply. Long-term average EC would increase under Alternative 7, relative to
3 Existing Conditions, during the months of April and May by 0.2 mS/cm in the Sacramento River at
4 Collinsville (Appendix 8H, *Electrical Conductivity*, Table EC-21). Long-term average EC would
5 decrease relative to Existing Conditions in Montezuma Slough at National Steel during October–May
6 (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon Landing, with
7 long-term average EC levels increasing by 0.8–3.3 mS/cm, depending on the month, nearly doubling
8 during some months the long-term average EC relative to Existing Conditions (Appendix 8H, Table
9 EC-23). Sunrise Duck Club and Volanti Slough also would have long-term average EC increases of
10 0.1–1.6 mS/cm (Appendix 8H, Tables EC-24 and EC-25). Modeling of this alternative assumed no
11 operation of the Montezuma Slough Salinity Control Gates, but the project description assumes
12 continued operation of the Salinity Control Gates, consistent with assumptions included in the No
13 Action Alternative. A sensitivity analysis modeling run conducted for Alternative 4 Scenario H3 with
14 the gates operational consistent with the No Action Alternative resulted in substantially lower EC
15 levels than indicated in the original Alternative 4 modeling results, but EC levels were still
16 somewhat higher than EC levels under Existing Conditions and the No Action Alternative for several
17 locations and months. Another modeling run with the gates operational and restoration areas
18 removed resulted in EC levels nearly equivalent to Existing Conditions and the No Action
19 Alternative, indicating that design and siting of restoration areas has notable bearing on EC levels at
20 different locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on
21 these sensitivity analyses). These analyses also indicate that increases are related primarily to the
22 hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity analyses,
23 optimizing the design and siting of restoration areas may limit the magnitude of long-term EC
24 increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the EC increases
25 between alternatives, the findings from these analyses can be extended to this alternative as well.

26 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
27 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
28 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
29 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
30 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
31 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
32 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
33 certain locations could be substantial, depending on siting and design of restoration areas, and it is
34 uncertain the degree to which current management plans for the Suisun Marsh would be able to
35 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
36 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
37 Long-term average EC increases in Suisun Marsh under Alternative 7 relative to the No Action
38 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh is section
39 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
40 concentrations could contribute to additional impairment.

41 ***SWP/CVP Export Service Areas***

42 At the Banks and Jones pumping plants, Alternative 7 would result in no exceedances of the Bay-
43 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, *Electrical*
44 *Conductivity*, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
45 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 7.

1 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 7
2 would decrease substantially: 47% for the entire period modeled and 51% during the drought
3 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 43% for
4 the entire period modeled and 46% during the drought period modeled (Appendix 8H, Table EC-18).

5 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 7
6 would also decrease substantially: 52% for the entire period modeled and 59% during the drought
7 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 50% for
8 the entire period modeled and 57% during the drought period modeled. (Appendix 8H, Table EC-18)

9 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
10 pumping plants, Alternative 7 would not cause degradation of water quality with respect to EC in
11 the SWP/CVP Export Service Areas; rather, Alternative 7 would improve long-term average EC
12 conditions in the SWP/CVP Export Service Areas.

13 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
14 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
15 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
16 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
17 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
18 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
19 impact discussion under the No Action Alternative).

20 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
21 elevated EC. Alternative 7 would result in lower average EC levels relative to Existing Conditions and
22 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
23 related to elevated EC in the SWP/CVP Export Service Areas waters.

24 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives in the western
25 Delta under Alternative 7, relative to the No Action Alternative, would contribute to adverse effects
26 on the agricultural beneficial uses. In addition, the increased frequency of exceedance of the San
27 Joaquin River at Prisoners Point EC objective and long-term and drought period average EC could
28 contribute to adverse effects on fish and wildlife beneficial uses (specifically, indirect adverse effects
29 on striped bass spawning), though there is a high degree of uncertainty associated with this impact.
30 Given that the western Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC,
31 the increase in the incidence of exceedance of EC objectives in this portion of the Delta has the
32 potential to contribute to additional beneficial use impairment. The increases in long-term average
33 EC levels that could occur in Suisun Marsh would further degrade existing EC levels and could
34 contribute to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is section 303(d)
35 listed as impaired due to elevated EC, and the potential increases in long-term average EC levels
36 could contribute to additional beneficial use impairment. These increases in EC constitute an
37 adverse effect on water quality. Mitigation Measure WQ-11 would be available to reduce these
38 effects. Implementation of this measure along with a separate other commitment as set forth in
39 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-related
40 changes would reduce these effects.

41 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
43 purpose of making the CEQA impact determination for this constituent. For additional details on the

1 effects assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 River flow rate and reservoir storage reductions that would occur under Alternative 7, relative to
4 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
5 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
6 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
7 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
8 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
9 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
10 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
11 Delta.

12 Relative to Existing Conditions, Alternative 7 would not result in any substantial increases in long-
13 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
14 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
15 would decrease at both plants and, thus, this alternative would not contribute to additional
16 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
17 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
18 relative to Existing Conditions.

19 In the Plan Area, Alternative 7 would result in an increase in the frequency with which Bay-Delta
20 WQCP EC objectives are exceeded in the Sacramento River at Emmaton (agricultural objective; 13%
21 increase), and San Joaquin River at Prisoners Point (fish and wildlife objective; 34% increase) in the
22 interior Delta for the entire period modeled (1976–1991). The increased frequency of exceedance of
23 the fish and wildlife objective at Prisoners Point could contribute to adverse effects on aquatic life
24 (specifically, indirect adverse effects on striped bass spawning), though there is a high degree of
25 uncertainty associated with this impact. The increased frequency of the EC exceedance at Emmaton
26 could contribute to adverse effects on agricultural uses. Because EC is not bioaccumulative, the
27 increases in long-term average EC levels would not directly cause bioaccumulative problems in
28 aquatic life or humans. The western Delta is Clean Water Act section 303(d) listed for elevated EC
29 and the increased frequency of exceedance of EC objectives that would occur in this portion of the
30 Delta could make beneficial use impairment measurably worse. This impact is considered to be
31 significant.

32 Further, relative to Existing Conditions, Alternative 7 could result in substantial increases in long-
33 term average EC during the months of October through May in Suisun Marsh. The increases in long-
34 term average EC levels that could occur in Suisun Marsh could further degrade existing EC levels and
35 thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because EC is
36 not bioaccumulative, the increases in long-term average EC levels would not directly cause
37 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
38 elevated EC and the increases in long-term average EC that would occur in the marsh could make
39 beneficial use impairment measurably worse. This impact is considered to be significant.

40 Implementation of Mitigation Measure WQ-11 along with a separate other commitment relating to
41 the potential increased costs associated with EC-related changes would reduce these effects. While
42 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
43 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
44 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.

1 However, because the effectiveness of this mitigation measure to result in feasible measures for
 2 reducing water quality effects is uncertain, this impact is considered to remain significant and
 3 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
 4 Alternative 1A.

5 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 6 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*,
 7 *AMMs*, and *CMs*, a separate other commitment to address the potential increased water treatment
 8 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 9 purveyor operations. Potential options for making use of this financial commitment include funding
 10 or providing other assistance towards acquiring alternative water supplies or towards modifying
 11 existing operations when EC concentrations at a particular location reduce opportunities to operate
 12 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
 13 actions that could be taken pursuant to this commitment in order to reduce the water quality
 14 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
 15 bromide.

16 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 17 **Quality Conditions**

18 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

19 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
 20 **CM21**

21 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 7 would be the same as those discussed
 22 for Alternative 1A and are considered not to be adverse.

23 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 24 measures proposed under Alternative 1A. As such, effects on EC resulting from the implementation
 25 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 26 considered to be less than significant. No mitigation is required.

27 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 Under Alternative 7, the magnitude and timing of reservoir releases and river flows upstream of the
 31 Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 32 Existing Conditions and the No Action Alternative.

33 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 34 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 35 relationships for mercury and methylmercury. No significant, predictive regression relationships
 36 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 37 (monthly or annual) (Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
 38 total mercury and flow is to be expected based on the association of mercury with suspended
 39 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the
 40 Sacramento River under Alternative 7 relative to Existing Conditions and the No Action Alternative
 41 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is

1 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
2 In addition, even though it may be flow-affected, total mercury concentrations remain well below
3 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
4 the water bodies of the affected environment located upstream of the Delta would not be of
5 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
6 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
7 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
8 remain above guidance levels at upstream of Delta locations, but will not change substantially
9 relative to Existing Conditions or the No Action Alternative due to changes in flows under
10 Alternative 7.

11 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
12 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
13 Mercury Control Program. These projects will target specific sources of mercury and methylation
14 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
15 The implementation of these projects could help to ensure that upstream of Delta environments will
16 not be substantially degraded for water quality with respect to mercury or methylmercury.

17 **Delta**

18 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
19 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
20 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
21 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
22 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
23 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
24 information.

25 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
26 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
27 change in assimilative capacity of waterborne total mercury of Alternative 7 relative to the 25 ng/L
28 ecological risk benchmark as compared to Existing Conditions showed a 7% reduction at Old River
29 at Rock Slough and Contra Costa Pumping Plant, and a 6.6% reduction at those same locations
30 relative to the No Action Alternative. These changes are not expected to result in adverse effects to
31 beneficial use (Figures 8-53a and 8-54a). Similarly, changes in methylmercury concentration are
32 expected to be relatively small. The greatest annual average methylmercury concentration for
33 drought conditions was 0.164 ng/L for the San Joaquin River at Buckley Cove which was slightly
34 higher than Existing Conditions (0.161 ng/L), and slightly lower than the No Action Alternative
35 (0.167 ng/L) (Appendix 8I, *Mercury*, Table I-6). All modeled input concentrations exceeded the
36 methylmercury TMDL guidance objective of 0.06 ng/L, therefore percentage change in assimilative
37 capacity was not evaluated for methylmercury.

38 Fish tissue estimates show substantial percentage increases in concentration and exceedance
39 quotients for mercury at some Delta locations. The greatest changes in exceedance quotients
40 relative to Existing Conditions and the No Action Alternative are 30–39% at the Contra Costa
41 Pumping Plant and 32–45% for Old River at Rock Slough (Figures 8-55a and 8-55b; Appendix 8I,
42 Table I-14b). Because these increases are substantial, and it is evident that substantive increases are
43 expected at numerous locations throughout the Delta, these changes may be measurable in the

1 environment. See Appendix 8I for a discussion of the uncertainty associated with the fish tissue
2 estimates.

3 **SWP/CVP Export Service Areas**

4 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
5 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
6 methylmercury concentrations for Alternative 7 are projected to be lower than Existing Conditions
7 and the No Action Alternative (Appendix 8I, *Mercury*, Figures I-8 and I-9). Therefore, mercury shows
8 an increased assimilative capacity at these locations (Figures 8-53a and 8-54a).

9 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
10 Alternative 7, relative to Existing Conditions and the No Action Alternative at any location within the
11 Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 30%
12 improvement relative to Existing Conditions, 32% relative to the No Action Alternative)(Figures 8-
13 55a and 8-55b; Appendix 8I, Table I-14b).

14 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
15 comparison of Alternative 7 to the No Action Alternative (as waterborne and bioaccumulated forms)
16 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

17 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
18 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
19 purpose of making the CEQA impact determination for this constituent. For additional details on the
20 effects assessment findings that support this CEQA impact determination, see the effects assessment
21 discussion that immediately precedes this conclusion.

22 Under Alternative 7, greater water demands and climate change would alter the magnitude and
23 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
24 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
25 methylmercury upstream of the Delta will not be substantially different relative to Existing
26 Conditions due to the lack of important relationships between mercury/methylmercury
27 concentrations and flow for the major rivers.

28 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
29 capacity exists. Monthly average waterborne concentrations of total and methylmercury, over the
30 period of record, are very similar to Existing Conditions, but showed notable increases at some
31 locations. Estimates of fish tissue mercury concentrations show substantial increases would occur
32 for several sites for Alternative 7 as compared to Existing Conditions for Delta sites.

33 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
34 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
35 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
36 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 7 as
37 compared to Existing Conditions.

38 As such, this alternative is not expected to cause additional exceedance of applicable water quality
39 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
40 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
41 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
42 make existing mercury-related impairment in the Delta measurably worse. In comparison to

1 Existing Conditions, Alternative 7 would increase levels of mercury by frequency, magnitude, and
 2 geographic extent such that the affected environment would be expected to have measurably higher
 3 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
 4 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
 5 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
 6 unknown. General mercury management measures through CM12, or actions taken by other entities
 7 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury
 8 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
 9 reduced to a level that would be less than significant as a result of CM12 or other future actions.
 10 Therefore, the impact would be significant and unavoidable.

11 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-**
 12 **CM21**

13 **NEPA Effects:** Some habitat restoration activities under Alternative 7 would occur on lands in the
 14 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 15 Alternative 7 have the potential to increase water residence times and increase accumulation of
 16 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 17 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 18 possible but uncertain depending on the specific restoration design implemented at a particular
 19 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 20 not currently available. However, DSM2 modeling for Alternative 7 operations does incorporate
 21 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 22 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 23 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 24 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 25 potential for increased mercury and methylmercury concentrations under Alternative 7.

26 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 27 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 28 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 29 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 30 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 31 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 32 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 33 better inform restoration design,
- 34 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 35 techniques,
- 36 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 37 organic material at a restoration site,
- 38 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 39 biologically unavailable, inorganic form of mercury,
- 40 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
- 41 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 42 at a site.

1 Because of the uncertainties associated with site-specific estimates of methylmercury
 2 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 3 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 4 need to be evaluated separately for each restoration effort, as part of design and implementation.
 5 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 6 potential effect of implementing CM2–CM21 is considered adverse.

7 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 8 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 9 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 10 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 11 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 12 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 13 measurable increase in methylmercury concentrations would make existing mercury-related
 14 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 15 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
 16 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 17 Design of restoration sites under Alternative 7 would be guided by CM12 which requires
 18 development of site specific mercury management plans as restoration actions are implemented.
 19 The effectiveness of minimization and mitigation actions implemented according to the mercury
 20 management plans is not known at this time although the potential to reduce methylmercury
 21 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 22 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 23 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 24 impact being considered significant. No mitigation measures would be available until specific
 25 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 26 unavoidable.

27 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 28 **Maintenance (CM1)**

29 ***Upstream of the Delta***

30 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
 31 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 32 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

33 Under Alternative 7, modeling indicates that long-term annual average flows on the San Joaquin
 34 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
 35 virtually the same relative to the No Action Alternative (Appendix 5A, *BDCP/California WaterFix*
 36 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 37 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 38 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 39 affected, if at all, by changes in flow rates under Alternative 7.

40 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 41 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 42 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 43 water bodies, with regards to nitrate.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
7 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
8 information.

9 Results of the mixing calculations indicate that under Alternative 7, relative to Existing Conditions
10 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
11 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 25 and 26). Long-
12 term average nitrate concentrations are anticipated to increase at most locations in the Delta. The
13 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
14 Plant #1 (all >85% increase). Long-term average concentrations were estimated to increase to 0.67,
15 1.04 and 1.10 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
16 Plant#1, respectively, due primarily to increased San Joaquin River water percentage at these
17 locations (see Appendix 8D, *Source Water Fingerprinting Results*). Although changes at specific Delta
18 locations and for specific months may be substantial on a relative basis, the absolute concentration
19 of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of
20 10 mg/L-N, as well as all other thresholds identified in Table 8-50. No additional exceedances of the
21 MCL are anticipated at any location (Appendix 8J, *Nitrate*, Table 25). On a monthly average basis and
22 on a long term annual average basis, for all modeled years and for the drought period (1987–1991)
23 only, use of assimilative capacity available under Existing Conditions and the No Action Alternative,
24 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock
25 Slough and Contra Costa Pumping Plant #1, and averaged approximately 6% on a long-term average
26 basis (Appendix 8J, Table 27). Similarly, the use of available assimilative capacity at Franks Tract
27 was up to approximately 6%, and averaged 3% over the long term. The concentrations estimated for
28 these locations would not increase the likelihood of exceeding the 10 mg/L-N MCL, nor would they
29 increase the risk for adverse effects to beneficial uses. At all other locations, use of assimilative
30 capacity was negligible (<5%) (Appendix 8J, Table 27).

31 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
32 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
33 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
34 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
35 the modeling.

- 36 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
37 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
38 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
39 the increase becoming greater with increasing distance downstream. However, the increase in
40 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
41 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
42 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board
43 2010a:32).
- 44 • Under Alternative 7, the planned upgrades to the SRWTP, which include nitrification/partial
45 denitrification, would substantially decrease ammonia concentrations in the discharge, but

1 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
2 higher than under Existing Conditions.

- 3 • Overall, under Alternative 7, the nitrogen load from the SRWTP discharge is expected to
4 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
5 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
6 of the facility are expected to be higher than modeling results indicate for both Existing
7 Conditions and Alternative 7, the increase is expected to be greater under Existing Conditions
8 than for Alternative 7 due to the upgrades that are assumed under Alternative 7.

9 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
10 immediately downstream of other wastewater treatment plants that practice nitrification, but not
11 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
12 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
13 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
14 State has determined that no beneficial uses are adversely affected by the discharge, and that the
15 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
16 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
17 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
18 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
19 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
20 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
21 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

22 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
23 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
24 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

25 ***SWP/CVP Export Service Areas***

26 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
27 nitrate-N at the Banks and Jones pumping plants.

28 Results of the mixing calculations indicate that under Alternative 7, relative to Existing Conditions
29 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
30 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Tables 25 and
31 26). During the late summer, particularly in the drought period assessed, concentrations are
32 expected to increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally,
33 given the many factors that contribute to potential algal blooms in the SWP and CVP canals within
34 the Export Service Area, and the lack of studies that have shown a direct relationship between
35 nutrient concentrations in the canals and reservoirs and problematic algal blooms in these water
36 bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal increases
37 in nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
38 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, Table 25).
39 On a monthly average basis and on a long term annual average basis, for all modeled years and for
40 the drought period (1987–1991) only, use of assimilative capacity available under Existing
41 Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible for both
42 Banks and Jones pumping plants (Appendix 8J, Table 27).

1 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
2 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
3 degrade the quality of exported water, with regards to nitrate.

4 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
5 CM1 are considered to be not adverse.

6 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
7 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
8 purpose of making the CEQA impact determination for this constituent. For additional details on the
9 effects assessment findings that support this CEQA impact determination, see the effects assessment
10 discussion that immediately precedes this conclusion.

11 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
12 substantial dilution available for point sources and the lack of substantial nonpoint sources of
13 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
14 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
15 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
16 Consequently, any modified reservoir operations and subsequent changes in river flows under
17 Alternative 7, relative to Existing Conditions, are expected to have negligible, if any, effects on
18 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
19 watershed and upstream of the Delta in the San Joaquin River watershed.

20 In the Delta, results of the mixing calculations indicate that under Alternative 7, relative to Existing
21 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
22 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
23 Plant #1 (all >85% increase), due primarily to increased San Joaquin River water percentage at
24 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low
25 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
26 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
27 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
28 MCL, nor would they increase the risk for adverse effects to beneficial uses.

29 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
30 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
31 indicate that under Alternative 7, relative to Existing Conditions, long-term average nitrate
32 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
33 exceedances of the MCL are anticipated. Monthly average use of assimilative capacity available
34 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants in drought
35 conditions was at times >50%, but the absolute value of these changes (i.e., in mg/L-N) was small.
36 Additionally, given the many factors that contribute to potential algal blooms in the SWP and CVP
37 canals within the Export Service Area, and the lack of studies that have shown a direct relationship
38 between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these
39 water bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal
40 increases in nitrate concentrations would increase the potential for problem algal blooms in the
41 SWP and CVP Export Service Area.

42 Based on the above, this alternative is not expected to cause additional exceedance of applicable
43 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
44 adverse effects on any beneficial uses of waters in the affected environment. No long-term water

1 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
 2 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
 3 the affected environment and thus any increases that may occur in some areas and months would
 4 not make any existing nitrate-related impairment measurably worse because no such impairments
 5 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 6 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 7 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 8 significant. No mitigation is required.

9 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2–**
 10 **CM21**

11 **NEPA Effects:** Effects of CM2–CM21 on nitrate under Alternative 7 would be the same as those
 12 discussed for Alternative 1A and are considered not to be adverse.

13 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 14 measures proposed under Alternative 1A. As such, effects on nitrate resulting from the
 15 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 16 This impact is considered to be less than significant. No mitigation is required.

17 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 18 **Operations and Maintenance (CM1)**

19 ***Upstream of the Delta***

20 Under Alternative 7, there would be no substantial change to the sources of DOC within the
 21 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 22 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 23 system operations and resulting reservoir storage levels and river flows would not be expected to
 24 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 25 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 26 7, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,
 27 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 28 degrade the quality of these water bodies, with regards to DOC.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 34 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 35 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 36 information.

37 Under Alternative 7, the geographic extent of effects pertaining to long-term average DOC
 38 concentrations in the Delta would be similar to that previously described for Alternative 1A,
 39 although the magnitude of predicted long-term increase and relative frequency of concentration
 40 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
 41 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the

1 modeled drought period, long-term average concentration increases ranging from 0.7–1.1 mg/L
 2 would be predicted ($\leq 30\%$ net increase), resulting in long-term average DOC concentrations greater
 3 than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, *Organic Carbon*, DOC Table 8).
 4 Increases in long-term average concentrations would correspond to more frequent concentration
 5 threshold exceedances, with the greatest change occurring at Rock Slough and Contra Costa PP No. 1
 6 locations. For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L would increase
 7 from 52% under Existing Conditions to 85% under the Alternative 7 (an increase from 47% to 82%
 8 for the drought period), and concentrations exceeding 4 mg/L would increase from 30% to 47%
 9 (32% to 57% for the drought period). For Contra Costa PP No. 1, long-term average DOC
 10 concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions to 85% under
 11 Alternative 7 (45% to 88% for the drought period), and concentrations exceeding 4 mg/L would
 12 increase from 32% to 52% (35% to 58% for the drought period). Relative change in frequency of
 13 threshold exceedance for other assessment locations would be similar or less. This comparison to
 14 Existing Conditions reflects changes in DOC due to both Alternative 7 operations (including north
 15 Delta intake capacity of 9,000 cfs and numerous other components of Operational Scenario E) and
 16 climate change/sea level rise.

17 In comparison, Alternative 7 relative to the No Action Alternative would generally result in a
 18 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
 19 increases of 0.7–1.0 mg/L DOC (i.e., $\leq 26\%$) would be predicted at Franks Tract, Rock Slough, and
 20 Contra Costa PP No. 1 relative to No Action Alternative) (Appendix 8K, *Organic Carbon*, DOC Table
 21 8). Threshold concentration exceedance frequency trends would also be similar to those discussed
 22 for the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance
 23 frequency at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-
 24 term average DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to
 25 33% (42% to 57% for the modeled drought period). Unlike the comparison to Existing Conditions,
 26 this comparison to the No Action Alternative reflects changes in DOC due only to Alternative 7
 27 operations.

28 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
 29 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
 30 significant changes in drinking water treatment plant design or operations. In particular, assessment
 31 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 32 drinking water treatment plants. Under Alternative 7, drinking water treatment plants obtaining
 33 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 34 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 35 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 36 such technologies would likely require substantial investment in new or modified infrastructure.

37 Relative to existing and No Action Alternative conditions, Alternative 7 would lead to predicted
 38 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
 39 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
 40 Slough would decrease $< 0.1\text{--}0.2$ mg/L, depending on baseline conditions comparison and modeling
 41 period.

42 ***SWP/CVP Export Service Areas***

43 Under Alternative 7, modeled long-term average DOC concentrations would decrease at Banks and
 44 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought

1 period. Modeled decreases would generally be similar between Existing Conditions and the No
2 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
3 would be predicted to decrease by 1.1 mg/L (1.3 mg/L during drought period) (Appendix 8K,
4 *Organic Carbon*, DOC Table 8). At Jones, long-term average DOC concentrations would be predicted
5 to decrease by 1.0 mg/L (1.2 mg/L during drought period). Such substantial improvement in long-
6 term average DOC concentrations would include fewer exceedances of concentration thresholds.
7 Average DOC concentrations exceeding the 2 mg/L concentration threshold would decrease from
8 100% under Existing Conditions and the No Action Alternative to 67% at Banks and 61% at Jones
9 under Alternative 7 (60% and 57%, respectively during the drought period), while concentrations
10 exceeding 4 mg/L would nearly be eliminated (i.e., $\leq 15\%$ exceedance frequency). Such modeled
11 improvement would correspond to substantial improvement in Export Service Areas water quality,
12 respective to DOC.

13 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
14 facilities under Alternative 7 would not be expected to create new sources of DOC or contribute
15 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
16 would not be expected to cause any substantial change in long-term average DOC concentrations
17 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

18 **NEPA Effects:** In summary, Alternative 7, relative to the No Action Alternative, would not cause a
19 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
20 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
21 decrease by as much as 1.4 mg/L, while long-term average DOC concentrations for some Delta
22 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
23 increase by as much as 1.0 mg/L. Resultant substantial changes in long-term average DOC at these
24 Delta interior locations could necessitate changes in water treatment plant operations or require
25 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
26 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
27 reduce these effects.

28 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
29 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
30 purpose of making the CEQA impact determination for this constituent. For additional details on the
31 effects assessment findings that support this CEQA impact determination, see the effects assessment
32 discussion that immediately precedes this conclusion.

33 While greater water demands under the Alternative 7 would alter the magnitude and timing of
34 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
35 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
36 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
37 flows would not be expected to cause a substantial long-term change in DOC concentrations
38 upstream of the Delta.

39 Relative to Existing Conditions, Alternative 7 would result in substantial increases (i.e., 0.7–1.1
40 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
41 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
42 changes in DOC would substantially increase the frequency with which long-term average
43 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
44 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve

1 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
 2 magnitude change in long-term average DOC concentrations would represent a substantially
 3 increased risk for adverse effects on existing MUN beneficial.

4 The assessment of Alternative 7 effects on DOC in the SWP/CVP Export Service Areas is based on
 5 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
 6 Existing Conditions, long-term average DOC concentrations would decrease by as much as 1.3 mg/L
 7 at Banks and Jones pumping plants. The frequency with which long-term average DOC
 8 concentrations would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted
 9 exceedances of >4 mg/L would be nearly eliminated (i.e., ≤15% exceedance frequency). As a result,
 10 substantial improvement in DOC-related water quality would be predicted in the SWP/CVP Export
 11 Service Areas.

12 Based on the above, Alternative 7 operation and maintenance would not result in any substantial
 13 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
 14 Alternative 7, water exported from the Delta to the SWP/CVP service area would be substantially
 15 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
 16 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 17 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
 18 conveyance facilities proposed under Alternative 7 would result in a substantial increase in long-
 19 term average DOC concentrations (i.e., 0.7–1.1 mg/L, equivalent to ≤30% relative increase) at
 20 Franks Tract, Rock Slough, and Contra Costa PP No.1. In particular, under Alternative 7, model
 21 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
 22 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
 23 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
 24 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
 25 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
 26 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
 27 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
 28 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
 29 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
 30 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
 31 uncertain and implementation would not necessarily reduce the identified impact to a level that
 32 would be less than significant, and therefore it is significant and unavoidable.

33 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
 34 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

35 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the discussion of Alternative 6A.

36 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 37 **Implementation of CM2–CM21**

38 **NEPA Effects:** CM2–CM21 under Alternative 7 would be similar to conservation measures under
 39 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
 40 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
 41 restored. Effects on DOC resulting from the implementation of CM2–CM21 would be similar to those
 42 previously discussed for Alternative 1A, except that the increased linear miles of channel margin
 43 habitat enhancement and increased acreage of seasonally inundated floodplain would increase the

1 overall Alternative 7 DOC loading to the Delta. In total, CM4–CM7 and CM10 could contribute
 2 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
 3 operational criteria for the related restoration activities. Substantially increased long-term average
 4 DOC in raw water supplies could lead to a need for treatment plant upgrades in order to
 5 appropriately manage DBP formation in treated drinking water. This potential for future DOC
 6 increases would lead to substantially greater associated risk of long-term adverse effects on the
 7 MUN beneficial use.

8 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 7 would
 9 present new localized sources of DOC to the study area, and in some circumstances would substitute
 10 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 11 proximity to municipal drinking water intakes, such restoration activities could contribute
 12 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 13 DOC could necessitate changes in water treatment plant operations or require treatment plant
 14 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 15 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

16 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 7 are similar to, and
 17 possibly greater than, those discussed for Alternative 1A. Similar to the discussion for Alternative
 18 1A, this impact is considered to be significant. It is uncertain whether implementation of Mitigation
 19 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
 20 remains significant and unavoidable.

21 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 22 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 23 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
 24 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 25 operations. Potential options for making use of this financial commitment include funding or
 26 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 27 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
 28 pursuant to this commitment in order to reduce the water quality treatment costs associated with
 29 water quality effects relating to DOC.

30 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 31 **Effects on Municipal Intakes**

32 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

33 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 34 **(CM1)**

35 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 7 would be the same as those
 36 discussed for Alternative 1A and are considered to not be adverse.

37 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 7 would be the same as those
 38 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 39 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 40 this constituent. For additional details on the effects assessment findings that support this CEQA
 41 impact determination, see the effects assessment discussion under Alternative 1A.

1 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
2 (water facilities and operations) under Alternative 7, relative to Existing Conditions, would not be
3 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
4 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
5 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
6 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
7 related regulations.

8 It is expected there would be no substantial change in Delta pathogen concentrations in response to
9 a shift in the Delta source water percentages under this alternative or substantial degradation of
10 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
11 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
12 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
13 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
14 and livestock-related uses, would continue under this alternative.

15 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
16 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
17 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
18 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
19 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
20 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
21 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

22 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
23 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
24 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
25 expected to increase substantially, no long-term water quality degradation for pathogens is
26 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
27 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
28 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
29 are expected to occur on a long-term basis, further degradation and impairment of this area is not
30 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
31 considered to be less than significant. No mitigation is required.

32 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

33 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 7 would be the same as those
34 discussed for Alternative 1A and are considered to not be adverse.

35 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
36 measures proposed under Alternative 1A. As such, effects on pathogens resulting from the
37 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
38 This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, under Alternative 7 no specific operations
 5 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
 6 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
 7 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
 8 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

9 Under Alternative 7, winter (November–March) and summer (April–October) season average flow
 10 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
 11 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
 12 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
 13 the summer and 4% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River,
 14 average flow rates would decrease no more than 5% during the summer, but would increase as
 15 much as 7% in the winter. American River average flow rates would decrease by as much as 15% in
 16 the summer but would increase by as much as 6% in the winter. Seasonal average flow rates on the
 17 San Joaquin River would decrease by as much as 12% in the summer, but increase by as much as 1%
 18 in the winter. For the same reasons stated for the No Action Alternative, decreased seasonal average
 19 flow of $\leq 15\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
 20 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
 21 affect other beneficial uses of water bodies upstream of the Delta.

22 ***Delta***

23 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 24 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 25 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

26 Under Alternative 7, the distribution and mixing of Delta source waters would change. Percentage
 27 change in monthly average source water fraction were evaluated for the modeled 16-year (1976–
 28 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 29 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 30 fractions. Relative to Existing Conditions, under Alternative 7 modeled San Joaquin River fractions
 31 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San
 32 Joaquin River at Antioch (Appendix 8D, *Source Water Fingerprinting Results*). At Antioch, San
 33 Joaquin River source water fractions when modeled for the 16-year hydrologic period would
 34 increase by 11–14% from November through May (no increase $> 10\%$ for the modeled drought
 35 period). While this change at Antioch is not considered substantial, changes in San Joaquin River
 36 source water fraction in the Delta interior would be considerable. At Franks Tract, San Joaquin River
 37 source water fractions would increase between 18–28% for October through June (12–25% for
 38 November through June of the modeled drought period). Changes at Rock Slough and Contra Costa
 39 PP No. 1 would be very similar, where modeled San Joaquin River source water fractions would
 40 increase from 27–71% (11–70% for the modeled drought period) for October through June. Relative
 41 to Existing Conditions, there would be no modeled increases in Sacramento River fractions greater
 42 than 16% (with exception to Banks and Jones which are discussed below) and Delta agricultural
 43 fractions greater than 6%. Increases in San Joaquin River source water fraction at Franks Tract,
 44 Rock Slough, and Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento

1 River water, and as a result the San Joaquin River would account for greater than 50% of the total
2 source water volume at Franks Tract between March through May (<50% for all months during the
3 modeled drought period), and would be 50%, and as much as 81% during November through May at
4 Rock Slough and Contra Costa PP No. 1 for both the modeled drought and 16-year hydrologic
5 periods. While the source water and potential pesticide related toxicity co-occurrence predictions
6 do not mean adverse effects would occur, such considerable modeled increases in early summer
7 source water fraction at Franks Tract and winter and summer source water fractions at Rock Slough
8 and Contra Costa PP No. 1 could substantially alter the long-term risk of pesticide-related toxicity to
9 aquatic life, given the apparent greater incidence of pesticides in the San Joaquin River.

10 When compared to the No Action Alternative, changes in source water fractions would be similar in
11 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
12 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
13 Joaquin River fractions would increase 15% in July and 14% in August when compared to No Action
14 Alternative (Appendix 8D, *Source Water Fingerprinting Results*). These increases would primarily
15 balance through decreases in Sacramento River water and eastside tributary waters. Nevertheless,
16 the San Joaquin River at Buckley Cove during the modeled drought period would only account for
17 36% of the total source water volume in July and 26% in August. These changes at Buckley Cove are
18 not considered substantial, however, as discussed for Existing Conditions, under the No Action
19 Alternative the similar magnitude change at Franks Tract, Rock Slough, and Contra Costa PP No. 1
20 would be considered substantial and could substantially alter the long-term risk of pesticide-related
21 toxicity to aquatic life.

22 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
23 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
24 will occur at similar levels into the future. In reality, however, the makeup and character of the
25 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
26 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
27 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
28 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
29 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
30 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
31 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
32 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,
33 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall
34 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
35 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
36 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
37 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
38 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
39 these various efforts will ultimately be successful at resolving current pesticide related impairments
40 requires considerable speculation. While the fundamental assumptions that have guided this
41 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
42 actual studies and monitoring data collected from the recent past and, therefore, judging project
43 alternative effects in the future remain most accurate through use of these informed assumptions
44 rather than based on assumptions founded upon future speculative conditions.

1 **SWP/CVP Export Service Areas**

2 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 3 the Banks and Jones pumping plants. Under Alternative 7, Sacramento River source water fractions
 4 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
 5 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
 6 pumping plant, Sacramento source water fractions would generally increase from 27–79% for
 7 October through June (13–32% for December through March of the modeled drought period) and at
 8 Jones pumping plant Sacramento source water fractions would generally increase from 43–96% for
 9 October through June (37–89% for October through June of the modeled drought period). These
 10 increases in Sacramento source water fraction would primarily balance through equivalent
 11 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
 12 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
 13 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
 14 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
 15 improvement in export water quality respective to pesticides.

16 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
 17 American, and San Joaquin Rivers, under Alternative 7 relative to the No Action Alternative, are of
 18 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
 19 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
 20 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
 21 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
 22 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
 23 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
 25 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 26 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 27 constituent. For additional details on the effects assessment findings that support this CEQA impact
 28 determination, see the effects assessment discussion that immediately precedes this conclusion.

29 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
 30 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
 31 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
 32 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
 33 substantially increase the long-term risk of pesticide-related water quality degradation and related
 34 toxicity to aquatic life in these water bodies upstream of the Delta.

35 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
 36 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
 37 and maintenance activities would not affect these sources, changes in Delta source water fraction
 38 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
 39 Alternative 7, modeled long-term average San Joaquin River source water fractions at Franks Tract,
 40 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
 41 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

42 The assessment of Alternative 7 effects on pesticides in the SWP/CVP Export Service Areas is based
 43 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source

1 water fractions would increase substantially at both Banks and Jones pumping plants and would
2 generally represent an improvement in export water quality respective to pesticides.

3 Based on the above, Alternative 7 would not result in any substantial change in long-term average
4 pesticide concentration or result in substantial increase in the anticipated frequency with which
5 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
6 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
7 pesticides are currently used throughout the affected environment, and while some of these
8 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
9 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
10 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
11 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
12 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
13 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
14 flows and Delta source water fractions would not be expected to make any of these beneficial use
15 impairments measurably worse, with principal exception to locations in the Delta that would receive
16 a substantially greater fraction San Joaquin River water under Alternative 7. Long-term average San
17 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
18 locations would change considerably for some months such that the long-term risk of pesticide-
19 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
20 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
21 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
22 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
23 feasible mitigation available to reduce the effect of this significant impact.

24 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2- 25 CM21**

26 **NEPA Effects:** CM2–CM21 under Alternative 7 would be similar to conservation measures under
27 Alternative 1A, but 40 linear miles rather than 20 linear miles of channel margin habitat would be
28 enhanced, and 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be
29 restored. Effects on pesticides resulting from the implementation of CM2–CM21 would be similar to
30 those previously discussed for Alternative 1A. In summary, CM13 proposes the use of herbicides to
31 control invasive aquatic vegetation around habitat restoration sites. Herbicides directly applied to
32 water could include adverse effects on non-target aquatic life, such as aquatic invertebrates and
33 beneficial aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient
34 frequency and magnitude such that beneficial uses would be impacted, thus constituting an adverse
35 effect on water quality.

36 In summary, based on the discussion above, the effects on pesticides from implementing CM2–CM21
37 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
38 effect.

39 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 7 are similar to
40 conservation measures discussed for Alternative 1A. Potential environmental effects related only to
41 CM13 are considered to be significant. Mitigation is required. While Mitigation Measure WQ-22 is
42 available to partially reduce this impact of pesticides, no feasible mitigation is available that would
43 reduce it to a level that would be less than significant.

1 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
2 **Strategies**

3 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

4 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
5 **and Maintenance (CM1)**

6 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
7 of the affected environment under Alternative 7 would be very similar (i.e., nearly the same) to
8 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
9 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
10 7, which are considered to be not adverse.

11 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
12 provided above are summarized here, and are then compared to the CEQA thresholds of significance
13 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
14 constituent. For additional details on the effects assessment findings that support this CEQA impact
15 determination, see the effects assessment discussion that immediately precedes this conclusion.

16 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
17 because changes in flows do not necessarily result in changes in concentrations or loading of
18 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
19 Delta are not anticipated for Alternative 7, relative to Existing Conditions.

20 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
21 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
22 long term-average basis under Alternative 7, relative to Existing Conditions. Algal growth rates are
23 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
24 that may occur at some locations and times within the Delta would be expected to have little effect
25 on primary productivity in the Delta.

26 The assessment of effects of phosphorus under Alternative 7 in the SWP and CVP Export Service
27 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
28 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
29 anticipated to change substantially on a long term-average basis.

30 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
31 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
32 CVP and SWP service areas under Alternative 7 relative to Existing Conditions. As such, this
33 alternative is not expected to cause additional exceedance of applicable water quality
34 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
35 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
36 are not expected to increase substantially, no long-term water quality degradation is expected to
37 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
38 within the affected environment and thus any minor increases that may occur in some areas would
39 not make any existing phosphorus-related impairment measurably worse because no such
40 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
41 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in

1 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
2 than significant. No mitigation is required.

3 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
4 **CM2–CM21**

5 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
6 environment under Alternative 7 would be very similar (i.e., nearly the same) to those discussed for
7 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
8 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
9 effects of these same actions under Alternative 7, which are considered to be not adverse.

10 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
11 measures proposed under Alternative 1A. As such, effects on phosphorus resulting from the
12 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
13 This impact is considered to be less than significant. No mitigation is required.

14 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
15 **Maintenance (CM1)**

16 ***Upstream of the Delta***

17 For the same reasons stated for the No Action Alternative, Alternative 7 would have negligible, if
18 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
19 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
20 concentrations that could occur in the water bodies of the affected environment located upstream of
21 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
22 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
23 selenium.

24 ***Delta***

25 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
26 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
27 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
28 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
29 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
30 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
31 information.

32 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
33 locations under Alternative 7, relative to Existing Conditions and the No Action Alternative, are
34 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-17 and M-27 for most biota
35 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
36 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
37 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
38 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
39 water at each modeled assessment location for all years. Appendix 8M, Figure M-24 provides more
40 detail in the form of monthly patterns of selenium concentrations in water during the modeling
41 period.

1 Alternative 7 would result in small to moderate changes in average selenium concentrations in
2 water at all modeled Delta assessment locations relative to Existing Conditions and the No Action
3 Alternative (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some
4 interior and western Delta locations would increase by 0.01–0.13 µg/L for the entire period
5 modeled. The increases in selenium concentrations in water would result in reductions in available
6 assimilative capacity for selenium of 1–12%, relative to the 1.3 µg/L USEPA draft water quality
7 criterion (Figures 8-59a and 8-60a). The long-term average selenium concentrations in water under
8 Alternative 7 (range 0.09–0.38 µg/L) would be similar to those for Existing Conditions (range 0.09–
9 0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and all would be well below the
10 USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table 9a).

11 Relative to Existing Conditions and the No Action Alternative, Alternative 7 would generally result in
12 small changes (less than 4%) in estimated selenium concentrations in most biota (whole-body fish
13 (excluding sturgeon), bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) throughout
14 the Delta, with little difference among locations (Figures 8-61a through 8-64b; Appendix 8M,
15 *Selenium*, Table M-27). Despite the small changes in selenium concentrations in biota, Level of
16 Concern Exceedance Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for
17 selenium concentrations in those biota for all years and for drought years are less than 1.0
18 (indicating low probability of adverse effects). Similarly, Advisory Tissue Level Exceedance
19 Quotients for selenium concentrations in fish fillets for all years and drought years also are less than
20 1.0. Estimated selenium concentrations in sturgeon for the San Joaquin River at Antioch are
21 predicted to increase by about 30% relative to Existing Conditions and to the No Action Alternative
22 in all years (from about 4.7 to 6.1 mg/kg dry weight). Likewise, those for sturgeon in the Sacramento
23 River at Mallard Island are predicted to increase by about 18% in all years (from about 4.4 to 5.2
24 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31). Selenium concentrations in sturgeon
25 during drought years are expected to increase by 11–24% at those locations. Detection of changes in
26 whole-body sturgeon such as those estimated for the western Delta may require large sample sizes
27 because of the inherent variability in fish tissue selenium concentrations. Low Toxicity Threshold
28 Exceedance Quotients for selenium concentrations in sturgeon in the western Delta would exceed
29 1.0 for drought years at both locations (as they do for Existing Conditions and the No Action
30 Alternative) and for all years at the San Joaquin River at Antioch, whereas Existing Conditions and
31 the No Action Alternative do not (quotient increases from 0.94 to 1.2 at San Joaquin at Antioch)
32 (Appendix 8M, Table M-32). High Toxicity Threshold Exceedance Quotients for selenium
33 concentrations in sturgeon in the western Delta would exceed 1.0 for drought years in the San
34 Joaquin River at Antioch, whereas Existing Conditions and the No Action Alternative do not
35 (quotient increases from about 0.85 to 1.1) (Appendix 8M, Table M-32).

36 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
37 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
38 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
39 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
40 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
41 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
42 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
43 the two western Delta locations and used literature-derived uptake factors and trophic transfer
44 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
45 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
46 the greater bioaccumulation rates for bass at low waterborne selenium than at higher

1 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
2 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
3 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
4 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
5 estimates for sturgeon based on “fixed” K_{ds} for all years and for drought years without regard to
6 waterborne selenium concentration at the two locations in different time periods.

7 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
8 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
9 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
10 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
11 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
12 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
13 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
14 most areas of the Delta.

15 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
16 Alternative 7 would be greater in the South Delta and East Delta than in other sub-regions. Relative
17 to Existing Conditions, annual average residence times for Alternative 7 in the South Delta are
18 expected to increase by more than 35 days (Table 8-60a). and in the East Delta increase by more
19 than 20 days. Increases in residence times for other sub-regions would be smaller, especially as
20 compared to Existing Conditions and the No Action Alternative (which are longer than those
21 modeled for the South Delta). As mentioned above, these results incorporate hydrodynamic effects
22 of both CM1 and CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of
23 CM2 and CM4. However, it is expected that CM2 and CM4 are substantial drivers of the increased
24 residence time.

25 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
26 hydrologic conditions [e.g., Delta outflow and residence time for water], K_{ds} [the ratio of selenium
27 concentrations in particulates, as the lowest level of the food chain, relative to the water-borne
28 concentration], and associated tissue concentrations [especially in clams and their consumers, such
29 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
30 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
31 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
32 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
33 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

34 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
35 as related to residence time, but the effects of residence time are incorporated in the
36 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
37 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
38 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
39 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
40 concentrations are currently low and not approaching thresholds of concern (which, as discussed
41 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
42 residence time alone would not be expected to cause them to then approach or exceed thresholds of
43 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
44 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
45 sparse, the most likely area in which biota tissues would be at levels high enough that additional

1 bioaccumulation due to increased residence time from restoration areas would be a concern is the
 2 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
 3 increase in residence time estimated in the western Delta is 3 days relative to Existing Conditions,
 4 and 1 day relative to the No Action Alternative. Given the available information, these increases are
 5 small enough that they are not expected to substantially affect selenium bioaccumulation in the
 6 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
 7 residence times, further discussion is included in Impact WQ-26 below.

8 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 7 would
 9 result in small changes (less than 4%) in selenium concentrations throughout the Delta for most
 10 biota, although larger increases in selenium concentrations are predicted for sturgeon in the
 11 western Delta. The Low Toxicity Threshold Exceedance Quotient for selenium concentrations in
 12 sturgeon for all years in the San Joaquin River at Antioch would increase from 0.94 for Existing
 13 Conditions and the No Action Alternative to 1.2, and from 0.88 to 1.0 at Sacramento River at Mallard
 14 Island. The High Toxicity Threshold Exceedance Quotient for selenium concentrations for sturgeon
 15 at Antioch would increase from 0.85 for Existing Conditions and 0.86 for the No Action Alternative
 16 to 1.1. Concentrations of selenium in sturgeon would exceed the higher benchmark for Antioch only
 17 in drought years, indicating a high potential for effects. The modeling of bioaccumulation for
 18 sturgeon is less calibrated to site-specific conditions than that for other biota, which was calibrated
 19 on a robust dataset for modeling of bioaccumulation in largemouth bass as a representative species
 20 for the Delta. Overall the predicted increase for Alternative 7 is high enough that it may represent a
 21 measureable increase in body burdens of sturgeon, which would constitute an adverse impact.

22 ***SWP/CVP Export Service Areas***

23 Alternative 7 would result in moderate (0.09–0.15 µg/L) decreases in average selenium
 24 concentrations in water at the Banks and Jones pumping plants, relative to the Existing Conditions
 25 and the No Action Alternative, for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a).
 26 These decreases in long-term average selenium concentrations in water would result increases in
 27 available assimilative capacity for selenium at these pumping plants of 9–16%, relative to the USEPA
 28 draft water quality criterion of 1.3 µg/L. Furthermore, the long-term average selenium
 29 concentrations in water for Alternative 7 (range 0.12–0.13 µg/L) would be well below the USEPA
 30 draft water quality criterion of 1.3 µg/L (Appendix 8M, Table 9a).

31 Relative to Existing Conditions and the No Action Alternative, Alternative 7 would result in small
 32 changes (less than 3%) in estimated selenium concentrations in biota (whole-body fish, bird eggs
 33 [invertebrate diet], bird eggs [fish diet], and fish fillets) at Banks and Jones pumping plants (Figures
 34 8-61a through 8-64b; Appendix 8M, *Selenium*, Table M-27). Concentrations in biota would not
 35 exceed any selenium benchmarks for Alternative 7 (Figures 8-61a through 8-64b).

36 ***NEPA Effects:*** Based on the discussion above, the effects on selenium from Alternative 7 are
 37 considered to be adverse. This determination is reached because selenium concentrations in whole-
 38 body sturgeon modeled at two western Delta locations would increase by an average of 21%, which
 39 may represent a measurable increase in the environment. These potentially measurable increases
 40 represent an adverse impact.

41 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 42 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 43 purpose of making the CEQA impact determination for selenium. For additional details on the effects

1 assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
4 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
5 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
6 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
7 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
8 Valley Regional Water Quality Control Board 2010d; State Water Resources Control Board 2010b,
9 2010c) that are expected to result in decreasing discharges of selenium from the San Joaquin River
10 to the Delta. Consequently, any modified reservoir operations and subsequent changes in river flows
11 under Alternative 7, relative to Existing Conditions, are expected to cause negligible changes in
12 selenium concentrations in water. Any negligible changes in selenium concentrations that may occur
13 in the water bodies of the affected environment located upstream of the Delta would not be of
14 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
15 substantially degrade the quality of these water bodies as related to selenium.

16 Relative to Existing Conditions, modeling estimates indicate that Alternative 7 would result in
17 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
18 no exceedances of benchmarks for biological effects. Relative to Existing Conditions, modeling
19 estimates indicate that Alternative 7 would increase selenium concentrations in whole-body
20 sturgeon modeled at two western Delta locations by an estimated 21%, which may represent a
21 measurable increase in the environment. Because both low and high toxicity benchmarks are
22 exceeded, these potentially measurable increases represent a potential impact to fish and wildlife
23 beneficial uses.

24 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
25 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
26 Alternative 7 would cause no increase in the frequency with which applicable benchmarks would be
27 exceeded, and would slightly improve the quality of water in selenium concentrations at the Banks
28 and Jones pumping plants.

29 Based on the above, although waterborne selenium concentrations would not exceed applicable
30 water quality objectives/criteria; however, significant impacts on some beneficial uses of waters in
31 the Delta could occur because high toxicity benchmarks would be exceeded (where they are not
32 under Existing Conditions), and uptake of selenium from water to biota may measurably increase. In
33 comparison to Existing Conditions, water quality conditions under this alternative would increase
34 levels of selenium (a bioaccumulative pollutant) by frequency, magnitude, and geographic extent
35 such that the affected environment may have measurably higher body burdens of selenium in
36 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish);
37 however, impacts to humans consuming those organisms are not expected to occur. Water quality
38 conditions under this alternative with respect to selenium would cause long-term degradation of
39 water quality in the western Delta. Except in the vicinity of the western Delta for sturgeon, water
40 quality conditions under this alternative would not increase levels of selenium by frequency,
41 magnitude, and geographic extent such that the affected environment would be expected to have
42 measurably higher body burdens of selenium in aquatic organisms. The greater level of selenium
43 bioaccumulation in the western Delta would further degrade water quality by measurable levels, on
44 a long-term basis, for selenium and, thus, cause the CWA Section 303(d)-listed impairment of
45 beneficial use to be made discernibly worse. This impact is considered significant. *AMM27 Selenium*

1 *Management*, which affords for site-specific measures to reduce effects, would be available to reduce
 2 BDCP-related effects associated with selenium. The effectiveness of AMM27 is uncertain and,
 3 therefore implementation may not reduce the identified impact to a level that would be less than
 4 significant, and therefore it is significant and unavoidable.

5 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–**
 6 **CM21**

7 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 7 would be the same as those
 8 discussed for Alternative 1A and are considered not to be adverse.

9 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 10 measures proposed under Alternative 1A. As such, effects on selenium resulting from the
 11 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 12 This impact is considered to be less than significant. No mitigation is required.

13 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
 14 **and Maintenance (CM1)**

15 ***Upstream of the Delta***

16 For the same reasons stated for the No Action Alternative, Alternative 7 would result in negligible,
 17 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
 18 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 19 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 20 annual and long-term average basis. As such, Alternative 7 would not be expected to substantially
 21 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
 22 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
 23 degrade the quality of these water bodies, with regard to trace metals.

24 ***Delta***

25 For the same reasons stated for the No Action Alternative, Alternative 7 would not result in
 26 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
 27 the No Action Alternative. However, substantial changes in source water fraction would occur in the
 28 south Delta (Appendix 8D, *Source Water Fingerprinting Results*). Throughout much of the south
 29 Delta, San Joaquin River water would replace Sacramento River water, with the future trace metals
 30 profile largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative,
 31 trace metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar
 32 and currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
 33 concentrations in the south Delta would likely be measurable, Alternative 7 would not be expected
 34 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
 35 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
 36 trace metals.

37 ***SWP/CVP Export Service Areas***

38 For the same reasons stated for the No Action Alternative, Alternative 7 would not result in
 39 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
 40 from the Sacramento River through the proposed conveyance facilities. As such, there is not
 41 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service

1 area waters under Alternative 7, relative to Existing Conditions and the No Action Alternative. As
2 such, Alternative 7 would not be expected to substantially increase the frequency with which
3 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
4 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
5 water bodies, with regard to trace metals.

6 **NEPA Effects:** In summary, Alternative 7, relative to the No Action Alternative, would not cause a
7 substantial increase in long-term average trace metals concentrations within the affected
8 environment, nor would it cause an increased frequency of water quality objective/criteria
9 exceedances within the affected environment. The effect on trace metals is determined not to be
10 adverse.

11 **CEQA Conclusion:** Effects of CM1 on trace metals under Alternative 7 would be similar to those
12 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
13 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
14 this constituent. For additional details on the effects assessment findings that support this CEQA
15 impact determination, see the effects assessment discussion under Alternative 1A.

16 While greater water demands under the Alternative 7 would alter the magnitude and timing of
17 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
18 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
19 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
20 therefore, changes in river flows would not be expected to cause a substantial long-term change in
21 trace metal concentrations upstream of the Delta.

22 Average and 95th percentile trace metal concentrations are very similar across the primary source
23 waters to the Delta. Given this similarity, very large changes in source water fraction would be
24 necessary to effect a relatively small change in trace metal concentration at a particular Delta
25 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
26 waters are all below their respective water quality criteria, including those that are hardness-based
27 without a WER adjustment. No mixing of these three source waters could result in a metal
28 concentration greater than the highest source water concentration, and given that trace metals do
29 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
30 not be expected to occur under the Alternative 7.

31 The assessment of the Alternative 7 effects on trace metals in the SWP/CVP Export Service Areas is
32 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
33 As just discussed regarding similarities in Delta source water trace metal concentrations, the
34 Alternative 7 is not expected to result in substantial changes in trace metal concentrations in Delta
35 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
36 in the SWP/CVP Export Service Area are expected to be negligible.

37 Based on the above, there would be no substantial long-term increase in trace metal concentrations
38 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
39 service area waters under Alternative 7 relative to Existing Conditions. As such, this alternative is
40 not expected to cause additional exceedance of applicable water quality objectives by frequency,
41 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
42 in the affected environment. Because trace metal concentrations are not expected to increase
43 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
44 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term

1 trace metal concentrations that may occur in water bodies of the affected environment would not be
 2 expected to make any existing beneficial use impairments measurably worse. The trace metals
 3 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 4 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
 5 significant. No mitigation is required.

6 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
 7 **CM2–CM21**

8 **NEPA Effects:** CM2–CM21 under Alternative 7 would be similar to those under Alternative 1A, but
 9 40 linear miles rather than 20 linear miles of channel margin habitat would be enhanced, and
 10 20,000 acres rather than 10,000 acres of seasonally inundated floodplain would be restored. Effects
 11 on trace metals resulting from the implementation of CM2–CM21 would be similar to those
 12 previously discussed for Alternative 1A. As they pertain to trace metals, implementation of CM2–
 13 CM21 would not be expected to adversely affect beneficial uses of the affected environment or
 14 substantially degrade water quality with respect to trace metals.

15 In summary, implementation of CM2–CM21 under Alternative 7, relative to the No Action
 16 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 17 metals from implementing CM2–CM21 is determined not to be adverse.

18 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 7 would not cause substantial
 19 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 20 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 21 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 22 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 23 environment. Because trace metal concentrations are not expected to increase substantially, no
 24 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 25 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 26 concentrations that may occur throughout the affected environment would not be expected to make
 27 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 28 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 29 problems in aquatic life or humans. This impact is considered to be less than significant. No
 30 mitigation is required.

31 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
 32 **Maintenance (CM1)**

33 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 7 would be the same as those
 34 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
 35 to not be adverse.

36 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 7 would be similar to those
 37 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 38 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 39 this constituent. For additional details on the effects assessment findings that support this CEQA
 40 impact determination, see the effects assessment discussion under Alternative 1A.

41 Changes river flow rate and reservoir storage that would occur under Alternative 7, relative to
 42 Existing Conditions, would not be expected to result in a substantial adverse change in TSS

1 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 2 suspended sediment concentrations are more affected by season than flow. Site-specific and
 3 temporal exceptions may occur due to localized temporary construction activities, dredging
 4 activities, development, or other land use changes would be site-specific and temporal, which would
 5 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 6 than substantial levels.

7 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 8 usually gradual, occurring over years, and high storm event inflows would not be substantially
 9 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 10 would not be substantially different from the levels under Existing Conditions. Consequently, this
 11 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 12 region, relative to Existing Conditions.

13 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 14 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 7, relative to Existing
 15 Conditions, because as stated above, this alternative is not expected to result in substantial changes
 16 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
 17 Conditions.

18 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 19 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 20 concentrations and turbidity levels are not expected to be substantially different, long-term water
 21 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 22 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
 23 listed constituents. This impact is considered to be less than significant. No mitigation is required.

24 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

25 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 7 would be the same as
 26 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
 27 is determined to not be adverse.

28 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 7 would be similar to conservation
 29 measures proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
 30 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 31 This impact is considered to be less than significant. No mitigation is required.

32 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 33 **(CM1–CM21)**

34 The conveyance features for CM1 under Alternative 7 would be very similar to those discussed for
 35 Alternative 1A. The primary difference between Alternative 7 and Alternative 1A is that under
 36 Alternative 7, there would be two fewer intakes and two fewer pumping plant locations, which
 37 would result in a reduced level of construction activity. Additional construction activity also would
 38 occur to restore channel margin and seasonally inundated floodplain habitats. However,
 39 construction techniques and locations of major features of the conveyance system within the Delta
 40 would be similar. The remainder of the facilities constructed under Alternative 7, including CM2–
 41 CM21, would be very similar to, or the same as, those to be constructed for Alternative 1A. However,
 42 under Alternative 7, there would be up to 20,000 acres of inundated floodplain habitat restored (as

1 opposed to 10,000 acres under the majority of the other alternatives), thus resulting in increased
2 construction-related disturbances.

3 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
4 associated with implementation of CM1–CM21 under Alternative 7 would be very similar to the
5 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM21
6 would be essentially identical. Nevertheless, the construction of CM1, and any individual
7 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
8 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, and other agency permitted
9 construction requirements would result in the potential water quality effects being largely avoided
10 and minimized. The specific environmental commitments that would be implemented under
11 Alternative 7 would be similar to those described for Alternative 1A. Consequently, relative to
12 Existing Conditions, Alternative 7 would not be expected to cause exceedance of applicable water
13 quality objectives/criteria or substantial water quality degradation with respect to constituents of
14 concern, and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta,
15 or in the SWP and CVP service area.

16 In summary, with implementation of environmental commitments in Appendix 3B, the potential
17 construction-related water quality effects are considered to be not adverse.

18 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 7
19 for construction-related activities along with agency-issued permits that also contain construction
20 requirements to protect water quality, the construction-related effects, relative to Existing
21 Conditions, would not be expected to cause or contribute to substantial alteration of existing
22 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
23 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
24 water quality with respect to the constituents of concern on a long-term average basis, and thus
25 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
26 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
27 would be temporary and intermittent in nature, the construction would involve negligible
28 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
29 environment. As such, construction activities would not contribute measurably to bioaccumulation
30 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
31 Based on these findings, this impact is determined to be less than significant. No mitigation is
32 required.

33 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 34 **and Maintenance (CM1)**

35 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
36 concentrations, in water bodies of the affected environment under Alternative 7 would be very
37 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
38 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
39 Services Areas under Alternative 1A would similarly change under Alternative 7, relative to Existing
40 Conditions and the No Action Alternative. For the Delta in particular, there are differences in the
41 direction and magnitude of water residence time changes during the *Microcystis* bloom period
42 among the six Delta sub-regions under Alternative 7 compared to Alternative 1A, relative to Existing
43 Conditions and No Action Alternative. However, under Alternative 7, relative to Existing Conditions
44 and No Action Alternative, water residence times during the *Microcystis* bloom period in various

1 Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A, lead to
2 an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout
3 the Delta.

4 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
5 would occur in the Delta under Alternative 7, which could lead to earlier occurrences of *Microcystis*
6 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
7 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
8 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
9 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative 7
10 may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
11 because water temperatures will increase in the Export Service Areas due to the expected increase
12 in ambient air temperatures resulting from climate change.

13 NEPA Effects: Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
14 affected environment under Alternative 7 would be very similar to (i.e., nearly the same) to those
15 discussed for Alternative 1A. In summary, Alternative 7 operations and maintenance, relative to the
16 No Action Alternative, would result in long-term increases in hydraulic residence time of various
17 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
18 increased residence time could result in a concurrent increase in the frequency, magnitude, and
19 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
20 As a result, Alternative 7 operation and maintenance activities would cause further degradation to
21 water quality with respect to *Microcystis* in the Delta. Under Alternative 7, relative to No Action
22 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
23 affected source water from the south Delta intakes and unaffected source water from the
24 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
25 and maintenance under Alternative 7 will result in increased or decreased levels of *Microcystis* and
26 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
27 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
28 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
29 *Microcystis* from implementing CM1 is determined to be adverse.

30 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
31 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
32 purpose of making the CEQA impact determination for this constituent. For additional details on the
33 effects assessment findings that support this CEQA impact determination, see the effects assessment
34 discussion that immediately precedes this conclusion.

35 Under Alternative 7, additional impacts from *Microcystis* in the reservoirs and watersheds upstream
36 of the Delta are not expected, relative to Existing Conditions. Operations and maintenance occurring
37 under Alternative 7 is not expected to change nutrient levels in upstream reservoirs or
38 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
39 conducive to *Microcystis* production.

40 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
41 expected to increase under Alternative 7, resulting in an increase in the frequency, magnitude and
42 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
43 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
44 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected

1 throughout the Delta during the summer and fall bloom period, due in small part to climate change
2 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
3 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
4 production expected within any Delta sub-region is unknown because conditions will vary across
5 the complex networks of intertwining channels, shallow back water areas, and submerged islands
6 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
7 to Alternative 7. Consequently, it is possible that increases in the frequency, magnitude, and
8 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
9 maintenance of Alternative 7 and the hydrodynamic impacts of restoration (CM2 and CM4).

10 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
11 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
12 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
13 Under Alternative 7, relative to Existing Conditions, the potential for *Microcystis* to occur in the
14 Export Service Area is expected to increase due to increasing water temperature, but this impact is
15 driven entirely by climate change and not Alternative 7. Water exported from the Delta to the Export
16 Service Area is expected to be a mixture of *Microcystis*-affected source water from the south Delta
17 intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
18 determined whether operations and maintenance under Alternative 7, relative to existing
19 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
20 of source waters exported from Banks and Jones pumping plants.

21 Based on the above, this alternative would not be expected to cause additional exceedance of
22 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
23 would cause significant impacts on any beneficial uses of waters in the affected environment.
24 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
25 increases that could occur in some areas would not make any existing *Microcystis* impairment
26 measurably worse because no such impairments currently exist. However, because it is possible that
27 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
28 occur due to the operations and maintenance of Alternative 7 and the hydrodynamic impacts of
29 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
30 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
31 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences due to climate change and sea
32 level rise may lead to increased microcystin presence in the Delta relative to Existing Conditions.
33 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
34 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
35 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM1 is determined
36 to be significant.

37 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
38 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
39 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
40 remain significant and unavoidable.

41 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased** 42 ***Microcystis* Blooms**

43 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

1 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
2 **Water Residence Time**

3 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

4 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
5 **Measures (CM2–CM21)**

6 The effects of CM2–CM21 on *Microcystis* under Alternative 7 would be the same as those discussed
7 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
8 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
9 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters.
10 Because the hydrodynamic effects associated with implementing CM2 and CM4 were incorporated
11 into the modeling used to assess CM1, a detailed assessment of the effects of implementing CM2 and
12 CM4 on *Microcystis* blooms in the Delta via their effects on Delta water residence time is provided
13 under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation
14 of Mitigation Measure WQ-32a. The effectiveness of this mitigation measure to result in feasible
15 measures for reducing water quality effects is uncertain. CM3 and CM5–CM21 would not result in an
16 increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta.

17 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 7 would be the same as those
18 discussed for Alternative 1A and are considered to be adverse.

19 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
20 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
21 extent that would cause significant impacts on any beneficial uses of waters in the affected
22 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
23 and thus any increases that could occur in some areas would not make any existing *Microcystis*
24 impairment measurably worse because no such impairments currently exist. Because restoration
25 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
26 create local areas of warmer water during the bloom season, it is possible that increases in the
27 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
28 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
29 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
30 occurrences due to climate change and sea level rise may lead to increased microcystin presence in
31 the Delta relative to Existing Conditions. This has potential to cause microcystins to bioaccumulate
32 to greater levels in aquatic organisms that would, in turn, pose health risks to fish, wildlife or
33 humans. Although there is considerable uncertainty regarding this impact, the effects on *Microcystis*
34 from implementing CM2–CM21 are determined to be significant.

35 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
36 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
37 measures for reducing water quality effects is uncertain, this impact is considered to remain
38 significant and unavoidable.

39 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
40 ***Microcystis* Blooms**

41 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

1 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 2 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

3 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 4 that Alternative 7 would have a less than significant impact/no adverse effect on the following
 5 constituents in the Delta:

- 6 • Boron
- 7 • DO
- 8 • Pathogens
- 9 • Pesticides
- 10 • Trace Metals
- 11 • Turbidity and TSS

12 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 13 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 14 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 15 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 16 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 17 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
 18 geographic extent that would adversely affect any beneficial uses or substantially degrade the
 19 quality of the of San Francisco Bay.

20 The effects of Alternative 7 on bromide, chloride, and DOC, in the Delta were determined to be
 21 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
 22 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
 23 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
 24 adversely effect any beneficial uses of San Francisco Bay.

25 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
 26 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
 27 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
 28 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
 29 which would be the primary driver of salinity changes, would be two to three orders of magnitude
 30 lower than (and thus minimal compared to) the Bay's tidal flow.

31 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
 32 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
 33 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
 34 Suisun Bay.

35 While effects of Alternative 7 on the nutrients ammonia, nitrate, and phosphorus were determined
 36 to be less than significant/not adverse, these constituents are addressed further below because the
 37 response of the seaward bays to changed nutrient concentrations/loading may differ from the
 38 response of the Delta. Selenium and mercury are discussed further, because they are
 39 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
 40 and exports are of concern.

1 **Nutrients: Ammonia, Nitrate, and Phosphorus**

2 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 7 would be
3 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
4 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
5 decrease by 13%, relative to Existing Conditions, and increase by 28%, relative to the No Action
6 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
7 Suisun and San Pablo Bays under Alternative 7 would not adversely impact primary productivity in
8 these embayments because light limitation and grazing currently limit algal production in these
9 embayments. To the extent that algal growth increases in relation to a change in ammonia
10 concentration, this would have net positive benefits, because current algal levels in these
11 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
12 cyanobacteria levels in the North Bay.

13 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 7 is
14 estimated to increase by 9%, relative to Existing Conditions, and increase by 4% relative to the No
15 Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus
16 loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary
17 productivity. However, there is uncertainty regarding the impact of nutrient ratios on
18 phytoplankton community composition and abundance. Any effect on phytoplankton community
19 composition would likely be small compared to the effects of grazing from introduced clams and
20 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
21 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
22 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
23 would result in adverse effects to beneficial uses.

24 **Mercury**

25 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
26 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
27 are estimated to change relatively little due to changes in source water fractions and net Delta
28 outflow that would occur under Alternative 7. Mercury load to the Bay is estimated to increase by 10
29 kg/year (4%), relative to Existing Conditions, and 7 kg/year (3%), relative to the No Action
30 Alternative. Methylmercury load is estimated to increase by 0.29 kg/year (8%), relative to Existing
31 Conditions, and increase by 0.20 kg/year (5%) relative to the No Action Alternative. The estimated
32 total mercury load to the Bay is 270 kg/year, which would be less than the San Francisco Bay
33 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
34 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
35 term average net Delta outflow and the long-term average mercury and methylmercury
36 concentrations in Delta source waters. The estimated changes in mercury load under the alternative
37 would also be substantially less than the considerable differences among estimates in the current
38 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
39 David et al. 2009).

40 Given that the estimated incremental increases of mercury and methylmercury loading to San
41 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
42 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
43 Francisco Bay due to Alternative 7 are not expected to result in adverse effects to beneficial uses or

1 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
2 303(d) impairment measurably worse.

3 **Selenium**

4 Changes in source water fraction and net Delta outflow under Alternative 7, relative to Existing
5 Conditions, are projected to cause the total selenium load to the North Bay to increase by 20%,
6 relative to Existing Conditions, and increase by 16%, relative to the No Action Alternative (Appendix
7 80, Table O-3). Changes in long-term average selenium concentrations of the North Bay are assumed
8 to be proportional to changes in North Bay selenium loads. Under Alternative 7, the long-term
9 average total selenium concentration of the North Bay is estimated to be 0.15 µg/L and the dissolved
10 selenium concentration is estimated to be 0.13 µg/L, which would be a 0.02 µg/L increase relative to
11 Existing Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved selenium
12 concentration would be below the target of 0.202 µg/L developed by Presser and Luoma (2013) to
13 coincide with a white sturgeon whole-body fish tissue selenium concentration not greater than 8
14 mg/kg in the North Bay.

15 The incremental increase in dissolved selenium concentrations in water projected to occur under
16 Alternative 7, relative to Existing Conditions and the No Action Alternative, would be higher than
17 under Alternatives 1A–5, but still low (0.02 µg/L). The increased dissolved selenium concentration
18 would be within the overall uncertainty of the analytical methods used to measure selenium in
19 water column samples; however, it also would be within the uncertainty associated with estimating
20 numeric water column selenium thresholds (Pressor and Luoma 2013). As described in Section
21 8.3.1.8, there have been improvements in selenium concentrations in the tissue of diving ducks and
22 muscle of white sturgeon since the initial CWA Section 303(d) listing of the North Bay for selenium
23 impairments, and selenium concentrations in white sturgeon muscle have also generally been below
24 the USEPA's draft recommended fish muscle tissue concentration of 11.8 mg/kg dry weight (San
25 Francisco Estuary Institute 2014). However, as described under Impact WQ-25, though there is
26 some uncertainty in the estimate of sturgeon concentrations at western Delta locations, the
27 predicted increases for Alternative 7 are high enough that they may represent measurably higher
28 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
29 wildlife (including fish). Because the projected incremental increases in dissolved selenium could
30 cause measurable changes in water column concentrations, and these incremental increases would
31 be within the uncertainty in the target water column threshold for dissolved selenium for protection
32 against adverse bioaccumulative effects in the North Bay ecosystem, and modeling predicts
33 concentrations in the western Delta may represent a measurable increase in body burdens of
34 sturgeon, there is potential that the incremental increase in dissolved selenium concentration
35 projected to occur in the North Bay under Alternative 7 could result in adverse effects beneficial
36 uses.

37 **NEPA Effects:** Based on the discussion above, Alternative 7, relative to the No Action Alternative,
38 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
39 DOC, EC, mercury, pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or
40 turbidity and TSS in the San Francisco Bay. Further, changes in these constituent concentrations in
41 Delta outflow would not be expected to cause changes in Bay concentrations of frequency,
42 magnitude, and geographic extent that would adversely affect any beneficial uses. In summary,
43 based on the discussion above, effects on the San Francisco Bay from implementation of CM1–CM21
44 are considered to be not adverse with respect to boron, bromide, chloride, DO, DOC, EC, mercury,
45 pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS.

1 However, Alternative 7 could result in increases in selenium concentrations in the North San
2 Francisco Bay that could result in adverse effects to fish and wildlife beneficial uses. This effect is
3 considered to be adverse.

4 **CEQA Conclusion:** Based on the above, Alternative 7 would not be expected to cause long-term
5 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
6 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
7 would result in substantially increased risk for adverse effects to one or more beneficial uses with
8 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
9 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Further, based on the above, this
10 alternative would not be expected to cause additional exceedance of applicable water quality
11 objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent that
12 would cause significant impacts on any beneficial uses of waters in the affected environment with
13 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
14 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Any changes in boron, bromide,
15 chloride, and DOC in the San Francisco Bay would not adversely affect beneficial uses, because the
16 uses most affected by changes in these parameters, MUN and AGR, are not beneficial uses of the Bay.
17 Further, no substantial changes in DO, pathogens, pesticides, trace metals or turbidity or TSS are
18 anticipated in the Delta, relative to Existing Conditions, therefore, no substantial changes these
19 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
20 measurable changes in Bay salinity, as the change in Delta outflow would two to three orders of
21 magnitude lower than (and thus minimal compared to) the Bay's tidal flow. Adverse changes in
22 *Microcystis* levels that could occur in the Delta would not cause adverse *Microcystis* blooms in the
23 Bay, because *Microcystis* are intolerant of the Bay's high salinity and, thus not have not been
24 detected downstream of Suisun Bay. The 13% decrease in total nitrogen load and 9% increase in
25 phosphorus load, relative to Existing Conditions, are expected to have minimal effect on water
26 quality degradation, primary productivity, or phytoplankton community composition. The estimated
27 increase in mercury load (10 kg/year; 4%) and methylmercury load (0.29 kg/year; 8%), relative to
28 Existing Conditions, is within the level of uncertainty in the mass load estimate and not expected to
29 contribute to water quality degradation, make the CWA section 303(d) mercury impairment
30 measurably worse or cause mercury/methylmercury to bioaccumulate to greater levels in aquatic
31 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans.

32 In regard to selenium, the estimated increase in selenium load would be 20% and the estimated
33 increase in dissolved selenium concentrations would be 0.02 µg/L. Though there is some
34 uncertainty in the estimate of sturgeon concentrations at western Delta locations, the predicted
35 increases are high enough that they may represent measurably higher body burdens of selenium in
36 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish). Thus,
37 the increase in selenium load may make the CWA section 303(d) selenium impairment measurably
38 worse and cause selenium to bioaccumulate to greater levels in aquatic organisms that would, in
39 turn, pose substantial health risks to fish and wildlife. This impact is considered to be significant.
40 *AMM27 Selenium Management*, which affords for site-specific measures to reduce effects, would be
41 available to reduce BDCP-related effects associated with selenium. The effectiveness of AMM27 is
42 uncertain and, therefore implementation may not reduce the identified impact to a level that would
43 be less than significant, and therefore it is significant and unavoidable.

8.3.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

Alternative 8 would comprise physical/structural components similar to those under Alternative 1A with the principal exceptions that Alternative 8 would have only three intakes and intake pumping plants (i.e., Intakes 2, 3, and 5). Alternative 8 would convey up to 9,000 cfs of water from the north Delta to the south Delta through pipelines/tunnels from three screened intakes on the east bank of the Sacramento River between Clarksburg and Walnut Grove. A 750-acre intermediate forebay and pumping plant would be constructed near Hood. A new 600-acre Byron Tract Forebay, adjacent to and south of Clifton Court Forebay, would be constructed which would provide water to the south Delta pumping plants. Water supply and conveyance operations would follow the guidelines described as Scenario F, which includes Fall X2. The alternative would provide up to 1.5 MAF in increased Delta outflow. CM2–CM21 would be implemented under this alternative, and would be the same as those under Alternative 1A. See Chapter 3, *Description of Alternatives*, Section 3.5.15, for additional details on Alternative 8.

Effects of the Alternative on Delta Hydrodynamics

Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can substantially affect water quality within the Delta:

- Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-sourced water and a concurrent increase in San Joaquin River-sourced water can increase the concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity, nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by decreased exports of San Joaquin River water (due to increased Sacramento River water exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows also can affect water residence time and many related physical, chemical, and biological variables.
- Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta outflow can increase the concentration of salts (bromide, chloride) and levels of electrical conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet and above normal water years) will decrease levels of these constituents, particularly in the west Delta.

Under Alternative 8, over the long term, average annual delta exports are anticipated to decrease by 2,046 TAF relative to Existing Conditions, and by 1,342 TAF relative to the No Action Alternative. Because, over the long-term, approximately 70% of the exported water would be from the new north Delta intakes, average monthly diversions at the south Delta intakes would be decreased because of the shift in diversions to the north Delta intakes (see Chapter 5, *Water Supply*, for more information). The result of this would be greatly increased San Joaquin River water influence throughout the south, west, and interior Delta, and a corresponding decrease in Sacramento River water influence. This can be seen, for example, in Appendix 8D, ALT 8–Old River at Rock Slough for ALL years (1976–1991), which shows increased San Joaquin River (SJR) percentage and decreased Sacramento River (SAC) percentage under the alternative, relative to Existing Conditions and the No Action Alternative.

1 Under Alternative 8, long-term average annual Delta outflow is anticipated to increase 2,195 TAF
 2 relative to Existing Conditions, due to both changes in operations (including north Delta intake
 3 capacity of 9,000 cfs and numerous other components of Operational Scenario F) and climate
 4 change/sea level rise (see Chapter 5, *Water Supply*, for more information). The result of this is
 5 decreased sea water intrusion in the west Delta. The decrease of sea water intrusion in the west
 6 Delta under Alternative 8 is greater relative to the Existing Conditions because it does not include
 7 operations to meet Fall X2, whereas the No Action alternative and Alternative 8 do. Long-term
 8 average annual Delta outflow is anticipated to increase under Alternative 8 by 1,445 TAF relative to
 9 the No Action Alternative, due only to changes in operations. The decreases in sea water intrusion
 10 (represented by an decrease in San Francisco Bay (BAY) percentage) can be seen, for example, in
 11 Appendix 8D, ALT 8–Sacramento River at Mallard Island for ALL years (1976–1991).

12 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 *Upstream of the Delta*

15 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
 16 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to
 17 Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N
 18 concentrations that could occur in the water bodies of the affected environment located upstream of
 19 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 20 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 21 ammonia.

22 *Delta*

23 Assessment of effects of ammonia under Alternative 8 is the same as discussed under Alternative
 24 1A, except that because flows in the Sacramento River at Freeport are different between the two
 25 alternatives, estimated monthly average and long term annual average predicted ammonia-N
 26 concentrations in the Sacramento River downstream of Freeport are different.

27 As Table 8-71 shows, estimated ammonia-N concentrations in the Sacramento River downstream of
 28 Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 8 and the No
 29 Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would
 30 occur during July through December, and remaining months would be unchanged or have a minor
 31 decrease. A minor increase in the annual average concentration would occur under Alternative 8,
 32 compared to the No Action Alternative. Moreover, the estimated concentrations downstream of
 33 Freeport under Alternative 8 would be similar to existing source water concentrations for the San
 34 Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated
 35 under Alternative 8, relative to the No Action Alternative, are not expected to substantially increase
 36 ammonia concentrations at any Delta locations.

1 **Table 8-71. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of**
 2 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 8**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 8	0.081	0.089	0.070	0.060	0.057	0.059	0.055	0.059	0.066	0.072	0.078	0.070	0.068

3

4 Any negligible increases in ammonia-N concentrations that could occur at certain locations in the
 5 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
 6 beneficial uses or substantially degrade the water quality at these locations, with regards to
 7 ammonia.

8 ***SWP/CVP Export Service Areas***

9 The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment
 10 of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for
 11 Alternative 1A, under Alternative 8 for areas of the Delta that are influenced by Sacramento River
 12 water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to
 13 decrease, relative to Existing Conditions (in association with less diversion of water influenced by
 14 the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta
 15 pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water
 16 quality of exported water, with regards to ammonia.

17 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
 18 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
 19 under Alternative 8, relative to the No Action Alternative. Any negligible increases in ammonia-N
 20 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
 21 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 22 degrade the water quality at these locations, with regards to ammonia.

23 ***NEPA Effects:*** In summary, based on the discussion above, effects on ammonia from implementation
 24 of CM1 are considered to be not adverse.

25 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 27 purpose of making the CEQA impact determination for this constituent. For additional details on the
 28 effects assessment findings that support this CEQA impact determination, see the effects assessment
 29 discussion that immediately precedes this conclusion.

30 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
 31 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
 32 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
 33 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
 34 any modified reservoir operations and subsequent changes in river flows under Alternative 8,
 35 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
 36 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
 37 of the Delta in the San Joaquin River watershed.

1 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
 2 substantially lower under Alternative 8, relative to Existing Conditions, due to upgrades to the
 3 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
 4 that are influenced by Sacramento River water are expected to decrease. At locations which are not
 5 influenced notably by Sacramento River water, concentrations are expected to remain relatively
 6 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
 7 either of these concentrations.

8 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
 9 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
 10 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
 11 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 8,
 12 relative to Existing Conditions.

13 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
 14 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
 15 CVP and SWP service areas under Alternative 8 relative to Existing Conditions. As such, this
 16 alternative is not expected to cause additional exceedance of applicable water quality
 17 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 18 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
 19 not expected to increase substantially, no long-term water quality degradation is expected to occur
 20 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
 21 affected environment and thus any minor increases that could occur in some areas would not make
 22 any existing ammonia-related impairment measurably worse because no such impairments
 23 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in
 24 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 25 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 26 significant. No mitigation is required.

27 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2- 28 CM21**

29 **NEPA Effects:** Effects of CM2–CM21 on ammonia under Alternative 8 would be the same as those
 30 discussed for Alternative 1A and are considered to be not adverse.

31 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 32 measures proposed under Alternative 1A. As such, effects on ammonia resulting from the
 33 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 34 This impact is considered to be less than significant. No mitigation is required.

35 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and 36 Maintenance (CM1)**

37 ***Upstream of the Delta***

38 Effects of CM1 on boron under Alternative 8 in areas upstream of the Delta would be very similar to
 39 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 40 in the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 41 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 42 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin

1 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
2 project operations, climate change, and increased water demands) and the No Action Alternative
3 considering only changes due to Alternative 8 operations. The reduced flow would result in possible
4 increases in long-term average boron concentrations of up to about 3% relative to the Existing
5 Conditions (Appendix 8F, *Boron*, Bo-24). The increased boron concentrations would not increase the
6 frequency of exceedances of any applicable objectives or criteria and would not be expected to cause
7 further degradation at measurable levels in the lower San Joaquin River, and thus would not cause
8 the existing impairment there to be discernibly worse. Consequently, Alternative 8 would not be
9 expected to cause exceedance of boron objectives/criteria or substantially degrade water quality
10 with respect to boron, and thus would not adversely affect any beneficial uses of the Sacramento
11 River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

12 **Delta**

13 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
14 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
15 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
16 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
17 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
18 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
19 information.

20 Effects of CM1 on boron under Alternative 8 in the Delta would be similar to the effects discussed for
21 Alternative 1A. Relative to the Existing Conditions and No Action Alternative, Alternative 8 would
22 result in increased long-term average boron concentrations for the 16-year period modeled at
23 interior Delta locations (by as much as 10% at the SF Mokelumne River at Staten Island, 35% at
24 Franks Tract, 58% at Old River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-20). The comparison
25 to Existing Conditions reflects changes due to both Alternative 8 operations (including north Delta
26 intake capacity of 9,000 cfs and numerous other components of Operational Scenario E) and climate
27 change/sea level rise. The comparison to the No Action Alternative reflects changes due only to
28 operations.

29 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
30 concentrations at western Delta assessment locations (more discussion of this phenomenon is
31 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
32 diversions which occur primarily at interior Delta locations.

33 The long-term annual average and monthly average boron concentrations, for either the 16-year
34 period or drought period modeled, would never exceed the 2,000 µg/L human health advisory
35 objective (i.e., for children) or 500 µg/L agricultural objective at any of the eleven Delta assessment
36 locations, which represents no change from the Existing Conditions and No Action Alternative
37 (Appendix 8F, *Boron*, Table Bo-3A). The increased concentrations at interior Delta locations would
38 result in moderate reductions in the long-term average assimilative capacity of up to 16% at Franks
39 Tract and up to 34% at Old River at Rock Slough locations (Appendix 8F, Table Bo-21). However,
40 because the absolute boron concentrations would still be well below the lowest 500 µg/L objective
41 for the protection of the agricultural beneficial use under Alternative 8, the levels of boron
42 degradation would not be of sufficient magnitude to substantially increase the risk of exceeding
43 objectives or cause adverse effects to municipal and agricultural water supply beneficial uses, or any
44 other beneficial uses, in the Delta (Appendix 8F, Figure Bo-5).

1 **SWP/CVP Export Service Areas**

2 Effects of CM1 on boron under Alternative 8 in the Delta would be similar to the effects discussed for
3 Alternative 1A. Under Alternative 8, long-term average boron concentrations would decrease by as
4 much as 37% at the Banks Pumping Plant and by as much as 47% at Jones Pumping Plant relative to
5 Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-20) as a result of
6 export of a greater proportion of low-boron Sacramento River water. Commensurate with the
7 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
8 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
9 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
10 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
11 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
12 Joaquin River and associated TMDL actions for reducing boron loading.

13 Maintenance of SWP and CVP facilities under Alternative 8 would not be expected to create new
14 sources of boron or contribute towards a substantial change in existing sources of boron in the
15 affected environment. Maintenance activities would not be expected to cause any substantial
16 increases in boron concentrations or degradation with respect to boron such that objectives would
17 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
18 affected environment.

19 **NEPA Effects:** In summary, relative to the No Action Alternative conditions, Alternative 8 would
20 result in relatively small long-term average increases in boron levels in the San Joaquin River and
21 moderate increases in the interior and western Delta locations Delta. However, the predicted
22 changes in the Delta would not be expected to result in exceedances of applicable objectives or
23 further water quality degradation such that objectives would likely be exceeded or there would be
24 substantially increased risk of adverse effects on water quality.

25 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
26 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
27 purpose of making the CEQA impact determination for this constituent. For additional details on the
28 effects assessment findings that support this CEQA impact determination, see the effects assessment
29 discussion that immediately precedes this conclusion.

30 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
31 river flow rate and reservoir storage reductions that would occur under the Alternative 8, relative to
32 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
33 Additionally, relative to Existing Conditions, Alternative 8 would not result in reductions in river
34 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
35 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

36 Moderate increased boron levels (i.e., up to 58% increased concentration) and degradation
37 predicted for interior and western Delta locations in response to a shift in the Delta source water
38 percentages and tidal habitat restoration under this alternative would not be expected to cause
39 exceedances of objectives. Alternative 8 maintenance also would not result in any substantial
40 increases in boron concentrations in the affected environment. Boron concentrations would be
41 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
42 potential improvement to boron loading in the lower San Joaquin River.

1 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 8
 2 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 3 Existing Conditions, Alternative 8 would not result in substantially increased boron concentrations
 4 such that frequency of exceedances of municipal and agricultural water supply objectives would
 5 increase. The levels of boron degradation that may occur under Alternative 8, while widespread in
 6 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
 7 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
 8 environment. Long-term average boron concentrations would decrease in Delta water exports to the
 9 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
 10 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 8 would not be
 11 expected to cause any substantial increases in boron concentrations or degradation with respect to
 12 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
 13 adversely affected anywhere in the affected environment. Based on these findings, this impact is
 14 determined to be less than significant. No mitigation is required.

15 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

16 **NEPA Effects:** Effects of CM2–CM21 on boron under Alternative 8 would be the same as those
 17 discussed for Alternative 1A and are determined to be not adverse.

18 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 19 measures proposed under Alternative 1A. As such, effects on boron resulting from the
 20 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 21 This impact is considered to be less than significant. No mitigation is required.

22 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 23 **Maintenance (CM1)**

24 ***Upstream of the Delta***

25 Under Alternative 8 there would be no expected change to the sources of bromide in the Sacramento
 26 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
 27 and resultant changes in flows from altered system-wide operations under Alternative 8 would have
 28 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
 29 watersheds. Consequently, Alternative 8 would not be expected to adversely affect the MUN
 30 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
 31 associated reservoirs upstream of the Delta.

32 Under Alternative 8, modeling indicates that long-term annual average flows on the San Joaquin
 33 River would decrease by 6%, relative to Existing Conditions, and would remain virtually the same
 34 relative to No Action Alternative (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
 35 *Technical Appendix*). These decreases in flow would result in possible increases in long-term average
 36 bromide concentrations of about 3%, relative to Existing Conditions and less than <1% relative to
 37 the No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower San
 38 Joaquin River bromide levels that could occur under Alternative 8, relative to existing and No Action
 39 Alternative conditions would not be expected to adversely affect the MUN beneficial use, or any
 40 other beneficial uses, of the lower San Joaquin River.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
7 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
8 information.

9 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
10 Conditions, Alternative 8 would result in increases in long-term average bromide concentrations at
11 Staten Island and Barker Slough, while long-term average concentrations would decrease at the
12 other assessment locations (Appendix 8E, *Bromide*, Table 18). At Barker Slough, predicted long-term
13 average bromide concentrations would increase from 51 µg/L to 54 µg/L (4% relative increase) for
14 the modeled 16-year hydrologic period, and would increase from 54 µg/L to 80 µg/L (50% relative
15 increase) for the modeled drought period. At Barker Slough, the predicted 50 µg/L exceedance
16 frequency would decrease from 49% under Existing Conditions to 34% under Alternative 8, but
17 would increase slightly from 55% to 62% during the drought period. At Barker Slough, the predicted
18 100 µg/L exceedance frequency would increase from 0% under Existing Conditions to 10% under
19 Alternative 8, and would increase from 0% to 27% during the drought period. At Staten Island,
20 predicted long-term average bromide concentrations would increase from 50 µg/L to 64 µg/L (29%
21 relative increase) for the modeled 16-year hydrologic period and would increase from 51 µg/L to 65
22 µg/L (26% relative increase) for the modeled drought period. At Staten Island, increases in average
23 bromide concentrations would correspond to an increased frequency of 50 µg/l threshold
24 exceedance, from 47% under Existing Conditions to 80% under Alternative 8 (52% to 87% for the
25 modeled drought period), and an increase from 1% to 2% (0% to 0% for the modeled drought
26 period) for the 100 µg/L threshold. Changes in exceedance frequency of the 50 µg/L and 100 µg/L
27 concentration thresholds at other assessment locations would be less considerable, with exception
28 to Franks Tract. Although long-term average bromide concentrations were modeled to decrease at
29 Franks Tract, exceedances of the 100 µg/L threshold would increase slightly, from 82% under
30 Existing Conditions to 98% under Alternative 8 (78% to 93% for the modeled drought period). This
31 comparison to Existing Conditions reflects changes in bromide due to both Alternative 8 operations
32 (including north Delta intake capacity of 9,000 cfs and numerous other components of Operational
33 Scenario F) and climate change/sea level rise.

34 Due to the relatively small differences between modeled Existing Conditions and the No Action
35 baseline, changes in long-term average bromide concentrations and changes in exceedance
36 frequencies relative to the No Action Alternative are generally of similar magnitude to those
37 previously described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 18).
38 Modeled long-term average bromide concentration at Barker Slough is predicted to increase by 8%
39 (50% for the modeled drought period) relative to the No Action Alternative. Modeled long-term
40 average bromide concentration increases at Staten Island are predicted to increase by 33% (30% for
41 the modeled drought period) relative to the No Action Alternative. However, unlike the Existing
42 Conditions comparison, long-term average bromide concentrations at Buckley Cove would increase
43 relative to the No Action Alternative, although the increases would be relatively small ($\leq 2\%$). Unlike
44 the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes
45 in bromide due only to Alternative 8 operations.

1 At Barker Slough, modeled long-term average bromide concentrations for the two baseline
2 conditions are very similar (Appendix 8E, Table 18). Such similarity demonstrates that the modeled
3 Alternative 8 change in bromide is almost entirely due to Alternative 8 operations, and not climate
4 change/sea level rise. Therefore, operations are the primary driver of effects on bromide at Barker
5 Slough, regardless whether Alternative 8 is compared to Existing Conditions, or compared to the No
6 Action Alternative.

7 Results of the modeling approach which used relationships between EC and chloride and between
8 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
9 mass-balance approach (see Appendix 8E, *Bromide*, Table 19). For most locations, the frequency of
10 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
11 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
12 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
13 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
14 that presented above from the mass-balance modeling approach. Results indicate 4% exceedance
15 over the modeled period under Alternative 8, as compared to 1% under Existing Conditions and 2%
16 under the No Action Alternative. For the drought period, exceedance frequency increased from 0%
17 under Existing Conditions and the No Action Alternative, to 12% under Alternative 8. Because the
18 mass-balance approach predicts a greater level of impact at Barker Slough, determination of impacts
19 was based on the mass-balance results.

20 While the increase in long-term average bromide concentrations at Barker Slough are relatively
21 small when modeled over a representative 16-year hydrologic period, increases during the modeled
22 drought period, principally the relative increase in 100 µg/L exceedance frequency, would represent
23 a substantial change in source water quality during a season of drought. As discussed for Alternative
24 1A, drinking water treatment plants obtaining water via the North Bay Aqueduct utilize a variety of
25 conventional and enhanced treatment technologies in order to achieve DBP drinking water criteria.
26 While the implications of such a modeled drought period change in bromide concentrations at
27 Barker Slough is difficult to predict, the substantial modeled increases could lead to adverse changes
28 in the formation of disinfection byproducts such that considerable treatment plant upgrades may be
29 necessary in order to achieve equivalent levels of health protection during seasons of drought.
30 Increases at Staten Island are also considerable, although there are no existing or foreseeable
31 municipal intakes in the immediate vicinity. Because many of the other modeled locations already
32 frequently exceed the 100 µg/L threshold under Existing Conditions and the No Action Alternative,
33 these locations likely already require treatment plant technologies to achieve equivalent levels of
34 health protection, and thus no additional treatment technologies would be triggered by the small
35 increases in the frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the
36 drinking water beneficial use would be expected at these locations.

37 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
38 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
39 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
40 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
41 Slough and City of Antioch under Alternative 8 would experience a period average increase in
42 bromide during the months when these intakes would most likely be utilized. For those wet and
43 above normal water year types where mass balance modeling would predict water quality typically
44 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 146
45 µg/L (42% increase) at City of Antioch and would increase from 150 µg/L to 193 µg/L (29%
46 increase) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).

1 Increases would be similar for the No Action Alternative comparison. Modeling results using the EC
2 to chloride and chloride to bromide relationships show increases during these months, but the
3 relative magnitude of the increases is much lower (Appendix 8E, Table 26). Regardless of the
4 differences in the data between the two modeling approaches, the decisions surrounding the use of
5 these seasonal intakes is largely driven by acceptable water quality, and thus have historically been
6 opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
7 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
8 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

9 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
10 conditions, Alternative 8 would lead to predicted improvements in long-term average bromide
11 concentrations at Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to Banks and
12 Jones (discussed below). At these locations, long-term average bromide concentrations would be
13 predicted to decrease by as much as 11–37%, depending on baseline comparison. Modeling results
14 using the EC to chloride and chloride to bromide relationships generally do not show similar
15 decreases for Rock Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on
16 the small magnitude of increases predicted, these increases would not adversely affect beneficial
17 uses at those locations.

18 Important to the results presented above is the assumed habitat restoration footprint on both the
19 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
20 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
21 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
22 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
23 deviations from modeled habitat restoration and implementation schedule will lead to different
24 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
25 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
26 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
27 management changes to BDCP restoration activities, including location, magnitude, and timing of
28 restoration, the estimates are not predictive of the bromide levels that would actually occur in
29 Barker Slough or elsewhere in the Delta.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 8, improvement in long-term average bromide concentrations would occur at the
32 Banks and Jones pumping plants. Long-term average bromide concentrations for the modeled 16-
33 year hydrologic period at these locations would decrease by as much as 75% relative to Existing
34 Conditions and 69% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 18). As a
35 result, exceedances of the 50 µg/L and 100 µg/L assessment thresholds would be substantially
36 reduced, resulting in considerable overall improvement in Export Service Areas water quality
37 respective to bromide. Commensurate with the decrease in exported bromide, an improvement in
38 lower San Joaquin River bromide would also be observed since bromide in the lower San Joaquin
39 River is principally related to irrigation water deliveries from the Delta. While the magnitude of this
40 expected lower San Joaquin River improvement in bromide is difficult to predict, the relative
41 decrease in overall loading of bromide to the Export Service Areas would likely alleviate or lessen
42 any expected increase in bromide concentrations at Vernalis (see discussion of Upstream of the
43 Delta) as well as locations in the Delta receiving a large fraction of San Joaquin River water, such as
44 much of the south Delta.

1 The discussion above is based on results of the mass-balance modeling approach. Results of the
2 modeling approach which used relationships between EC and chloride and between chloride and
3 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
4 using these data results in the same conclusions as are presented above for the mass-balance
5 approach (see Appendix 8E, *Bromide*, Table 19).

6 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
7 facilities under Alternative 8 would not be expected to create new sources of bromide or contribute
8 towards a substantial change in existing sources of bromide in the affected environment.
9 Maintenance activities would not be expected to cause any substantial change in bromide such that
10 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
11 affected environment.

12 **NEPA Effects:** In summary, Alternative 8 operations and maintenance, relative to the No Action
13 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
14 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
15 However, Alternative 8 operation and maintenance activities would cause substantial degradation
16 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
17 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
18 changes in water treatment plant operations or require treatment plant upgrades in order to
19 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
20 Measure WQ-5 is available to reduce these effects. Implementation of this measure along with a
21 separate other commitment as set forth in Appendix 3B, *Environmental Commitments, AMMs, and*
22 *CMs*, relating to the potential increased treatment costs associated with bromide-related changes
23 would reduce these effects.

24 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
25 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
26 purpose of making the CEQA impact determination for this constituent. For additional details on the
27 effects assessment findings that support this CEQA impact determination, see the effects assessment
28 discussion that immediately precedes this conclusion.

29 Under Alternative 8 there would be no expected change to the sources of bromide in the Sacramento
30 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
31 and resultant changes in flows from altered system-wide operations under Alternative 8 would have
32 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
33 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
34 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
35 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 8, long-term
36 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
37 increases in long-term average bromide of about 3% relative to Existing Conditions.

38 Relative to Existing Conditions, Alternative 8 would result in increases in long-term average
39 bromide concentration at Staten Island and Barker Slough. There are no existing or foreseeable
40 municipal drinking water intakes in the vicinity of Staten Island, but Barker Slough is the source of
41 the North Bay Aqueduct. While the increase in long-term average bromide concentrations at Barker
42 Slough are predicted to be relatively small when modeled over a representative 16-year hydrologic
43 period, increases during the modeled drought period would represent a substantial change in
44 source water quality during a season of drought. These predicted drought season related increases

1 in bromide at Barker Slough could lead to adverse changes in the formation of disinfection
2 byproducts at drinking water treatment plants such that considerable water treatment plant
3 upgrades would be necessary in order to achieve equivalent levels of drinking water health
4 protection.

5 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
6 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 8,
7 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
8 long-term average bromide concentrations are predicted to decrease by as much as 75% relative to
9 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
10 in the SWP/CVP Export Service Areas.

11 Based on the above, Alternative 8 operation and maintenance would not result in any substantial
12 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
13 Alternative 8, water exported from the Delta to the SWP/CVP service area would be substantially
14 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
15 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
16 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 8
17 operation and maintenance activities would not cause substantial long-term degradation to water
18 quality respective to bromide with the exception of water quality at Barker Slough (drought period
19 only) and at Staten Island in the eastern Delta. There are no existing or foreseeable municipal
20 intakes in the vicinity of Staten Island, but Barker Slough is the source of the North Bay Aqueduct. At
21 Barker Slough, modeled long-term annual average concentrations of bromide would increase by
22 50% during the modeled drought period. For the modeled drought period the frequency of
23 predicted bromide concentrations exceeding 100 µg/L would increase from 0% under Existing
24 Conditions to 27% under Alternative 8. Substantial changes in long-term average bromide during
25 seasons of drought could necessitate changes in treatment plant operation or require treatment
26 plant upgrades in order to maintain DBP compliance. The model predicted change at Barker Slough
27 during the drought period is substantial and, therefore, would represent a substantially increased
28 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
29 undertaken. The impact is considered significant.

30 Implementation of Mitigation Measure WQ-5 along with a separate other commitment relating to
31 the potential increased treatment costs associated with bromide-related changes would reduce
32 these effects. While mitigation measures to reduce these water quality effects in affected water
33 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
34 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
35 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
36 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
37 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
38 discussion of Alternative 1A.

39 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
40 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
41 separate other commitment to address the potential increased water treatment costs that could
42 result from bromide-related concentration effects on municipal water purveyor operations.
43 Potential options for making use of this financial commitment include funding or providing other
44 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
45 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing

1 water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that
 2 could be taken pursuant to this commitment in order to reduce the water quality treatment costs
 3 associated with water quality effects relating to chloride, electrical conductivity, and bromide.

4 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 5 **Conditions**

6 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

7 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 8 **CM21**

9 **NEPA Effects:** CM2–CM21 under Alternative 8 would be similar to conservation measures under
 10 Alternative 1A. As discussed for Alternative 1A, implementation of the CM2–CM21 would not
 11 present new or substantially changed sources of bromide to the study area. Some conservation
 12 measures may replace or substitute for existing irrigated agriculture in the Delta. This replacement
 13 or substitution is not expected to substantially increase or present new sources of bromide. CM2–
 14 CM21 would not be expected to cause any substantial change in bromide such that MUN beneficial
 15 uses, or any other beneficial use, would be adversely affected anywhere in the affected environment.

16 In summary, implementation of CM2–CM21 under Alternative 8, relative to the No Action
 17 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 18 from implementing CM2–CM21 are determined to not be adverse.

19 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 20 measures proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
 21 CM21 would not present new or substantially changed sources of bromide to the study area. As
 22 such, effects on bromide resulting from the implementation of CM2–CM21 would be similar to those
 23 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 24 mitigation is required.

25 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 26 **Maintenance (CM1)**

27 ***Upstream of the Delta***

28 Under Alternative 8 there would be no expected change to the sources of chloride in the Sacramento
 29 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 30 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 31 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
 32 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
 33 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
 34 result of climate change). The reduced flow would result in possible increases in long-term average
 35 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
 36 Action Alternative (Appendix 8G, *Chloride*, Table Cl-62). Consequently, Alternative 8 would not be
 37 expected to cause exceedance of chloride objectives/criteria or substantially degrade water quality
 38 with respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento
 39 River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

1 **Delta**

2 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
3 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
4 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
5 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
6 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
7 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
8 information.

9 Relative to the Existing Conditions and No Action Alternative, Alternative 8 would result in similar
10 or reduced long-term average chloride concentrations for the 16-year period modeled at most of the
11 assessment locations, and, depending on the modeling approach (see Section 8.3.1.3), increased
12 concentrations at the North Bay Aqueduct at Barker Slough (i.e., up to 6% compared to No Action
13 Alternative), Contra Costa Canal at Pumping Plant #1 (i.e., up to 24% compared to No Action
14 Alternative), Rock Slough (i.e., up to 18% compared to No Action Alternative), and the SF
15 Mokelumne at Staten Island (i.e., up to 29% compared to No Action Alternative) (Appendix 8G,
16 *Chloride*, Table CI-49 and Table CI-50). Moreover, the direction and magnitude of predicted changes
17 for Alternative 8 are similar between the alternatives, thus, the effects relative to Existing Conditions
18 and the No Action Alternative are discussed together. Additionally, implementation of tidal habitat
19 restoration under CM4 would increase the tidal exchange volume in the Delta, and thus may
20 contribute to increased chloride concentrations in the Bay source water as a result of increased
21 salinity intrusion. More discussion of this phenomenon is included in Section 8.3.1.3. Consequently,
22 while uncertain, the magnitude of chloride increases may be greater than indicated herein and
23 would affect the western Delta assessment locations the most which are influenced to the greatest
24 extent by the Bay source water. The comparison to Existing Conditions reflects changes in chloride
25 due to both Alternative 8 operations (including north Delta intake capacity of 9,000 cfs and
26 numerous other components of Operational Scenario E) and climate change/sea level rise. The
27 comparison to the No Action Alternative reflects changes in chloride due only to operations. The
28 following outlines the modeled chloride changes relative to the applicable objectives and beneficial
29 uses of Delta waters.

30 *Municipal Beneficial Uses*

31 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
32 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
33 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
34 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
35 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
36 Pumping Plant #1 locations. For Alternative 8, the modeled frequency of objective exceedance
37 would increase from 7% of years under Existing Conditions and 0% under the No Action Alternative
38 to 13% of years under Alternative 8 (Appendix 8G, *Chloride*, Table CI-64).

39 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
40 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
41 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
42 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
43 year period. For Alternative 8, the modeled frequency of objective exceedance would decrease, from

1 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
2 modeled days under Alternative 8 (Appendix 8G, *Chloride*, Table Cl-63).

3 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
4 estimation of chloride concentrations through both an mass balance approach and an EC-chloride
5 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
6 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
7 approach to model monthly average chloride concentrations for the 16-year period, the predicted
8 frequency of exceeding the 250 mg/L objective would decrease up to 15% (i.e., 24% for Existing
9 Conditions to 9%) at the Contra Costa Canal at Pumping Plant #1 (Appendix 8G, *Chloride*, Table Cl-
10 51 and Figure Cl-13). The frequency of exceedances would decrease at the San Joaquin River at
11 Antioch (i.e., from 66% under Existing Conditions to 58%) with no substantial change predicted for
12 Mallard Island (i.e., maximum increase of 1%) (Appendix 8G, Table Cl-51) and no substantial long-
13 term degradation (Appendix 8G, Table Cl-53). However, relative to the No Action conditions,
14 available assimilative capacity for chloride at the Contra Costa Canal at Pumping Plant #1 would be
15 substantially reduced in September and October (i.e., up to 100%, or eliminated, for the drought
16 period modeled) (Appendix 8G, Table Cl-53), reflecting substantial degradation when
17 concentrations would be near, or exceed, the objective.

18 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
19 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
20 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, Table Cl-52 and
21 Table Cl-54). Specifically, while the model predicted exceedance frequency would decrease at the
22 Contra Costa Canal at Pumping Plant #1 and Rock Slough locations, use of assimilative capacity
23 would increase substantially for the months of February through June as well as September (i.e.,
24 maximum of 82% in March for the modeled drought period). Due to such seasonal long-term
25 average water quality degradation at these locations, the potential exists for substantial adverse
26 effects on the municipal and industrial beneficial uses through reduced opportunity for diversion of
27 water with acceptable chloride levels. Moreover, due to the increased frequency of exceeding the
28 150 mg/L Bay-Delta WQCP objective, the potential exists for adverse effects on the municipal and
29 industrial beneficial uses at Contra Costa Pumping Plant #1 and Antioch.

30 *303(d) Listed Water Bodies*

31 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
32 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
33 nearest DSM2-modeled location to Tom Paine in the south Delta, would generally be similar
34 compared to Existing Conditions and No Action Alternative, and thus, would not be further degraded
35 on a long-term basis (Appendix 8G, Figure Cl-14).

36 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
37 modeled would generally be similar, or decrease, compared to Existing Conditions and No Action
38 Alternative in some months during October through May at the Sacramento River at Collinsville
39 (Appendix 8G, Figure Cl-15), Mallard Island (Appendix 8G, Figure Cl-13). However, chloride
40 concentrations would increase substantially at Montezuma Slough at Beldon's Landing (i.e., over a
41 doubling of concentration in December through February) (Appendix 8G, Figure Cl-16). Although
42 modeling of Alternative 8 assumed no operation of the Montezuma Slough Salinity Control Gates, the
43 project description assumes continued operation of the Salinity Control Gates, consistent with
44 assumptions included in the No Action Alternative. A sensitivity analysis modeling run conducted

1 for Alternative 4 with the gates operational consistent with the No Action Alternative resulted in
2 substantially lower EC levels than indicated in the original Alternative 4 modeling results for Suisun
3 Marsh, but EC levels were still somewhat higher than EC levels under Existing Conditions for several
4 locations and months. Although chloride was not specifically modeled in this sensitivity analysis, it
5 is expected that chloride concentrations would be nearly proportional to EC levels in Suisun Marsh.
6 Another modeling run with the gates operational and restoration areas removed resulted in EC
7 levels nearly equivalent to Existing Conditions, indicating that design and siting of restoration areas
8 has notable bearing on EC levels at different locations within Suisun Marsh (see Appendix 8H,
9 Attachment 1, for more information on these sensitivity analyses). These analyses also indicate that
10 increases in salinity are related primarily to the hydrodynamic effects of CM4, not operational
11 components of CM1. Based on the sensitivity analyses, optimizing the design and siting of
12 restoration areas may limit the magnitude of long-term chloride increases in the Marsh. However,
13 the chloride concentration increases at certain locations could be substantial, depending on siting
14 and design of restoration areas. Thus, these increased chloride levels in Suisun Marsh are
15 considered to contribute to additional, measureable long-term degradation that potentially would
16 adversely affect the necessary actions to reduce chloride loading for any TMDL that is developed.

17 ***SWP/CVP Export Service Areas***

18 Under Alternative 8, long-term average chloride concentrations based on the mass balance analysis
19 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
20 decrease by as much as 73% relative to Existing Conditions and 70% compared to No Action
21 Alternative (Appendix 8G, *Chloride*, Table CI-49). The modeled frequency of exceedances of
22 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
23 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
24 *Chloride*, Table CI-51). Consequently, water exported into the SWP/CVP service area would
25 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
26 the No Action Alternative conditions.

27 Results of the modeling approach which used relationships between EC and chloride (see Section
28 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
29 results in the same conclusions as are presented above for the mass-balance approach (Appendix
30 8G, Table CI-50 and Table CI-52).

31 Commensurate with the reduced chloride concentrations in water exported to the service area,
32 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
33 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
34 San Joaquin River flows (see discussion of Upstream of the Delta).

35 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
36 contribute towards a substantial change in existing sources of chloride in the affected environment.
37 Maintenance activities would not be expected to cause any substantial change in chloride such that
38 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
39 affected anywhere in the affected environment.

40 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 8 would
41 result in substantial increased water quality degradation relative to the 150 mg/L Bay-Delta WCCP
42 objective at Contra Costa Pumping Plant #1 and Antioch, substantial seasonal use of assimilative
43 capacity at Contra Costa Pumping Plant #1 and Rock Slough, and could contribute to measureable
44 water quality degradation relative to the 303(d) impairment in Suisun Marsh. The predicted

1 chloride increases constitute an adverse effect on water quality (see Mitigation Measure WQ-7;
2 implementation of this measure along with a separate other commitment relating to the potential
3 increased chloride treatment costs would reduce these effects). Additionally, the predicted changes
4 relative to the No Action Alternative conditions indicate that in addition to the effects of climate
5 change/sea level rise, implementation of CM1 and CM4 under Alternative 8 would contribute
6 substantially to the adverse water quality effects.

7 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
8 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
9 purpose of making the CEQA impact determination for this constituent. For additional details on the
10 effects assessment findings that support this CEQA impact determination, see the effects assessment
11 discussion that immediately precedes this conclusion.

12 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
13 thus river flow rate and reservoir storage reductions that would occur under the Alternative 8,
14 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
15 chloride levels. Additionally, relative to Existing Conditions, the Alternative 8 would not result in
16 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
17 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
18 watershed.

19 Relative to Existing Conditions, Alternative 8 operations would result in reduced chloride
20 concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP objective at
21 interior and western Delta locations would be reduced. Nevertheless, due to the predicted increased
22 frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at Contra Costa Pumping Plant #1
23 and Antioch as well as substantial seasonal use of assimilative capacity at Contra Costa Pumping
24 Plant #1, the potential exists for adverse effects on the municipal and industrial beneficial uses at
25 Contra Costa Pumping Plant #1 and Antioch (see Mitigation Measure WQ-7; implementation of this
26 measure along with a separate other commitment relating to the potential increased chloride
27 treatment costs would reduce these effects). Moreover, the modeled increased chloride
28 concentrations and degradation in the western Delta could further contribute, at measurable levels
29 (i.e., over a doubling of concentration), to the existing 303(d) listed impairment due to chloride in
30 Suisun Marsh for the protection of fish and wildlife.

31 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
32 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
33 River.

34 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
35 8 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
36 Alternative 8 maintenance would not result in any substantial changes in chloride concentration
37 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
38 this impact is determined to be significant due to increased chloride concentrations and frequency
39 of objective exceedance in the western Delta, as well as potential adverse effects on fish and wildlife
40 beneficial uses in Suisun Marsh.

41 While mitigation measures to reduce these water quality effects in affected water bodies to less-
42 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
43 recommended to attempt to reduce the effect that increased chloride concentrations may have on
44 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in

1 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
 2 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
 3 discussion of Alternative 1A.

4 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 5 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
 6 separate other commitment to address the potential increased water treatment costs that could
 7 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 8 operations. Potential options for making use of this financial commitment include funding or
 9 providing other assistance towards acquiring alternative water supplies or towards modifying
 10 existing operations when chloride concentrations at a particular location reduce opportunities to
 11 operate existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
 12 potential actions that could be taken pursuant to this commitment in order to reduce the water
 13 quality treatment costs associated with water quality effects relating to chloride, electrical
 14 conductivity, and bromide.

15 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 16 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

17 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

18 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 19 **CM21**

20 **NEPA Effects:** Under Alternative 8, the types and geographic extent of effects on chloride
 21 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 22 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
 23 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 24 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
 25 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 26 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
 27 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 28 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 29 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

30 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM21
 31 are considered to be not adverse.

32 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 8 would not present new or
 33 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 34 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 35 with habitat restoration conservation measures may result in some reduction in discharge of
 36 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 37 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 38 mitigation is required.

1 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 **NEPA Effects:** Effects of CM1 on DO under Alternative 8 would be the same as those discussed for
4 Alternative 1A and are considered not to be adverse.

5 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 8 would be similar to conservation
6 measures discussed for Alternative 1A, and are summarized here, then compared to the CEQA
7 thresholds of significance (defined in Section 8.3.2) for the purpose of making the CEQA impact
8 determination for this constituent. For additional details on the effects assessment findings that
9 support this CEQA impact determination, see the effects assessment discussion under Alternative
10 1A.

11 Reservoir storage reductions that would occur under Alternative 8, relative to Existing Conditions,
12 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
13 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
14 Similarly, river flow rate reductions that would occur would not be expected to result in a
15 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
16 flows would remain within the ranges historically seen under Existing Conditions and the affected
17 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
18 water temperature would not be expected to cause DO levels to be outside of the range seen
19 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
20 change sufficiently to affect DO levels.

21 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
22 Delta source water percentages under this alternative or substantial degradation of these water
23 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
24 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
25 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
26 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
27 the reaeration of Delta waters would not be expected to change substantially.

28 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
29 Export Service Areas waters under Alternative 8, relative to Existing Conditions. Because the
30 biochemical oxygen demand of the exported water would not be expected to substantially differ
31 from that under Existing Conditions (due to ever increasing water quality regulations), canal
32 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
33 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
34 downstream reservoirs.

35 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
36 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
37 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
38 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
39 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
40 because no substantial decreases in DO levels would be expected, greater degradation and DO-
41 related impairment of these areas would not be expected. This impact would be less than significant.
42 No mitigation is required.

1 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

2 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 8 would be the same as those
3 discussed for Alternative 1A and are considered not to be adverse.

4 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
5 measures proposed under Alternative 1A. As such, effects on DO resulting from the implementation
6 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
7 considered to be less than significant. No mitigation is required.

8 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
9 **Operations and Maintenance (CM1)**

10 ***Upstream of the Delta***

11 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
12 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
13 the San Joaquin River upstream of the Delta under Alternative 8 are not expected to be outside the
14 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
15 minor changes in EC levels that could occur under Alternative 8 in water bodies upstream of the
16 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
17 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

18 ***Delta***

19 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
20 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
21 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
22 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
23 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
24 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
25 information.

26 Relative to Existing Conditions, Alternative 8 would result in an increase in the number of days the
27 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, and the San
28 Joaquin River at Vernalis, Prisoners Point, and Brandt Bridge, and in the Old River near Middle River
29 (Appendix 8H, *Electrical Conductivity*, Table EC-8).

30 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
31 (1976–1991) would increase from 6% under Existing Conditions to 22% under Alternative 8, and
32 the percentage of days out of compliance would increase from 11% under Existing Conditions to
33 34% under Alternative 7.

34 The increase in the percentage of days the Vernalis EC objective would be exceeded would be <1%,
35 and the percentage of days out of compliance with the EC objective would increase from 7% under
36 Existing Conditions to 8% under Alternative 8. These increases are minimal, and are not considered
37 substantial, in light of the overall modeling uncertainty.

38 The percentage of days the Prisoners Point EC objective would be exceeded for the entire period
39 modeled would increase from 6% under Existing Conditions to 38% under Alternative 8, and the
40 percentage of days out of compliance with the EC objective would increase from 10% under Existing

1 Conditions to 38% under Alternative 8. Sensitivity analyses conducted for Alternative 4 Scenario H3
2 indicated that removing all tidal restoration areas would reduce the number of exceedances, but
3 there would still be substantially more exceedances than under Existing Conditions or the No Action
4 Alternative. Results of the sensitivity analyses indicate that the exceedances are partially a function
5 of the operations of the alternative itself, perhaps due to Head of Old River Barrier assumptions and
6 south Delta export differences (see Appendix 8H, *Electrical Conductivity*, Attachment 1, for more
7 discussion of these sensitivity analyses). Due to similarities in the nature of the exceedances
8 between alternatives, the findings from these analyses can be extended to this alternative as well.
9 Appendix 8H, Attachment 2, contains a more detailed assessment of the likelihood of these
10 exceedances impacting aquatic life beneficial uses. Specifically, Appendix 8H, Attachment 2,
11 discusses whether these exceedances might have indirect effects on striped bass spawning in the
12 Delta, and concludes that the high level of uncertainty precludes making a definitive determination.

13 In the San Joaquin River at Brandt Bridge, the percentage of days exceeding the EC objective would
14 increase from 3% under Existing Conditions to 4% under Alternative 8; the percentage of days out
15 of compliance would increase from 8% under Existing Conditions to 9% under Alternative 8. The
16 increase in the percentage of days the Old River EC objective would be exceeded and out of
17 compliance for the entire period modeled (1976–1991) would be <1%. These increases are minimal,
18 and are not considered substantial, in light of the overall modeling uncertainty.

19 Average EC levels at the western and southern Delta compliance locations and San Joaquin River at
20 San Andreas Landing (an interior Delta location) would decrease from 0–44% for the entire period
21 modeled and 2–43% during the drought period modeled (1987–1991) (Appendix 8H, Table EC-19).
22 In the S. Fork Mokelumne River at Terminous, average EC would increase 5% for the entire period
23 modeled and drought period modeled. Average EC in the S. Fork Mokelumne River at Terminous
24 would increase during all months (Appendix 8H, Table EC-19). Given that the western Delta is Clean
25 Water Act section 303(d) listed as impaired due to elevated EC, the increase in the incidence of
26 exceedance of EC objectives under Alternative 8, relative to Existing Conditions has the potential to
27 contribute to additional impairment and potentially adversely affect beneficial uses. The comparison
28 to Existing Conditions reflects changes in EC due to both Alternative 8 operations (including north
29 Delta intake capacity of 9,000 cfs and numerous other components of Operational Scenario F) and
30 climate change/sea level rise.

31 Relative to the No Action Alternative, the change in percentage compliance with Bay-Delta WQCP EC
32 objectives under Alternative 8 would be similar to that described above relative to Existing
33 Conditions. The exception is that there would also be a slight increase (<1%) in the percentage of
34 days the EC objective would be exceeded in the Old River at Tracy for the entire period modeled.
35 Also, Old River at Tracy also would have an increase in the number of days out of compliance with
36 the EC objectives. The percentage of days out of compliance with Tracy Bridge EC objectives would
37 increase from 8% to 9% for the entire period modeled. For the entire period modeled, average EC
38 levels would increase at all Delta compliance locations relative to the No Action Alternative, except
39 in the San Joaquin River at San Andreas Landing and Jersey Point. The greatest average EC increase
40 would occur in the San Joaquin River at Prisoners Point (7%); the increase at the other locations
41 would be <1–6% (Appendix 8H, Table EC-19). Similarly, during the drought period modeled,
42 average EC would increase at all locations, except the San Joaquin River at San Andreas Landing and
43 Jersey Point. The greatest average EC increase during the drought period modeled would occur in
44 the S. Fork Mokelumne River at Terminous (6%); the increases at the other locations would be 1–
45 4% (Appendix 8H, Table EC-19). Given that the western and southern Delta are Clean Water Act
46 section 303(d) listed as impaired due to elevated EC, the increase in the incidence of exceedance of

1 EC objectives under Alternative 7, relative to the No Action Alternative, has the potential to
2 contribute to additional impairment and potentially adversely affect beneficial uses. The comparison
3 to the No Action Alternative reflects changes in EC due only to Alternative 8 operations (including
4 north Delta intake capacity of 9,000 cfs and numerous other components of Operational Scenario F).

5 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
6 fish and wildlife apply. Long-term average EC would decrease under Alternative 8, relative to
7 Existing Conditions, during October–May in the Sacramento River at Collinsville and Montezuma
8 Slough at National Steel (Appendix 8H, *Electrical Conductivity*, Tables EC-21 and EC-22). The most
9 substantial increase would occur near Beldon Landing, with long-term average EC levels increasing
10 by 0.1–3.5 mS/cm, depending on the month (Appendix 8H, Table EC-23). Sunrise Duck Club would
11 have long-term average EC increases of 0.2–0.8 mS/cm (Appendix 8H, Table EC-24) and Volanti
12 Slough would have long-term average EC increases of 0.1–1.1 mS/cm. The degree to which the long-
13 term average EC increases would cause exceedance of Bay-Delta WQCP objectives is unknown,
14 because objectives are expressed as a monthly average of daily high tide EC, which does not have to
15 be met if it can be demonstrated “equivalent or better protection will be provided at the location”
16 (State Water Resources Control Board 2006:14). Modeling of this alternative assumed no operation
17 of the Montezuma Slough Salinity Control Gates, but the project description assumes continued
18 operation of the Salinity Control Gates, consistent with assumptions included in the No Action
19 Alternative. A sensitivity analysis modeling run conducted for Alternative 4 Scenario H3 with the
20 gates operational consistent with the No Action Alternative resulted in substantially lower EC levels
21 than indicated in the original Alternative 4 modeling results, but EC levels were still somewhat
22 higher than EC levels under Existing Conditions and the No Action Alternative for several locations
23 and months. Another modeling run with the gates operational and restoration areas removed
24 resulted in EC levels nearly equivalent to Existing Conditions and the No Action Alternative,
25 indicating that design and siting of restoration areas has notable bearing on EC levels at different
26 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
27 sensitivity analyses). These analyses also indicate that increases are related primarily to the
28 hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity analyses,
29 optimizing the design and siting of restoration areas may limit the magnitude of long-term EC
30 increases to be on the order of 1 mS/cm or less. Due to similarities in the nature of the EC increases
31 between alternatives, the findings from these analyses can be extended to this alternative as well.

32 The long-term average EC increase in Suisun Marsh may, or may not, contribute to adverse effects
33 on beneficial uses, depending on how and when wetlands are flooded, soil leaching cycles, how
34 agricultural use of water is managed, and future actions taken with respect to the marsh. However,
35 the EC increases at certain locations could be substantial and it is uncertain the degree to which
36 current management plans for the Suisun Marsh would be able to address these substantially higher
37 EC levels and protect beneficial uses. Thus, these increased EC levels in Suisun Marsh are considered
38 to have a potentially adverse effect on marsh beneficial uses. Long-term average EC increases in
39 Suisun Marsh under Alternative 8 relative to the No Action Alternative would be similar to the
40 increases relative to Existing Conditions. Suisun Marsh is section 303(d) listed as impaired due to
41 elevated EC, and the potential increases in long-term average EC concentrations could contribute to
42 additional impairment relative to Existing Conditions and the No Action Alternative.

43 ***SWP/CVP Export Service Areas***

44 At the Banks and Jones pumping plants, Alternative 8 would result in no exceedances of the Bay-
45 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, *Electrical*

1 *Conductivity*, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
2 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 8.

3 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 8
4 would decrease substantially: 49% for the entire period modeled and 53% during the drought
5 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 45% for
6 the entire period modeled and 50% during the drought period modeled (Appendix 8H, Table EC-19).

7 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 8
8 would also decrease substantially: 53% for the entire period modeled and 62% during the drought
9 period modeled. Relative to the No Action Alternative, average EC levels would decrease by 51% for
10 the entire period modeled and 60% during the drought period modeled. (Appendix 8H, Table EC-19)

11 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
12 pumping plants, Alternative 8 would not cause degradation of water quality with respect to EC in
13 the SWP/CVP Export Service Areas; rather, Alternative 8 would improve long-term average EC
14 conditions in the SWP/CVP Export Service Areas.

15 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
16 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
17 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
18 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
19 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
20 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
21 impact discussion under the No Action Alternative).

22 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
23 elevated EC. Alternative 8 would result in lower average EC levels relative to Existing Conditions and
24 the No Action Alternative and, thus, would not contribute to additional beneficial use impairment
25 related to elevated EC in the SWP/CVP Export Service Areas waters.

26 **NEPA Effects:** In summary, the increased frequency of exceedance of EC objectives in the western
27 Delta under Alternative 8, relative to the No Action Alternative, would contribute to adverse effects
28 on the agricultural beneficial uses. In addition, the increased frequency of exceedance of the San
29 Joaquin River at Prisoners Point EC objective and long-term and drought period average EC could
30 contribute to adverse effects on fish and wildlife beneficial uses (specifically, indirect adverse effects
31 on striped bass spawning), though there is a high degree of uncertainty associated with this impact.
32 Given that the western Delta is Clean Water Act section 303(d) listed as impaired due to elevated EC,
33 the increase in the incidence of exceedance of EC objectives in this portion of the Delta has the
34 potential to contribute to additional beneficial use impairment. The increases in long-term average
35 EC levels that could occur in Suisun Marsh would further degrade existing EC levels and could
36 contribute additional to adverse effects on the fish and wildlife beneficial uses. Suisun Marsh is
37 section 303(d) listed as impaired due to elevated EC, and the potential increases in long-term
38 average EC levels could contribute to additional beneficial use impairment. These increases in EC
39 constitute an adverse effect on water quality. Mitigation Measure WQ-11 would be available to
40 reduce these effects. Implementation of this measure along with a separate other commitment as set
41 forth in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, relating to the potential EC-
42 related changes would reduce these effects.

1 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
2 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
3 purpose of making the CEQA impact determination for this constituent. For additional details on the
4 effects assessment findings that support this CEQA impact determination, see the effects assessment
5 discussion that immediately precedes this conclusion.

6 River flow rate and reservoir storage reductions that would occur under Alternative 8, relative to
7 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
8 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
9 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
10 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
11 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
12 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
13 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
14 Delta.

15 Relative to Existing Conditions, Alternative 8 would not result in any substantial increases in long-
16 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the
17 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
18 would decrease at both plants and, thus, this alternative would not contribute to additional
19 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
20 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
21 relative to Existing Conditions.

22 In the Plan Area, Alternative 8 would result in an increase in the frequency with which Bay-Delta
23 WQCP EC objectives are exceeded in the Sacramento River at Emmaton (agricultural objective; 16%
24 increase) and Prisoners Point (fish and wildlife objective; 32% increase) in the interior Delta for the
25 entire period modeled (1976–1991). The increased frequency of exceedance of the fish and wildlife
26 objective at Prisoners Point could contribute to adverse effects on aquatic life (specifically, indirect
27 adverse effects on striped bass spawning), though there is a high degree of uncertainty associated
28 with this impact. The increased frequency of the EC exceedance at Emmaton could contribute to
29 adverse effects on agricultural uses. Because EC is not bioaccumulative, the increases in long-term
30 average EC levels would not directly cause bioaccumulative problems in aquatic life or humans. The
31 western Delta is Clean Water Act section 303(d) listed for elevated EC and the increased frequency
32 of exceedance of EC objectives that would occur in this portion of the Delta could make beneficial
33 use impairment measurably worse. This impact is considered to be significant.

34 Further, relative to Existing Conditions, Alternative 8 could result in substantial increases in long-
35 term average EC during the months of October through May in Suisun Marsh. The increases in long-
36 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
37 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
38 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
39 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
40 elevated EC and the increases in long-term average EC that would occur in the marsh could make
41 beneficial use impairment measurably worse. This impact is considered to be significant.

42 Implementation of Mitigation Measure WQ-11 along with a separate other commitment relating to
43 the potential increased costs associated with EC-related changes would reduce these effects. While
44 mitigation measures to reduce these water quality effects in affected water bodies to less-than-

1 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
 2 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
 3 However, because the effectiveness of this mitigation measure to result in feasible measures for
 4 reducing water quality effects is uncertain, this impact is considered to remain significant and
 5 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
 6 Alternative 1A.

7 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
 8 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 9 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
 10 costs that could result from EC concentration effects on municipal, industrial and agricultural water
 11 purveyor operations. Potential options for making use of this financial commitment include funding
 12 or providing other assistance towards acquiring alternative water supplies or towards modifying
 13 existing operations when EC concentrations at a particular location reduce opportunities to operate
 14 existing water supply diversion facilities. Please refer to Appendix 3B, *Environmental Commitments,*
 15 *AMMs, and CMs*, for the full list of potential actions that could be taken pursuant to this commitment
 16 in order to reduce the water quality treatment costs associated with water quality effects relating to
 17 chloride, electrical conductivity, and bromide.

18 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
 19 **Quality Conditions**

20 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

21 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2-**
 22 **CM21**

23 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 8 would be the same as those discussed
 24 for Alternative 1A and are considered not to be adverse.

25 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 26 measures proposed under Alternative 1A. As such, effects on EC resulting from the implementation
 27 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 28 considered to be less than significant. No mitigation is required.

29 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 Under Alternative 8, the magnitude and timing of reservoir releases and river flows upstream of the
 33 Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
 34 Existing Conditions and the No Action Alternative.

35 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
 36 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
 37 relationships for mercury and methylmercury. No significant, predictive regression relationships
 38 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
 39 (monthly or annual) (Appendix 8I, Figures I-10 through I-13). Such a positive relationship between
 40 total mercury and flow is to be expected based on the association of mercury with suspended
 41 sediment and the mobilization of sediments during storm flows. However, the changes in flow in the

1 Sacramento River under Alternative 8 relative to Existing Conditions and the No Action Alternative
 2 are not of the magnitude of storm flows, in which substantial sediment-associated mercury is
 3 mobilized. Therefore mercury loading should not be substantially different due to changes in flow.
 4 In addition, even though it may be flow-affected, total mercury concentrations remain well below
 5 criteria at upstream locations. Any negligible changes in mercury concentrations that may occur in
 6 the water bodies of the affected environment located upstream of the Delta would not be of
 7 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 8 substantially degrade the quality of these water bodies as related to mercury. Both waterborne
 9 methylmercury concentrations and largemouth bass fillet mercury concentrations are expected to
 10 remain above guidance levels at upstream of Delta locations, but will not change substantially
 11 relative to Existing Conditions or the No Action Alternative due to changes in flows under
 12 Alternative 8.

13 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 14 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 15 Mercury Control Program. These projects will target specific sources of mercury and methylation
 16 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 17 The implementation of these projects could help to ensure that upstream of Delta environments will
 18 not be substantially degraded for water quality with respect to mercury or methylmercury.

19 **Delta**

20 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 21 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 22 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 23 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 24 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 25 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 26 information.

27 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
 28 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
 29 change in assimilative capacity of waterborne total mercury of Alternative 8 relative to the 25 ng/L
 30 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease of 7%
 31 for the Contra Costa Pumping Plant, and 6.9% at the same location for the No Action Alternative
 32 (Figures 8-53a and 8-54a). Similarly, changes in methylmercury concentration are expected to be
 33 relatively small. The greatest annual average methylmercury concentration for drought conditions
 34 was 0.165 ng/L for the San Joaquin River at Buckley Cove, which was slightly higher than Existing
 35 Conditions and slightly lower than the No Action Alternative (Appendix 8I, Figure I-9). All modeled
 36 input concentrations exceeded the methylmercury TMDL guidance objective of 0.06 ng/L, therefore
 37 percentage change in assimilative capacity was not evaluated for methylmercury.

38 Fish tissue estimates show more substantial percentage increases in concentration and exceedance
 39 quotients for mercury at some Delta locations. The greatest changes in exceedance quotients
 40 relative to Existing Conditions and the No Action Alternative are 33–40% at the Contra Costa
 41 Pumping Plant and 34–46% for Old River at Rock Slough (Figures 8-55a and 8-55b; Appendix 8I,
 42 *Mercury*, Table I-15b). Because these increases are substantial, and it is evident that substantive
 43 increases are expected at numerous locations throughout the Delta, these changes may be

1 measurable in the environment. See Appendix 8I for a discussion of the uncertainty associated with
2 the fish tissue estimates.

3 ***SWP/CVP Export Service Areas***

4 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
5 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
6 methylmercury concentrations for Alternative 8 are projected to be lower than Existing Conditions
7 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-8 and
8 I-9). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53a
9 and 8-54a).

10 The largest improvements in bass tissue mercury concentrations and exceedance quotients for
11 Alternative 8, relative to Existing Conditions and the No Action Alternative at any location within the
12 Delta are expected for the export pump locations (specifically, at Jones Pumping plant, 27%
13 improvement relative to Existing Conditions, 31% relative to the No Action Alternative) (Figures 8-
14 55a and 8-55b; Appendix 8I, Table I-15b).

15 ***NEPA Effects:*** Based on the above discussion, the effects of mercury and methylmercury in
16 comparison of Alternative 8 to the No Action Alternative (as waterborne and bioaccumulated forms)
17 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

18 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
19 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
20 purpose of making the CEQA impact determination for this constituent. For additional details on the
21 effects assessment findings that support this CEQA impact determination, see the effects assessment
22 discussion that immediately precedes this conclusion.

23 Under Alternative 8, greater water demands and climate change would alter the magnitude and
24 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
25 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
26 methylmercury upstream of the Delta will not be substantially different relative to Existing
27 Conditions due to the lack of important relationships between mercury/methylmercury
28 concentrations and flow for the major rivers.

29 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
30 capacity exists. Monthly average waterborne concentrations of total and methylmercury, over the
31 period of record, are very similar to Existing Conditions, but showed notable increases at some
32 locations. Estimates of fish tissue mercury concentrations show substantial increases would occur
33 for several sites for Alternative 8, relative to Existing Conditions.

34 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
35 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
36 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
37 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 8 as
38 compared to Existing Conditions.

39 As such, this alternative is not expected to cause additional exceedance of applicable water quality
40 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
41 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
42 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would

1 make existing mercury-related impairment in the Delta measurably worse. In comparison to
 2 Existing Conditions, Alternative 8 would increase levels of mercury by frequency, magnitude, and
 3 geographic extent such that the affected environment would be expected to have measurably higher
 4 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
 5 wildlife (including fish) or humans consuming those organisms.

6 This impact is considered to be significant. Feasible or effective actions to reduce the effects on
 7 mercury resulting from CM1 are unknown. General mercury management measures through CM12,
 8 or actions taken by other entities or programs such as TMDL implementation, may minimize or
 9 reduce sources and inputs of mercury to the Delta and methylmercury formation. However, it is
 10 uncertain whether this impact would be reduced to a level that would be less than significant as a
 11 result of CM12 or other future actions. Therefore, the impact would be significant and unavoidable.

12 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2- 13 CM21**

14 **NEPA Effects:** Some habitat restoration activities under Alternative 8 would occur on lands in the
 15 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under
 16 Alternative 8 have the potential to increase water residence times and increase accumulation of
 17 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 18 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 19 possible but uncertain depending on the specific restoration design implemented at a particular
 20 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 21 not currently available. However, DSM2 modeling for Alternative 8 operations does incorporate
 22 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 23 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 24 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 25 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 26 potential for increased mercury and methylmercury concentrations under Alternative 8.

27 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 28 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 29 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 30 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 31 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 32 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 33 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 34 better inform restoration design,
- 35 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 36 techniques,
- 37 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 38 organic material at a restoration site,
- 39 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 40 biologically unavailable, inorganic form of mercury,
- 41 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and

- 1 • Considering capping mercury laden sediments, where possible to reduce methylation potential
2 at a site.

3 Because of the uncertainties associated with site-specific estimates of methylmercury
4 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
5 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
6 need to be evaluated separately for each restoration effort, as part of design and implementation.
7 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
8 potential effect of implementing CM2–CM21 is considered adverse.

9 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
10 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
11 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
12 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
13 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
14 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
15 measurable increase in methylmercury concentrations would make existing mercury-related
16 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
17 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat
18 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
19 Design of restoration sites under Alternative 8 would be guided by CM12 which requires
20 development of site specific mercury management plans as restoration actions are implemented.
21 The effectiveness of minimization and mitigation actions implemented according to the mercury
22 management plans is not known at this time although the potential to reduce methylmercury
23 concentrations exists based on current research. Although the BDCP will implement CM12 with the
24 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
25 and the potential for increases in methylmercury concentrations in the Delta result in this potential
26 impact being considered significant. No mitigation measures would be available until specific
27 restoration actions are proposed. Therefore this programmatic impact is considered significant and
28 unavoidable.

29 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 30 **Maintenance (CM1)**

31 ***Upstream of the Delta***

32 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
33 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
34 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

35 Under Alternative 8, modeling indicates that long-term annual average flows on the San Joaquin
36 River would decrease by an estimated 6%, relative to Existing Conditions, and would remain
37 virtually the same relative to No Action (Appendix 5A, *BDCP/California WaterFix FEIR/FEIS*
38 *Modeling Technical Appendix*). Given these relatively small decreases in flows and the weak
39 correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*, Figure 2), it
40 is expected that nitrate concentrations in the San Joaquin River would be minimally affected, if at all,
41 by changes in flow rates under Alternative 8.

42 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
43 environment located upstream of the Delta would not be of frequency, magnitude and geographic

1 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
2 water bodies, with regards to nitrate.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
9 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
10 information.

11 Results of the mixing calculations indicate that under Alternative 8, relative to Existing Conditions
12 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
13 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 28 and 29). Long-
14 term average nitrate concentrations are anticipated to increase at most locations in the Delta. The
15 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
16 Plant #1 (all >85% increase). Long-term average concentrations were estimated to increase to 0.68,
17 1.06 and 1.13 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
18 Plant#1, respectively, due primarily to increased San Joaquin River water percentage at these
19 locations (see Appendix 8D, *Source Water Fingerprinting Results*). Although changes at specific Delta
20 locations and for specific months may be substantial on a relative basis, the absolute concentration
21 of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of
22 10 mg/L-N, as well as all other thresholds identified in Table 8-50. No additional exceedances of the
23 MCL are anticipated at any location (Appendix 8J, Table 28). On a monthly average basis and on a
24 long term annual average basis, for all modeled years and for the drought period (1987–1991) only,
25 use of assimilative capacity available under Existing Conditions and the No Action Alternative,
26 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock
27 Slough and Contra Costa Pumping Plant #1, and averaged approximately 6% on a long-term average
28 basis (Appendix 8J, Table 30). Similarly, the use of available assimilative capacity at Franks Tract
29 was up to approximately 6%, and averaged 3% over the long term. The concentrations estimated for
30 these locations would not increase the likelihood of exceeding the 10 mg/L-N MCL, nor would they
31 increase the risk for adverse effects to beneficial uses. At all other locations, use of assimilative
32 capacity was negligible (<5%) (Appendix 8J, Table 30).

33 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
34 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
35 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
36 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
37 the modeling.

- 38 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
39 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
40 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
41 the increase becoming greater with increasing distance downstream. However, the increase in
42 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
43 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,

1 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board
2 2010a:32).

- 3 • Under Alternative 8, the planned upgrades to the SRWTP, which include nitrification/partial
4 denitrification, would substantially decrease ammonia concentrations in the discharge, but
5 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
6 higher than under Existing Conditions.
- 7 • Overall, under Alternative 8, the nitrogen load from the SRWTP discharge is expected to
8 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
9 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
10 of the facility are expected to be higher than modeling results indicate for both Existing
11 Conditions and Alternative 8, the increase is expected to be greater under Existing Conditions
12 than for Alternative 8 due to the upgrades that are assumed under Alternative 8.

13 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
14 immediately downstream of other wastewater treatment plants that practice nitrification, but not
15 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
16 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
17 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
18 State has determined that no beneficial uses are adversely affected by the discharge, and that the
19 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
20 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
21 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
22 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
23 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
24 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
25 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

26 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
27 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
28 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

29 ***SWP/CVP Export Service Areas***

30 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
31 nitrate-N at the Banks and Jones pumping plants.

32 Results of the mixing calculations indicate that under Alternative 8, relative to Existing Conditions
33 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
34 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Tables 28 and
35 29). During the late summer, particularly in the drought period assessed, concentrations are
36 expected to increase, but the absolute value of these changes (i.e., in mg/L-N) is small. Additionally,
37 given the many factors that contribute to potential algal blooms in the SWP and CVP canals within
38 the Export Service Area, and the lack of studies that have shown a direct relationship between
39 nutrient concentrations in the canals and reservoirs and problematic algal blooms in these water
40 bodies, there is no basis to conclude that these small (i.e., generally <0.5 mg/L-N), seasonal increases
41 in nitrate concentrations would increase the potential for problem algal blooms in the SWP and CVP
42 Export Service Area. No additional exceedances of the MCL are anticipated (Appendix 8J, *Nitrate*,
43 Table 28). On a monthly average basis and on a long term annual average basis, for all modeled

1 years and for the drought period (1987–1991) only, use of assimilative capacity available under
2 Existing Conditions and the No Action Alternative, relative to the 10 mg/L-N MCL, was negligible for
3 both Banks and Jones pumping plants (Appendix 8J, Table 30).

4 Any increases in nitrate-N concentrations that may occur in water exported via Banks and Jones
5 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
6 degrade the quality of exported water, with regards to nitrate.

7 **NEPA Effects:** In summary, based on the discussion above, the effects on nitrate from implementing
8 CM1 are considered to be not adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
15 substantial dilution available for point sources and the lack of substantial nonpoint sources of
16 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
17 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
18 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
19 Consequently, any modified reservoir operations and subsequent changes in river flows under
20 Alternative 8, relative to Existing Conditions, are expected to have negligible, if any, effects on
21 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
22 watershed and upstream of the Delta in the San Joaquin River watershed.

23 In the Delta, results of the mixing calculations indicate that under Alternative 8, relative to Existing
24 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
25 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
26 Plant #1 (all >85% increase), due primarily to increased San Joaquin River water percentage at
27 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low
28 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
29 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
30 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
31 MCL, nor would they increase the risk for adverse effects to beneficial uses.

32 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
33 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
34 indicate that under Alternative 8, relative to Existing Conditions, long-term average nitrate
35 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
36 exceedances of the MCL are anticipated. Monthly average use of assimilative capacity available
37 under Existing Conditions, relative to the MCL, for both Banks and Jones pumping plants in drought
38 conditions was at times >50%, but the absolute value of these changes (i.e., in mg/L-N) was small.
39 Additionally, given the many factors that contribute to potential algal blooms in the SWP and CVP
40 canals within the Export Service Area, and the lack of studies that have shown a direct relationship
41 between nutrient concentrations in the canals and reservoirs and problematic algal blooms in these
42 water bodies, there is no basis to conclude that these small (i.e., generally <0.3 mg/L-N), seasonal
43 increases in nitrate concentrations would increase the potential for problem algal blooms in the
44 SWP and CVP Export Service Area.

1 Based on the above, this alternative is not expected to cause additional exceedance of applicable
 2 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 3 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
 4 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
 5 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
 6 the affected environment and thus any increases that may occur in some areas and months would
 7 not make any existing nitrate-related impairment measurably worse because no such impairments
 8 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 9 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 10 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 11 significant. No mitigation is required.

12 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2–**
 13 **CM21**

14 **NEPA Effects:** Effects of CM2–CM21 on nitrate under Alternative 8 would be the same as those
 15 discussed for Alternative 1A and are considered not to be adverse.

16 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 17 measures proposed under Alternative 1A. As such, effects on nitrate resulting from the
 18 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 19 This impact is considered to be less than significant. No mitigation is required.

20 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 21 **Operations and Maintenance (CM1)**

22 ***Upstream of the Delta***

23 Under Alternative 8, there would be no substantial change to the sources of DOC within the
 24 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 25 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 26 system operations and resulting reservoir storage levels and river flows would not be expected to
 27 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 28 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under
 29 Alternative 8, relative to Existing Conditions and the No Action Alternative, would not be of
 30 sufficient frequency, magnitude and geographic extent that would adversely affect any beneficial
 31 uses or substantially degrade the quality of these water bodies, with regards to DOC.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 37 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 38 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 39 information.

40 Under Alternative 8 relative to Existing Conditions, the geographic extent of effects pertaining to
 41 long-term average DOC concentrations in the Delta would be similar to that previously described for

1 Alternative 1A, although the magnitude of predicted long-term increase and relative frequency of
2 concentration threshold exceedances would be substantially greater. Modeled effects would be
3 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic
4 period and the modeled drought period, long-term average concentration increases ranging from
5 0.7–1.1 mg/L would be predicted ($\leq 32\%$ net increase), resulting in long-term average DOC
6 concentrations greater than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, *Organic*
7 *Carbon*, DOC Table 9). Increases in long-term average concentrations would correspond to more
8 frequent concentration threshold exceedances, with the greatest change occurring at Rock Slough
9 and Contra Costa PP No. 1 locations. For Rock Slough, long-term average DOC concentrations
10 exceeding 3 mg/L would increase from 52% under Existing Conditions to 90% under the Alternative
11 8 (an increase from 47% to 88% for the drought period), and concentrations exceeding 4 mg/L
12 would increase from 30% to 48% (32% to 57% for the drought period). For Contra Costa PP No. 1,
13 long-term average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing
14 Conditions to 93% under Alternative 8 (45% to 95% for the drought period), and concentrations
15 exceeding 4 mg/L would increase from 32% to 55% (35% to 60% for the drought period). Relative
16 change in frequency of threshold exceedance for other assessment locations would be similar or
17 less. This comparison to Existing Conditions reflects changes in DOC due to both Alternative 8
18 operations (including north Delta intake capacity of 9,000 cfs and numerous other components of
19 Operational Scenario F) and climate change/sea level rise.

20 In comparison, Alternative 8 relative to the No Action Alternative would generally result in a
21 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
22 increases of 0.7–1.0 mg/L DOC (i.e., $\leq 27\%$) would be predicted at Franks Tract, Rock Slough, and
23 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table 9).
24 Threshold concentration exceedance frequency trends would also be similar to those discussed for
25 the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance frequency
26 at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-term average
27 DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to 32% (42% to
28 58% for the modeled drought period). Unlike the comparison to Existing Conditions, this
29 comparison to the No Action Alternative reflects changes in DOC due only to Alternative 8
30 operations.

31 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
32 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger
33 significant changes in drinking water treatment plant design or operations. In particular, assessment
34 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
35 drinking water treatment plants. Under Alternative 8, drinking water treatment plants obtaining
36 water from these interior Delta locations would likely need to upgrade existing treatment systems in
37 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
38 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
39 such technologies would likely require substantial investment in new or modified infrastructure.

40 Relative to existing and No Action Alternative conditions, Alternative 8 would lead to predicted
41 improvements in long-term average DOC concentrations at Barker Slough, as well as Banks and
42 Jones pumping plants (discussed below). Predicted long-term average DOC concentrations at Barker
43 Slough would decrease ≤ 0.1 mg/L, depending on baseline conditions comparison and modeling
44 period.

1 **SWP/CVP Export Service Areas**

2 Under Alternative 8, modeled long-term average DOC concentrations would decrease at Banks and
3 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
4 period. Modeled decreases would generally be similar between Existing Conditions and the No
5 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
6 would be predicted to decrease by 1.0 mg/L (1.2 mg/L during drought period) (Appendix 8K,
7 *Organic Carbon*, DOC Table 9). At Jones, long-term average DOC concentrations would be predicted
8 to decrease by 1.0 mg/L (1.1 mg/L during drought period). Such substantial improvement in long-
9 term average DOC concentrations would include fewer exceedances of concentration thresholds.
10 Average DOC concentrations exceeding the 2 mg/L concentration threshold would decrease from
11 100% under Existing Conditions and the No Action Alternative to 63% at Banks and 61% at Jones
12 under Alternative 8 (62% and 57%, respectively during the drought period), while concentrations
13 exceeding 4 mg/L would nearly be eliminated (i.e., $\leq 17\%$ exceedance frequency). Such modeled
14 improvement would correspond to substantial improvement in Export Service Areas water quality,
15 respective to DOC.

16 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
17 facilities under Alternative 8 would not be expected to create new sources of DOC or contribute
18 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
19 would not be expected to cause any substantial change in long-term average DOC concentrations
20 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

21 **NEPA Effects:** In summary, Alternative 8, relative to the No Action Alternative, would not cause a
22 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
23 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
24 decrease by as much as 1.3 mg/L, while long-term average DOC concentrations for some Delta
25 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
26 increase by as much as 1.0 mg/L. Resultant substantial changes in long-term average DOC at these
27 Delta interior locations could necessitate changes in water treatment plant operations or require
28 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
29 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
30 reduce these effects.

31 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
32 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
33 purpose of making the CEQA impact determination for this constituent. For additional details on the
34 effects assessment findings that support this CEQA impact determination, see the effects assessment
35 discussion that immediately precedes this conclusion.

36 While greater water demands under the Alternative 8 would alter the magnitude and timing of
37 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
38 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
39 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
40 flows would not be expected to cause a substantial long-term change in DOC concentrations
41 upstream of the Delta.

42 Relative to Existing Conditions, Alternative 8 would result in substantial increases (i.e., 0.7–1.1
43 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
44 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted

1 changes in DOC would substantially increase the frequency with which long-term average
 2 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
 3 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
 4 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
 5 magnitude change in long-term average DOC concentrations would represent a substantially
 6 increased risk for adverse effects on existing MUN beneficial.

7 The assessment of Alternative 8 effects on DOC in the SWP/CVP Export Service Areas is based on
 8 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
 9 Existing Conditions, long-term average DOC concentrations would decrease by as much as 1.2 mg/L
 10 at Banks and Jones pumping plants. The frequency with which long-term average DOC
 11 concentrations would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted
 12 exceedances of >4 mg/L would be nearly eliminated (i.e., ≤17% exceedance frequency). As a result,
 13 substantial improvement in DOC-related water quality would be predicted in the SWP/CVP Export
 14 Service Areas.

15 Based on the above, Alternative 8 operation and maintenance would not result in any substantial
 16 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
 17 Alternative 8, water exported from the Delta to the SWP/CVP service area would be substantially
 18 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
 19 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 20 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
 21 conveyance facilities proposed under Alternative 8 would result in a substantial increase in long-
 22 term average DOC concentrations (i.e., 0.7–1.1 mg/L, equivalent to ≤32% relative increase) at
 23 Franks Tract, Rock Slough, and Contra Costa PP No.1. In particular, under Alternative 8, model
 24 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
 25 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
 26 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
 27 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
 28 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
 29 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
 30 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
 31 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
 32 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
 33 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is
 34 uncertain and implementation would not necessarily reduce the identified impact to a level that
 35 would be less than significant, and therefore it is significant and unavoidable.

36 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
 37 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

38 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the discussion of Alternative 6A.

39 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 40 **Implementation of CM2–CM21**

41 **NEPA Effects:** CM2–CM21 under Alternative 8 would be similar to conservation measures under
 42 Alternative 1A. Effects on DOC resulting from the implementation of CM2–CM21 would be similar to
 43 those previously discussed for Alternative 1A. In total, CM4–CM7 and CM10 could contribute

1 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
 2 operational criteria for the related restoration activities. Substantially increased long-term average
 3 DOC in raw water supplies could lead to a need for treatment plant upgrades in order to
 4 appropriately manage DBP formation in treated drinking water. This potential for future DOC
 5 increases would lead to substantially greater associated risk of long-term adverse effects on the
 6 MUN beneficial use.

7 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 8 would
 8 present new localized sources of DOC to the study area, and in some circumstances would substitute
 9 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
 10 proximity to municipal drinking water intakes, such restoration activities could contribute
 11 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
 12 DOC could necessitate changes in water treatment plant operations or require treatment plant
 13 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
 14 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

15 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 8 are similar to, and
 16 possibly greater than, those discussed for Alternative 1A. Similar to the discussion for Alternative
 17 1A, this impact is considered to be significant. It is uncertain whether implementation of Mitigation
 18 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
 19 remains significant and unavoidable.

20 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
 21 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
 22 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
 23 costs that could result from DOC concentration effects on municipal and industrial water purveyor
 24 operations. Potential options for making use of this financial commitment include funding or
 25 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
 26 control strategies. Please refer to Appendix 3B, *Environmental Commitments, AMMs, and CMs*, for the
 27 full list of potential actions that could be taken pursuant to this commitment in order to reduce the
 28 water quality treatment costs associated with water quality effects relating to DOC.

29 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
 30 **Effects on Municipal Intakes**

31 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

32 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
 33 **(CM1)**

34 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 8 would be the same as those
 35 discussed for Alternative 1A and are considered to not be adverse.

36 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 8 would be the same as those
 37 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 38 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 39 this constituent. For additional details on the effects assessment findings that support this CEQA
 40 impact determination, see the effects assessment discussion under Alternative 1A.

41 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
 42 (water facilities and operations) under Alternative 8, relative to Existing Conditions, would not be

1 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
 2 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
 3 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
 4 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
 5 related regulations.

6 It is expected there would be no substantial change in Delta pathogen concentrations in response to
 7 a shift in the Delta source water percentages under this alternative or substantial degradation of
 8 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
 9 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
 10 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
 11 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
 12 and livestock-related uses, would continue under this alternative.

13 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
 14 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
 15 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
 16 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
 17 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
 18 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
 19 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

20 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 21 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 22 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
 23 expected to increase substantially, no long-term water quality degradation for pathogens is
 24 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
 25 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
 26 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
 27 are expected to occur on a long-term basis, further degradation and impairment of this area is not
 28 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
 29 considered to be less than significant. No mitigation is required.

30 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

31 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 8 would be the same as those
 32 discussed for Alternative 1A and are considered to not be adverse.

33 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 34 measures proposed under Alternative 1A. As such, effects on pathogens resulting from the
 35 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 36 This impact is considered to be less than significant. No mitigation is required.

37 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 38 **Maintenance (CM1)**

39 ***Upstream of the Delta***

40 For the same reasons stated for the No Action Alternative, under Alternative 8 no specific operations
 41 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and

1 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
 2 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
 3 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

4 Under Alternative 8, winter (November–March) and summer (April–October) season average flow
 5 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
 6 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
 7 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 8% during
 8 the summer and 1% during the winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River,
 9 average flow rates would decrease no more than 18% during the summer, but would increase as
 10 much as 30% in the winter. American River average flow rates would decrease by as much as 15%
 11 in the summer but would increase by as much as 5% in the winter. Seasonal average flow rates on
 12 the San Joaquin River would decrease by as much as 12% in the summer, but increase by as much as
 13 1% in the winter. For the same reasons stated for the No Action Alternative, decreased seasonal
 14 average flow of $\leq 18\%$ is not considered to be of sufficient magnitude to substantially increase
 15 pesticide concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor
 16 adversely affect other beneficial uses of water bodies upstream of the Delta.

17 **Delta**

18 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
 19 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
 20 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

21 Under Alternative 8, the distribution and mixing of Delta source waters would change. Percentage
 22 change in monthly average source water fraction was evaluated for the modeled 16-year (1976–
 23 1991) hydrologic period and a representative drought period (1987–1991), with special attention
 24 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
 25 fractions. Relative to Existing Conditions, under Alternative 8 modeled San Joaquin River fractions
 26 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San
 27 Joaquin River at Antioch (Appendix 8D, *Source Water Fingerprinting Results*). At Antioch, San
 28 Joaquin River source water fractions when modeled for the 16-year hydrologic period would
 29 increase by 11–14% from November through May (no increase $>10\%$ for the modeled drought
 30 period). While this change at Antioch is not considered substantial, changes in San Joaquin River
 31 source water fraction in the Delta interior would be considerable. At Franks Tract, San Joaquin River
 32 source water fractions would increase between 18–29% for October through June (11–25% for
 33 November through June of the modeled drought period). Changes at Rock Slough and Contra Costa
 34 PP No. 1 would be very similar, where modeled San Joaquin River source water fractions would
 35 increase from 28–72% (15–71% for the modeled drought period) for October through June. Relative
 36 to Existing Conditions, there would be no modeled increases in Sacramento River fractions greater
 37 than 15% (with exception to Banks and Jones which are discussed below) and Delta agricultural
 38 fractions greater than 8%. Increases in San Joaquin River source water fraction at Franks Tract,
 39 Rock Slough, and Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento
 40 River water, and as a result the San Joaquin River would account for greater than 50% of the total
 41 source water volume at Franks Tract between March through May ($<50\%$ for all months during the
 42 modeled drought period), and would be $\geq 50\%$, and as much as 81% during November through May
 43 at Rock Slough and Contra Costa PP No. 1 for both the modeled drought and 16-year hydrologic
 44 periods. While the source water and potential pesticide related toxicity co-occurrence predictions
 45 do not mean adverse effects would occur, such considerable modeled increases in early summer

1 source water fraction at Franks Tract and winter and summer source water fractions at Rock Slough
2 and Contra Costa PP No. 1 could substantially alter the long-term risk of pesticide-related toxicity to
3 aquatic life, given the apparent greater incidence of pesticides in the San Joaquin River.

4 When compared to the No Action Alternative, changes in source water fractions would be similar in
5 season, geographic extent, and magnitude to those discussed for Existing Conditions with exception
6 to Buckley Cove during the modeled drought period. At Buckley Cove, modeled drought period San
7 Joaquin River fractions would increase 23% in July and 28% in August when compared to No Action
8 Alternative (Appendix 8D, *Source Water Fingerprinting Results*). These increases would primarily
9 balance through decreases in Sacramento River water and eastside tributary waters. Nevertheless,
10 the San Joaquin River at Buckley Cove during the modeled drought period would only account for
11 44% of the total source water volume in July and 39% in August. These changes at Buckley Cove are
12 not considered substantial, however, as discussed for Existing Conditions, under the No Action
13 Alternative the similar magnitude change at Franks Tract, Rock Slough, and Contra Costa PP No. 1
14 would be considered substantial and could substantially alter the long-term risk of pesticide-related
15 toxicity to aquatic life.

16 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
17 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
18 will occur at similar levels into the future. In reality, however, the makeup and character of the
19 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
20 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
21 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
22 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
23 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
24 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
25 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
26 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,
27 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall
28 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
29 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
30 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
31 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
32 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
33 these various efforts will ultimately be successful at resolving current pesticide related impairments
34 requires considerable speculation. While the fundamental assumptions that have guided this
35 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
36 actual studies and monitoring data collected from the recent past and, therefore, judging project
37 alternative effects in the future remain most accurate through use of these informed assumptions
38 rather than based on assumptions founded upon future speculative conditions.

39 ***SWP/CVP Export Service Areas***

40 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
41 the Banks and Jones pumping plants. Under Alternative 8, Sacramento River source water fractions
42 would increase substantially at both Banks and Jones pumping plants relative to Existing Conditions
43 and the No Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks
44 pumping plant, Sacramento source water fractions would generally increase from 26–78% for
45 October through June (6–45% for December through March of the modeled drought period) and at

1 Jones pumping plant Sacramento source water fractions would generally increase from 42–95% for
2 October through June (37–88% for October through June of the modeled drought period). These
3 increases in Sacramento source water fraction would primarily balance through equivalent
4 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
5 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
6 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
7 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
8 improvement in export water quality respective to pesticides.

9 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
10 American, and San Joaquin Rivers, under Alternative 8 relative to the No Action Alternative, are of
11 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
12 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
13 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
14 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
15 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
16 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

17 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
18 provided above are summarized here, and are then compared to the CEQA thresholds of significance
19 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
20 constituent. For additional details on the effects assessment findings that support this CEQA impact
21 determination, see the effects assessment discussion that immediately precedes this conclusion.

22 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
23 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
24 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
25 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to
26 substantially increase the long-term risk of pesticide-related water quality degradation and related
27 toxicity to aquatic life in these water bodies upstream of the Delta.

28 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
29 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
30 and maintenance activities would not affect these sources, changes in Delta source water fraction
31 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
32 Alternative 8, modeled long-term average San Joaquin River source water fractions at Franks Tract,
33 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
34 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

35 The assessment of Alternative 8 effects on pesticides in the SWP/CVP Export Service Areas is based
36 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source
37 water fractions would increase substantially at both Banks and Jones pumping plants and would
38 generally represent an improvement in export water quality respective to pesticides.

39 Based on the above, Alternative 8 would not result in any substantial change in long-term average
40 pesticide concentration or result in substantial increase in the anticipated frequency with which
41 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
42 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
43 pesticides are currently used throughout the affected environment, and while some of these
44 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient

1 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
 2 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
 3 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 4 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
 5 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
 6 flows and Delta source water fractions would not be expected to make any of these beneficial use
 7 impairments measurably worse, with principal exception to locations in the Delta that would receive
 8 a substantially greater fraction San Joaquin River water under Alternative 8. Long-term average San
 9 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
 10 locations would change considerably for some months such that the long-term risk of pesticide-
 11 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
 12 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
 13 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
 14 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
 15 feasible mitigation available to reduce the effect of this significant impact.

16 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2-**
 17 **CM21**

18 **NEPA Effects:** CM2–CM21 under Alternative 8 would be similar to conservation measures under
 19 Alternative 1A. Effects on pesticides resulting from the implementation of CM2–CM21 would be
 20 similar to those previously discussed for Alternative 1A. In summary, CM13 proposes the use of
 21 herbicides to control invasive aquatic vegetation around habitat restoration sites. Herbicides
 22 directly applied to water could include adverse effects on non-target aquatic life, such as aquatic
 23 invertebrates and beneficial aquatic plants. As such, aquatic life toxicity objectives could be
 24 exceeded with sufficient frequency and magnitude such that beneficial uses would be impacted, thus
 25 constituting an adverse effect on water quality.

26 In summary, based on the discussion above, the effects on pesticides from implementing CM2-CM21
 27 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
 28 effect.

29 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 8 are similar to those
 30 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
 31 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
 32 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
 33 that would be less than significant.

34 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
 35 **Strategies**

36 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

37 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 38 **and Maintenance (CM1)**

39 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
 40 of the affected environment under Alternative 8 would be very similar (i.e., nearly the same) to
 41 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus

1 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
2 8, which are considered to be not adverse.

3 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
4 provided above are summarized here, and are then compared to the CEQA thresholds of significance
5 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
6 constituent. For additional details on the effects assessment findings that support this CEQA impact
7 determination, see the effects assessment discussion that immediately precedes this conclusion.

8 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
9 because changes in flows do not necessarily result in changes in concentrations or loading of
10 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
11 Delta are not anticipated for Alternative 8, relative to Existing Conditions.

12 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
13 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
14 long term-average basis under Alternative 8, relative to Existing Conditions. Algal growth rates are
15 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
16 that may occur at some locations and times within the Delta would be expected to have little effect
17 on primary productivity in the Delta.

18 The assessment of effects of phosphorus under Alternative 8 in the SWP and CVP Export Service
19 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
20 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
21 anticipated to change substantially on a long term-average basis.

22 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
23 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
24 CVP and SWP service areas under Alternative 8 relative to Existing Conditions. As such, this
25 alternative is not expected to cause additional exceedance of applicable water quality
26 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
27 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
28 are not expected to increase substantially, no long-term water quality degradation is expected to
29 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
30 within the affected environment and thus any minor increases that may occur in some areas would
31 not make any existing phosphorus-related impairment measurably worse because no such
32 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
33 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
34 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
35 than significant. No mitigation is required.

36 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of** 37 **CM2–CM21**

38 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
39 environment under Alternative 8 would be very similar (i.e., nearly the same) to those discussed for
40 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
41 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
42 effects of these same actions under Alternative 8, which are considered to be not adverse.

1 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
 2 measures proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 3 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 4 This impact is considered to be less than significant. No mitigation is required.

5 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 6 **Maintenance (CM1)**

7 ***Upstream of the Delta***

8 For the same reasons stated for the No Action Alternative, Alternative 8 would have negligible, if
 9 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 10 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 11 concentrations that could occur in the water bodies of the affected environment located upstream of
 12 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 13 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 14 selenium.

15 ***Delta***

16 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 17 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 18 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 19 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 20 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the
 21 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
 22 information.

23 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
 24 locations under Alternative 8, relative to Existing Conditions and the No Action Alternative, are
 25 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-18 and M-28 for most biota
 26 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
 27 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
 28 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
 29 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
 30 water at each modeled assessment location for all years. Appendix 8M, Figure M-24 provides more
 31 detail in the form of monthly patterns of selenium concentrations in water during the modeling
 32 period.

33 Alternative 8 would result in small to moderate changes in average selenium concentrations in
 34 water at modeled Delta assessment locations relative to Existing Conditions and the No Action
 35 Alternative (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some
 36 interior and western Delta locations would increase by 0.01–0.14 µg/L for the entire period
 37 modeled (1976–1991). These increases in selenium concentrations in water would result in
 38 reductions in available assimilative capacity for selenium of 1–13%, relative to the 1.3 µg/L USEPA
 39 draft water quality criterion (Figures 8-59a and 8-60a). The long-term average selenium
 40 concentrations in water for Alternative 8 (range 0.09–0.39 µg/L) would be similar to Existing
 41 Conditions (range 0.09–0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and all
 42 would be below the USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table 9a).

1 Relative to Existing Conditions and the No Action Alternative, Alternative 8 would generally result in
2 small changes (less than 4%) in estimated selenium concentrations in most biota (whole-body fish
3 (excluding sturgeon), bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Figures 8-
4 61a through 8-64b; Appendix 8M, *Selenium*, Table M-28). Despite the small changes in selenium
5 concentrations in biota, Level of Concern Exceedance Quotients (i.e., modeled tissue divided by
6 Level of Concern benchmarks) for selenium concentrations in those biota for all years and for
7 drought years are less than 1.0 (indicating low probability of adverse effects). Similarly, Advisory
8 Tissue Level Exceedance Quotients for selenium concentrations in fish fillets for all years and
9 drought years also are less than 1.0. Estimated selenium concentrations in sturgeon for the San
10 Joaquin River at Antioch are predicted to increase by about 31% relative to Existing Conditions and
11 to the No Action Alternative in all years (from about 4.7 to 6.1 mg/kg dry weight). Likewise, those
12 for sturgeon in the Sacramento River at Mallard Island are predicted to increase by about 17% in all
13 years (from about 4.4 to 5.2 mg/kg dry weight) (Appendix 8M, Tables M-30 and M-31). Selenium
14 concentrations in sturgeon during drought years are expected to increase by 23% at Antioch and
15 11% at Mallard Island. Detection of changes in whole-body sturgeon such as those estimated for the
16 western Delta may require large sample sizes because of the inherent variability in fish tissue
17 selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium concentrations
18 in sturgeon in the western Delta would exceed 1.0 for drought years at both locations (as they do for
19 Existing Conditions and the No Action Alternative) and for all years at Antioch, whereas Existing
20 Conditions and the No Action Alternative do not (quotient increases from 0.94 to 1.2 at Antioch)
21 (Appendix 8M, Table M-32). High Toxicity Threshold Exceedance Quotients for selenium
22 concentrations in sturgeon in the western Delta would exceed 1.0 for drought years at Antioch
23 unlike Existing Conditions and the No Action Alternative (quotient increases from 0.85 to 1.1)
24 (Appendix 8M, Table M-32).

25 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
26 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
27 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
28 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
29 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
30 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
31 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
32 the two western Delta locations and used literature-derived uptake factors and trophic transfer
33 factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was a
34 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
35 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
36 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
37 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
38 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
39 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
40 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
41 waterborne selenium concentration at the two locations in different time periods.

42 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
43 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
44 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
45 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
46 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an

1 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
2 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
3 most areas of the Delta.

4 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
5 Alternative 8 would be greater in the South Delta and East Delta than in other sub-regions. Relative
6 to Existing Conditions, annual average residence times for Alternative 8 in the South Delta are
7 expected to increase by more than 37 days (Table 8-60a). and in the East Delta increase by more
8 than 23 days. Increases in residence times for other sub-regions would be smaller, especially as
9 compared to Existing Conditions and the No Action Alternative (which are longer than those
10 modeled for the South Delta). As mentioned above, these results incorporate hydrodynamic effects
11 of both CM1 and CM2 and CM4, and the effects of CM1 cannot be distinguished from the effects of
12 CM2 and CM4. However, it is expected that CM2 and CM4 are substantial drivers of the increased
13 residence time.

14 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
15 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
16 concentrations in particulates, as the lowest level of the food chain, relative to the water-borne
17 concentration], and associated tissue concentrations [especially in clams and their consumers, such
18 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
19 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
20 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
21 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
22 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

23 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
24 as related to residence time, but the effects of residence time are incorporated in the
25 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
26 comparison to wet, normal, or all years; see Appendix 8M, *Selenium*. If increases in fish tissue or bird
27 egg selenium were to occur, the increases would likely be of concern only where fish tissues or bird
28 eggs are already elevated in selenium to near or above thresholds of concern. That is, where biota
29 concentrations are currently low and not approaching thresholds of concern (which, as discussed
30 above, is the case throughout the Delta, except for sturgeon in the western Delta), changes in
31 residence time alone would not be expected to cause them to then approach or exceed thresholds of
32 concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-listed
33 water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta are
34 sparse, the most likely area in which biota tissues would be at levels high enough that additional
35 bioaccumulation due to increased residence time from restoration areas would be a concern is the
36 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
37 increase in residence time estimated in the western Delta is 4 days relative to Existing Conditions,
38 and 2 days relative to the No Action Alternative. Given the available information, these increases are
39 small enough that they are not expected to substantially affect selenium bioaccumulation in the
40 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
41 residence times, further discussion is included in Impact WQ-26 below.

42 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 8 would
43 result in small changes in selenium concentrations throughout the Delta for most biota (less than
44 4%), although larger increases in selenium concentrations are predicted for sturgeon in the western
45 Delta. Concentrations of selenium in sturgeon would exceed the lower benchmark for both western

1 Delta locations for all years and drought years, indicating a low potential for effects. Concentrations
 2 of selenium in sturgeon would exceed the higher benchmark for Antioch only in drought years,
 3 indicating a high potential for effects. The modeling of bioaccumulation for sturgeon is less
 4 calibrated to site-specific conditions than that for other biota, which was calibrated on a robust
 5 dataset for modeling of bioaccumulation in largemouth bass as a representative species for the
 6 Delta. Overall, the predicted increases for Alternative 8 are high enough that they may represent a
 7 measureable increase in body burdens of sturgeon, which would constitute an adverse impact.

8 ***SWP/CVP Export Service Areas***

9 Alternative 8 would result in moderate (0.08–0.15 µg/L) decreases in average selenium
 10 concentrations at the Banks and Jones pumping plants, relative to Existing Conditions and the No
 11 Action Alternative, for the entire period modeled (Appendix 8M, *Selenium*, Table M-9a). These
 12 decreases in long-term average selenium concentrations in water would result in increases in
 13 available assimilative capacity for selenium at these pumping plants of 8–16%, relative to the 1.3
 14 µg/L ecological benchmark (Figures 8-59a and 8-60a). Furthermore, the long-term average
 15 selenium concentrations in water for Alternative 8 (range 0.09–0.39 µg/L) would be well below the
 16 USEPA draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-9a).

17 Relative to Existing Conditions and the No Action Alternative, Alternative 8 would result in small
 18 changes (less than 4%) in estimated selenium concentrations in biota (whole-body fish, bird eggs
 19 [invertebrate diet], bird eggs [fish diet], and fish fillets) at SWP/CVP service areas (Figures 8-61a
 20 through 8-64b; Appendix 8M, *Selenium*, Table M-28). Concentrations in biota would not exceed any
 21 selenium benchmarks for Alternative 8 (Figures 8-61a through 8-64b).

22 ***NEPA Effects:*** Based on the discussion above, the effects on selenium from Alternative 8 are
 23 considered to be adverse. This determination is reached because selenium concentrations in whole-
 24 body sturgeon modeled at two western Delta locations would increase by an average of 30%, which
 25 may represent a measurable increase in the environment. These potentially measurable increases
 26 represent an adverse impact.

27 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 28 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 29 purpose of making the CEQA impact determination for selenium. For additional details on the effects
 30 assessment findings that support this CEQA impact determination, see the effects assessment
 31 discussion that immediately precedes this conclusion.

32 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
 33 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
 34 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
 35 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
 36 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
 37 Valley Regional Water Quality Control Board 2010d; State Water Resources Control Board 2010b,
 38 2010c) that are expected to result in decreasing discharges of selenium from the San Joaquin River
 39 to the Delta. Consequently, any modified reservoir operations and subsequent changes in river flows
 40 under Alternative 8, relative to Existing Conditions, are expected to cause negligible changes in
 41 selenium concentrations in water. Any negligible changes in selenium concentrations that may occur
 42 in the water bodies of the affected environment located upstream of the Delta would not be of
 43 frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or
 44 substantially degrade the quality of these water bodies as related to selenium.

1 Relative to Existing Conditions, modeling estimates indicate that Alternative 8 would result in small
2 changes in selenium concentrations in water or most biota throughout the Delta, with no
3 exceedances of benchmarks for biological effects. Relative to Existing Conditions, modeling
4 estimates indicate that Alternative 8 would increase selenium concentrations in whole-body
5 sturgeon modeled at two western Delta locations by an estimated 21%, which may represent a
6 measureable increase in the environment. Because both low and high toxicity benchmarks are
7 exceeded, these potentially measureable increases represent a potential impact on fish and wildlife
8 beneficial uses.

9 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
10 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
11 Alternative 8 would cause no increase in the frequency with which applicable benchmarks would be
12 exceeded, and would slightly improve the quality of water in selenium concentrations at the Banks
13 and Jones pumping plants locations.

14 Based on the above, although waterborne selenium concentrations would not exceed applicable
15 water quality objectives/criteria; however, significant impacts on some beneficial uses of waters in
16 the Delta could occur because uptake of selenium from water to biota may measurably increase such
17 that high toxicity benchmarks may be exceeded. In comparison to Existing Conditions, water quality
18 conditions under this alternative would increase levels of selenium (a bioaccumulative pollutant) by
19 frequency, magnitude, and geographic extent such that the affected environment may have
20 measurably higher body burdens of selenium in aquatic organisms, thereby substantially increasing
21 the health risks to wildlife (including fish); however, impacts to humans consuming those organisms
22 are not expected to occur. Water quality conditions under this alternative with respect to selenium
23 would cause long-term degradation of water quality in the western Delta. Except in the vicinity of
24 the western Delta for sturgeon, water quality conditions under this alternative would not increase
25 levels of selenium by frequency, magnitude, and geographic extent such that the affected
26 environment would be expected to have measurably higher body burdens of selenium in aquatic
27 organisms. The greater level of selenium bioaccumulation in the western Delta would further
28 degrade water quality by measurable levels, on a long-term basis, for selenium and, thus, cause the
29 CWA Section 303(d)-listed impairment of beneficial use to be made discernibly worse. This impact
30 is considered significant. *AMM27 Selenium Management*, which affords for site-specific measures to
31 reduce effects, would be available to reduce BDCP-related effects associated with selenium. The
32 effectiveness of AMM27 is uncertain and, therefore implementation may not reduce the identified
33 impact to a level that would be less than significant, and therefore it is significant and unavoidable.

34 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2–** 35 **CM21**

36 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 8 would be the same as those
37 discussed for Alternative 1A and are considered not to be adverse.

38 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
39 measures proposed under Alternative 1A. As such, effects on selenium resulting from the
40 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
41 This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
2 **and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, Alternative 8 would result in negligible,
5 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
6 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
7 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
8 annual and long-term average basis. As such, Alternative 8 would not be expected to substantially
9 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
10 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
11 degrade the quality of these water bodies, with regard to trace metals.

12 ***Delta***

13 For the same reasons stated for the No Action Alternative, Alternative 8 would not result in
14 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
15 the No Action Alternative. However, substantial changes in source water fraction would occur in the
16 south Delta (Appendix 8D, *Source Water Fingerprinting Results*). Throughout much of the south
17 Delta, San Joaquin River water would replace Sacramento River water, with the future trace metals
18 profile largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative,
19 trace metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar
20 and currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
21 concentrations in the south Delta would likely be measurable, Alternative 8 would not be expected
22 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria
23 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
24 trace metals.

25 ***SWP/CVP Export Service Areas***

26 For the same reasons stated for the No Action Alternative, Alternative 8 would not result in
27 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
28 from the Sacramento River through the proposed conveyance facilities. As such, there is not
29 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
30 area waters under Alternative 8, relative to Existing Conditions and the No Action Alternative. As
31 such, Alternative 8 would not be expected to substantially increase the frequency with which
32 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
33 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
34 water bodies, with regard to trace metals.

35 ***NEPA Effects:*** In summary, Alternative 8, relative to the No Action Alternative, would not cause a
36 substantial increase in long-term average trace metals concentrations within the affected
37 environment, nor would it cause an increased frequency of water quality objective/criteria
38 exceedances within the affected environment. The effect on trace metals is determined not to be
39 adverse.

40 ***CEQA Conclusion:*** Effects of CM1 on trace metals under Alternative 8 would be similar to those
41 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
42 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for

1 this constituent. For additional details on the effects assessment findings that support this CEQA
2 impact determination, see the effects assessment discussion under Alternative 1A.

3 While greater water demands under the Alternative 8 would alter the magnitude and timing of
4 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
5 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
6 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
7 therefore, changes in river flows would not be expected to cause a substantial long-term change in
8 trace metal concentrations upstream of the Delta.

9 Average and 95th percentile trace metal concentrations are very similar across the primary source
10 waters to the Delta. Given this similarity, very large changes in source water fraction would be
11 necessary to effect a relatively small change in trace metal concentration at a particular Delta
12 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
13 waters are all below their respective water quality criteria, including those that are hardness-based
14 without a WER adjustment. No mixing of these three source waters could result in a metal
15 concentration greater than the highest source water concentration, and given that trace metals do
16 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
17 not be expected to occur under the Alternative 8.

18 The assessment of the Alternative 8 effects on trace metals in the SWP/CVP Export Service Areas is
19 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
20 As just discussed regarding similarities in Delta source water trace metal concentrations, the
21 Alternative 8 is not expected to result in substantial changes in trace metal concentrations in Delta
22 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
23 in the SWP/CVP Export Service Area are expected to be negligible.

24 There would be no substantial long-term increase in trace metal concentrations in the rivers and
25 reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export service area waters
26 under Alternative 8 relative to Existing Conditions. As such, this alternative is not expected to cause
27 additional exceedance of applicable water quality objectives by frequency, magnitude, and
28 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
29 environment. Because trace metal concentrations are not expected to increase substantially, no
30 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
31 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
32 concentrations that may occur in water bodies of the affected environment would not be expected to
33 make any existing beneficial use impairments measurably worse. The trace metals discussed in this
34 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
35 problems in aquatic life or humans. This impact is considered to be less than significant. No
36 mitigation is required.

37 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
38 **CM2–CM21**

39 **NEPA Effects:** CM2–CM21 under Alternative 8 would be similar to conservation measures under
40 Alternative 1A. Effects on trace metals resulting from the implementation of CM2–CM21 would be
41 similar to those previously discussed for Alternative 1A. As they pertain to trace metals,
42 implementation of CM2–CM21 would not be expected to adversely affect beneficial uses of the
43 affected environment or substantially degrade water quality with respect to trace metals.

1 In summary, implementation of CM2–CM21 under Alternative 8, relative to the No Action
 2 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
 3 metals from implementing CM2–CM21 is determined not to be adverse.

4 **CEQA Conclusion:** Implementation of CM2–CM21 under Alternative 8 would not cause substantial
 5 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
 6 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
 7 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 8 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 9 environment. Because trace metal concentrations are not expected to increase substantially, no
 10 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
 11 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
 12 concentrations that may occur throughout the affected environment would not be expected to make
 13 any existing beneficial use impairments measurably worse. The trace metals discussed in this
 14 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
 15 problems in aquatic life or humans. This impact is considered to be less than significant. No
 16 mitigation is required.

17 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
 18 **Maintenance (CM1)**

19 **NEPA Effects:** Effects of CM1 on TSS and turbidity under Alternative 8 would be the same as those
 20 discussed for Alternative 1A and are considered to not be adverse.

21 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 8 would be similar to those
 22 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 23 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 24 this constituent. For additional details on the effects assessment findings that support this CEQA
 25 impact determination, see the effects assessment discussion under Alternative 1A.

26 Changes river flow rate and reservoir storage that would occur under Alternative 8, relative to
 27 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
 28 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 29 suspended sediment concentrations are more affected by season than flow. Site-specific and
 30 temporal exceptions may occur due to localized temporary construction activities, dredging
 31 activities, development, or other land use changes would be site-specific and temporal, which would
 32 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 33 than substantial levels.

34 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 35 usually gradual, occurring over years, and high storm event inflows would not be substantially
 36 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 37 would not be substantially different from the levels under Existing Conditions. Consequently, this
 38 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 39 region, relative to Existing Conditions.

40 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 41 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 8, relative to Existing
 42 Conditions, because as stated above, this alternative is not expected to result in substantial changes

1 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
2 Conditions.

3 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
4 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
5 concentrations and turbidity levels are not expected to be substantially different, long-term water
6 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
7 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
8 listed constituents. This impact is considered to be less than significant. No mitigation is required.

9 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

10 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 8 would be the same as
11 those discussed for Alternative 1A and are considered to not be adverse.

12 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 8 would be similar to conservation
13 measures proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
14 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
15 This impact is considered to be less than significant. No mitigation is required.

16 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 17 **(CM1–CM21)**

18 The conveyance features for CM1 under Alternative 8 would be very similar to those discussed for
19 Alternative 1A. The primary difference between Alternative 8 and Alternative 1A is that under
20 Alternative 8, there would be two fewer intakes and two fewer pumping plant locations, which
21 would result in a reduced level of construction activity. Additional construction activity also would
22 occur to restore channel margin and seasonally inundated floodplain habitats. However,
23 construction techniques and locations of major features of the conveyance system within the Delta
24 would be similar. The remainder of the facilities constructed under Alternative 8, including CM2–
25 CM21, would be very similar to, or the same as, those to be constructed for Alternative 1A. However,
26 under Alternative 8, there would be up to 20,000 acres of inundated floodplain habitat restored (as
27 opposed to 10,000 acres under the majority of the other alternatives), thus resulting in increased
28 construction-related disturbances.

29 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
30 associated with implementation of CM1–CM21 under Alternative 8 would be very similar to the
31 effects discussed for Alternative 1A, and the effects anticipated with implementation of CM2–CM21
32 would be essentially identical. Nevertheless, the construction of CM1, and any individual
33 components necessitated by CM2, and CM4–CM10, with the implementation of the BMPs specified in
34 Appendix 3B, *Environmental Commitments, AMMs, and CMs*, and other agency permitted
35 construction requirements would result in the potential water quality effects being largely avoided
36 and minimized. The specific environmental commitments that would be implemented under
37 Alternative 8 would be similar to those described for Alternative 1A. Consequently, relative to
38 Existing Conditions, Alternative 8 would not be expected to cause exceedance of applicable water
39 quality objectives/criteria or substantial water quality degradation with respect to constituents of
40 concern, and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta,
41 or in the SWP and CVP service area.

1 In summary, with implementation of environmental commitments in Appendix 3B, the potential
2 construction-related water quality effects are considered to be not adverse.

3 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 8
4 for construction-related activities along with agency-issued permits that also contain construction
5 requirements to protect water quality, the construction-related effects, relative to Existing
6 Conditions, would not be expected to cause or contribute to substantial alteration of existing
7 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
8 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
9 water quality with respect to the constituents of concern on a long-term average basis, and thus
10 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
11 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
12 would be temporary and intermittent in nature, the construction would involve negligible
13 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
14 environment. As such, construction activities would not contribute measurably to bioaccumulation
15 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
16 Based on these findings, this impact is determined to be less than significant. No mitigation is
17 required.

18 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations 19 and Maintenance (CM1)**

20 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
21 concentrations, in water bodies of the affected environment under Alternative 8 would be very
22 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
23 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
24 Services Areas under Alternative 1A would similarly change under Alternative 8, relative to Existing
25 Conditions and the No Action Alternative. For the Delta in particular, there are differences in the
26 direction and magnitude of water residence time changes during the *Microcystis* bloom period
27 among the six Delta sub-regions under Alternative 8 compared to Alternative 1A, relative to Existing
28 Conditions and No Action Alternative. However, under Alternative 8, relative to Existing Conditions
29 and No Action Alternative, water residence times during the *Microcystis* bloom period in various
30 Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A, lead to
31 an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout
32 the Delta.

33 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
34 would occur in the Delta under Alternative 8, which could lead to earlier occurrences of *Microcystis*
35 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
36 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
37 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
38 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative 8
39 may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
40 because water temperatures will increase in the Export Service Areas due to the expected increase
41 in ambient air temperatures resulting from climate change.

42 **NEPA Effects:** Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
43 affected environment under Alternative 8 would be very similar to (i.e., nearly the same) to those
44 discussed for Alternative 1A. In summary, Alternative 8 operations and maintenance, relative to the

1 No Action Alternative, would result in long-term increases in hydraulic residence time of various
2 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
3 increased residence time could result in a concurrent increase in the frequency, magnitude, and
4 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
5 As a result, Alternative 8 operation and maintenance activities would cause further degradation to
6 water quality with respect to *Microcystis* in the Delta. Under Alternative 8, relative to No Action
7 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
8 affected source water from the south Delta intakes and unaffected source water from the
9 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
10 and maintenance under Alternative 8 will result in increased or decreased levels of *Microcystis* and
11 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
12 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
13 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
14 *Microcystis* from implementing CM1 is determined to be adverse.

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
17 purpose of making the CEQA impact determination for this constituent. For additional details on the
18 effects assessment findings that support this CEQA impact determination, see the effects assessment
19 discussion that immediately precedes this conclusion.

20 Under Alternative 8, additional impacts from *Microcystis* in the reservoirs and watersheds upstream
21 of the Delta are not expected, relative to Existing Conditions. Operations and maintenance occurring
22 under Alternative 8 is not expected to change nutrient levels in upstream reservoirs or
23 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
24 conducive to *Microcystis* production.

25 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
26 expected to increase under Alternative 8, resulting in an increase in the frequency, magnitude and
27 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
28 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
29 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
30 throughout the Delta during the summer and fall bloom period, due in small part to climate change
31 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
32 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
33 production expected within any Delta sub-region is unknown because conditions will vary across
34 the complex networks of intertwining channels, shallow back water areas, and submerged islands
35 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
36 to Alternative 8. Consequently, it is possible that increases in the frequency, magnitude, and
37 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
38 maintenance of Alternative 8 and the hydrodynamic impacts of restoration (CM2 and CM4).

39 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
40 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
41 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
42 Under Alternative 8, relative to Existing Conditions, the potential for *Microcystis* to occur in the
43 Export Service Area is expected to increase due to increasing water temperature, but this impact is
44 driven entirely by climate change and not Alternative 8. Water exported from the Delta to the Export
45 Service Area is expected to be a mixture of *Microcystis*-affected source water from the south Delta

1 intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
 2 determined whether operations and maintenance under Alternative 8, relative to existing
 3 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
 4 of source waters exported from Banks and Jones pumping plants.

5 Based on the above, this alternative would not be expected to cause additional exceedance of
 6 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 7 would cause significant impacts on any beneficial uses of waters in the affected environment.
 8 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
 9 increases that could occur in some areas would not make any existing *Microcystis* impairment
 10 measurably worse because no such impairments currently exist. However, because it is possible that
 11 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
 12 occur due to the operations and maintenance of Alternative 8 and the hydrodynamic impacts of
 13 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
 14 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
 15 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
 16 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
 17 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 18 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
 19 the effects on *Microcystis* from implementing CM1 is determined to be significant.

20 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
 21 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
 22 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
 23 remain significant and unavoidable.

24 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 25 ***Microcystis* Blooms**

26 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

27 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 28 **Water Residence Time**

29 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

30 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 31 **Measures (CM2–CM21)**

32 The effects of CM2–CM21 on *Microcystis* under Alternative 8 would be the same as those discussed
 33 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
 34 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
 35 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters
 36 from. Because the hydrodynamic effects associated with implementing CM2 and CM4 were
 37 incorporated into the modeling used to assess CM1, a detailed assessment of the effects of
 38 implementing CM2 and CM4 on *Microcystis* blooms in the Delta via their effects on Delta water
 39 residence time is provided under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be
 40 reduced by implementation of Mitigation Measures WQ-32a. The effectiveness of the mitigation
 41 measure to result in feasible measures for reducing water quality effects is uncertain. CM3 and

1 CM5–CM21 would not result in an increase in the frequency, magnitude, and geographic extent of
2 *Microcystis* blooms in the Delta.

3 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
4 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
5 measures for reducing water quality effects is uncertain, this impact is considered to remain
6 significant and unavoidable.

7 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 8 would be the same as those
8 discussed for Alternative 1A and are considered to be adverse.

9 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
10 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
11 extent that would cause significant impacts on any beneficial uses of waters in the affected
12 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
13 and thus any increases that could occur in some areas would not make any existing *Microcystis*
14 impairment measurably worse because no such impairments currently exist. Because restoration
15 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
16 create local areas of warmer water during the bloom season, it is possible that increases in the
17 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
18 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
19 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
20 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
21 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
22 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
23 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
24 determined to be significant.

25 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
26 ***Microcystis* Blooms**

27 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

28 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
29 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

30 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
31 that Alternative 8 would have a less than significant impact/no adverse effect on the following
32 constituents in the Delta:

- 33 ● Boron
- 34 ● DO
- 35 ● Pathogens
- 36 ● Pesticides
- 37 ● Trace Metals
- 38 ● Turbidity and TSS

1 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
2 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
3 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
4 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
5 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
6 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and
7 geographic extent that would adversely affect any beneficial uses or substantially degrade the
8 quality of the of San Francisco Bay.

9 The effects of Alternative 8 on bromide, chloride, and DOC, in the Delta were determined to be
10 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
11 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
12 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
13 adversely effect any beneficial uses of San Francisco Bay.

14 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR beneficial use
15 and fish and wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR
16 beneficial use designation. Further, as discussed for the No Action Alternative, changes in Delta
17 salinity would not contribute to measurable changes in Bay salinity, as the change in Delta outflow,
18 which would be the primary driver of salinity changes, would be two to three orders of magnitude
19 lower than (and thus minimal compared to) the Bay's tidal flow.

20 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
21 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
22 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
23 Suisun Bay.

24 While effects of Alternative 8 on the nutrients ammonia, nitrate, and phosphorus were determined
25 to be less than significant/not adverse, these constituents are addressed further below because the
26 response of the seaward bays to changed nutrient concentrations/loading may differ from the
27 response of the Delta. Selenium and mercury are discussed further, because they are
28 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
29 and exports are of concern.

30 ***Nutrients: Ammonia, Nitrate, and Phosphorus***

31 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 8 would be
32 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
33 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
34 decrease by 9%, relative to Existing Conditions, and increase by 33%, relative to the No Action
35 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
36 Suisun and San Pablo Bays under Alternative 8 would not adversely impact primary productivity in
37 these embayments because light limitation and grazing currently limit algal production in these
38 embayments. To the extent that algal growth increases in relation to a change in ammonia
39 concentration, this would have net positive benefits, because current algal levels in these
40 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
41 cyanobacteria levels in the North Bay.

42 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 8 is
43 estimated to increase by 14%, relative to Existing Conditions, and increase by 9% relative to the No

1 Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in phosphorus
2 loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry on primary
3 productivity. However, there is uncertainty regarding the impact of nutrient ratios on
4 phytoplankton community composition and abundance. Any effect on phytoplankton community
5 composition would likely be small compared to the effects of grazing from introduced clams and
6 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the
7 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
8 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
9 would result in adverse effects to beneficial uses.

10 **Mercury**

11 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
12 Appendix 80, Table O-2. Loads of mercury and methylmercury from the Delta to San Francisco Bay
13 are estimated to change relatively little due to changes in source water fractions and net Delta
14 outflow that would occur under Alternative 8. Mercury load to the Bay is estimated to increase by 16
15 kg/year (6%), relative to Existing Conditions, and 13 kg/year (5%), relative to the No Action
16 Alternative. Methylmercury load is estimated to increase by 0.40 kg/year (11%), relative to Existing
17 Conditions, and increase by 0.31 kg/year (8%) relative to the No Action Alternative. The estimated
18 total mercury load to the Bay is 276 kg/year, which would be less than the San Francisco Bay
19 mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in mercury and
20 methylmercury loads would be within the overall uncertainty associated with the estimates of long-
21 term average net Delta outflow and the long-term average mercury and methylmercury
22 concentrations in Delta source waters. The estimated changes in mercury load under the alternative
23 would also be substantially less than the considerable differences among estimates in the current
24 mercury load to San Francisco Bay (San Francisco Bay Regional Water Quality Control Board 2006;
25 David et al. 2009).

26 Given that the estimated incremental increases of mercury and methylmercury loading to San
27 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
28 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
29 Francisco Bay due to Alternative 8 are not expected to result in adverse effects to beneficial uses or
30 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
31 303(d) impairment measurably worse.

32 **Selenium**

33 Changes in source water fraction and net Delta outflow under Alternative 8, relative to Existing
34 Conditions, are projected to cause the total selenium load to the North Bay to increase by 24%,
35 relative to Existing Conditions, and increase by 20%, relative to the No Action Alternative (Appendix
36 80, Table O-3). Changes in long-term average selenium concentrations of the North Bay are assumed
37 to be proportional to changes in North Bay selenium loads. Under Alternative 8, the long-term
38 average total selenium concentration of the North Bay is estimated to be 0.16 µg/L and the dissolved
39 selenium concentration is estimated to be 0.14 µg/L, which would be a 0.03 µg/L increase relative to
40 Existing Conditions and the No Action Alternative (Appendix 80, Table O-3). The dissolved selenium
41 concentration would be below the target of 0.202 µg/L developed by Presser and Luoma (2013) to
42 coincide with a white sturgeon whole-body fish tissue selenium concentration not greater than 8
43 mg/kg in the North Bay.

1 The incremental increase in dissolved selenium concentrations projected to occur under Alternative
2 8, relative to Existing Conditions and the No Action Alternative, would be higher than under
3 Alternatives 1A–5, but still low (0.03 µg/L). The increased dissolved selenium concentration would
4 be within the overall uncertainty of the analytical methods used to measure selenium in water
5 column samples; however, it also would be within the uncertainty associated with estimating
6 numeric water column selenium thresholds (Pressor and Luoma 2013). As described in Section
7 8.3.1.8, there have been improvements in selenium concentrations in the tissue of diving ducks and
8 muscle of white sturgeon since the initial CWA Section 303(d) listing of the North Bay for selenium
9 impairments, and selenium concentrations in white sturgeon muscle have also generally been below
10 the USEPA’s draft recommended fish muscle tissue concentration of 11.8 mg/kg dry weight (San
11 Francisco Estuary Institute 2014). However, as described under Impact WQ-25, though there is
12 some uncertainty in the estimate of sturgeon concentrations at western Delta locations, the
13 predicted increases for Alternative 8 are high enough that they may represent measurably higher
14 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
15 wildlife (including fish). Because the projected incremental increases in dissolved selenium could
16 cause measurable changes in water column concentrations, and these incremental increases would
17 be within the uncertainty in the target water column threshold for dissolved selenium for protection
18 against adverse bioaccumulative effects in the North Bay ecosystem, and modeling predicts
19 concentrations in the western Delta may represent a measurable increase in body burdens of
20 sturgeon, there is potential that the incremental increase in dissolved selenium concentration
21 projected to occur in the North Bay under Alternative 8 could result in adverse effects beneficial
22 uses.

23 **NEPA Effects:** Based on the discussion above, Alternative 8, relative to the No Action Alternative,
24 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
25 DOC, EC, mercury, pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or
26 turbidity and TSS in the San Francisco Bay. Further, changes in these constituent concentrations in
27 Delta outflow would not be expected to cause changes in Bay concentrations of frequency,
28 magnitude, and geographic extent that would adversely affect any beneficial uses. In summary,
29 based on the discussion above, effects on the San Francisco Bay from implementation of CM1–CM21
30 are considered to be not adverse with respect to boron, bromide, chloride, DO, DOC, EC, mercury,
31 pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS.
32 However, Alternative 8 could result in increases in selenium concentrations in the North San
33 Francisco Bay that could result in adverse effects to fish and wildlife beneficial uses. This effect is
34 considered to be adverse.

35 **CEQA Conclusion:** Based on the above, Alternative 8 would not be expected to cause long-term
36 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
37 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
38 would result in substantially increased risk for adverse effects to one or more beneficial uses with
39 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
40 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Further, based on the above, this
41 alternative would not be expected to cause additional exceedance of applicable water quality
42 objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent that
43 would cause significant impacts on any beneficial uses of waters in the affected environment with
44 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
45 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Any changes in boron, bromide,
46 chloride, and DOC in the San Francisco Bay would not adversely affect beneficial uses, because the

1 uses most affected by changes in these parameters, MUN and AGR, are not beneficial uses of the Bay.
 2 Further, no substantial changes in DO, pathogens, pesticides, trace metals or turbidity or TSS are
 3 anticipated in the Delta, relative to Existing Conditions, therefore, no substantial changes these
 4 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
 5 measurable changes in Bay salinity, as the change in Delta outflow would two to three orders of
 6 magnitude lower than (and thus minimal compared to) the Bay's tidal flow. Adverse changes in
 7 *Microcystis* levels that could occur in the Delta would not cause adverse *Microcystis* blooms in the
 8 Bay, because *Microcystis* are intolerant of the Bay's high salinity and, thus not have not been
 9 detected downstream of Suisun Bay. The 9% decrease in total nitrogen load and 14% increase in
 10 phosphorus load, relative to Existing Conditions, are expected to have minimal effect on water
 11 quality degradation, primary productivity, or phytoplankton community composition. The estimated
 12 increase in mercury load (16 kg/year; 6%) and methylmercury load (0.40 kg/year; 11), relative to
 13 Existing Conditions, is within the level of uncertainty in the mass load estimate and not expected to
 14 contribute to water quality degradation, make the CWA section 303(d) mercury impairment
 15 measurably worse or cause mercury/methylmercury to bioaccumulate to greater levels in aquatic
 16 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans.

17 In regard to selenium, the estimated increase in selenium load would be 24% and the estimated
 18 increase in dissolved selenium concentrations would be 0.03 µg/L. Though there is some
 19 uncertainty in the estimate of sturgeon concentrations at western Delta locations, the predicted
 20 increases are high enough that they may represent measurably higher body burdens of selenium in
 21 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish). Thus,
 22 the increase in selenium load may make the CWA section 303(d) selenium impairment measurably
 23 worse and cause selenium to bioaccumulate to greater levels in aquatic organisms that would, in
 24 turn, pose substantial health risks to fish and wildlife. This impact is considered to be significant.
 25 *AMM27 Selenium Management*, which affords for site-specific measures to reduce effects, would be
 26 available to reduce BDCP-related effects associated with selenium. The effectiveness of AMM27 is
 27 uncertain and, therefore implementation may not reduce the identified impact to a level that would
 28 be less than significant, and therefore it is significant and unavoidable.

29 **8.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; 30 Operational Scenario G)**

31 Under Alternative 9, two fish-screened intakes would be constructed—one at the Delta Cross Channel
 32 and the other at Georgiana Slough. Water would be conveyed through a flow-collection channel and
 33 radial gates, eventually reaching the existing channel. Once in the channel, water would flow south
 34 through the Mokelumne River and San Joaquin River to Middle River and Victoria Canal, which
 35 would be dredged to accommodate increased flows. Along the way, diverted water would be guided
 36 by operable barriers. Water flowing through Victoria Canal would lead into two new canal segments
 37 and pass under two existing watercourses through culvert siphons, eventually reaching Clifton
 38 Court Forebay. From there, water would flow through existing SWP facilities, and a new canal would
 39 be constructed to connect the forebay to CVP facilities. Water supply and conveyance operational
 40 criteria under Alternative 9 would be guided by criteria identified in Scenario G. CM2–CM21 would
 41 be implemented under this alternative, and would be the same as those under Alternative 1A. See
 42 Chapter 3, *Description of Alternatives*, Section 3.5.16, for additional details on Alternative 9.

1 **Effects of the Alternative on Delta Hydrodynamics**

2 Under the No Action Alternative and Alternatives 1A–9, the following two primary factors can
3 substantially affect water quality within the Delta:

- 4 • Within the south, west, and interior Delta, a decrease in the percentage of Sacramento River-
5 sourced water and a concurrent increase in San Joaquin River-sourced water can increase the
6 concentrations of numerous constituents (e.g., boron, bromide, chloride, electrical conductivity,
7 nitrate, organic carbon, some pesticides, selenium). This source water replacement is caused by
8 decreased exports of San Joaquin River water (due to increased Sacramento River water
9 exports), or effects of climate change on timing of flows in the rivers. Changes in channel flows
10 also can affect water residence time and many related physical, chemical, and biological
11 variables.
- 12 • Particularly in the west Delta, sea water intrusion as a result of sea level rise or decreased Delta
13 outflow can increase the concentration of salts (bromide, chloride) and levels of electrical
14 conductivity. Conversely, increased Delta outflow (e.g., as a result of Fall X2 operations in wet
15 and above normal water years) will decrease levels of these constituents, particularly in the
16 west Delta.

17 Under Alternative 9, over the long term, average annual delta exports are anticipated to decrease by
18 766 TAF relative to Existing Conditions, and by 63 TAF relative to the No Action Alternative.
19 Although all of the diversions are from the existing south Delta intakes, the operable barriers
20 included under this alternative would result in the exported water containing a higher proportion of
21 Sacramento River water as opposed to San Joaquin River water (see Chapter 5, *Water Supply*, for
22 more information). The result of this would be greatly increased San Joaquin River water influence
23 throughout the south, west, and interior Delta, and a corresponding decrease in Sacramento River
24 water influence. This can be seen, for example, in Appendix 8D, *Source Water Fingerprinting Results*,
25 Figure 271, which shows increased San Joaquin River (SJR) percentage and decreased Sacramento
26 River (SAC) percentage under the alternative, relative to Existing Conditions and the No Action
27 Alternative.

28 Under Alternative 9, long-term average annual Delta outflow is anticipated to increase 807 TAF
29 relative to Existing Conditions, due to both changes in operations (including use of operable barriers
30 and numerous other components of Operational Scenario G) and climate change/sea level rise (see
31 Chapter 5, *Water Supply*, for more information). The result of this is decreased sea water intrusion in
32 the west Delta. The decrease of sea water intrusion in the west Delta under Alternative 9 would be
33 greater relative to the Existing Conditions because Existing Conditions do not include operations to
34 meet Fall X2, whereas the No Action Alternative and Alternative 9 do. Long-term average annual
35 Delta outflow is anticipated to increase under Alternative 9 by 57 TAF relative to the No Action
36 Alternative, due only to changes in operations. The decreases in sea water intrusion (represented by
37 an decrease in San Francisco Bay (BAY) percentage) can be seen, for example, in Appendix 8D,
38 Figure 271.

39 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 40 **Maintenance (CM1)**

41 ***Upstream of the Delta***

42 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
43 any, effect on ammonia concentrations in the rivers and reservoirs upstream of the Delta relative to

Existing Conditions and the No Action Alternative. Any negligible increases in ammonia-N concentrations that could occur in the water bodies of the affected environment located upstream of the Delta would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the quality of these water bodies, with regard to ammonia.

Delta

Assessment of effects of ammonia under Alternative 9 is the same as discussed under Alternative 1A, except that because flows in the Sacramento River at Freeport are different between the two alternatives, estimated monthly average and long term annual average predicted ammonia-N concentrations in the Sacramento River downstream of Freeport are different.

As Table 8-72 shows, estimated ammonia-N concentrations in the Sacramento River downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 9 and the No Action Alternative are expected to be similar. Minor increases in ammonia-N concentrations would occur during January through March, July, October, and December, and remaining months would be unchanged or have a minor decrease. A minor increase in the annual average concentration would occur under Alternative 9, compared to the No Action Alternative. Moreover, the estimated concentrations downstream of Freeport under Alternative 9 would be similar to existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated under Alternative 9, relative to the No Action Alternative, are not expected to substantially increase ammonia concentrations at any Delta locations.

Table 8-72. Estimated Ammonia-N (mg-L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative and Alternative 9

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative	0.074	0.084	0.069	0.060	0.057	0.060	0.058	0.064	0.067	0.060	0.067	0.064	0.065
Alternative 9	0.076	0.084	0.070	0.061	0.058	0.061	0.058	0.063	0.067	0.061	0.067	0.064	0.066

Any negligible increases in ammonia-N concentrations that could occur at certain locations in the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regards to ammonia.

SWP/CVP Export Service Areas

The assessment of effects on ammonia in the SWP/CVP Export Service Area is based on assessment of ammonia-N concentrations at Banks and Jones pumping plants. Similar to the discussion for Alternative 1A, under Alternative 9 for areas of the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease, relative to Existing Conditions (in association with less diversion of water influenced by the SRWTP). This decrease in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result in adverse effects on beneficial uses or substantially degrade water quality of exported water, with regards to ammonia.

1 Furthermore, as discussed above for the Plan Area, for all areas of the Delta, including Banks and
2 Jones pumping plants, ammonia-N concentrations are not expected to be substantially different
3 under Alternative 9, relative to No Action Alternative. Any negligible increases in ammonia-N
4 concentrations that could occur at Banks and Jones pumping plants would not be of frequency,
5 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
6 degrade the water quality at these locations, with regards to ammonia.

7 **NEPA Effects:** In summary, based on the discussion above, effects on ammonia from implementation
8 of CM1 are considered to be not adverse.

9 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
10 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
11 purpose of making the CEQA impact determination for this constituent. For additional details on the
12 effects assessment findings that support this CEQA impact determination, see the effects assessment
13 discussion that immediately precedes this conclusion.

14 Ammonia-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing
15 to the lack of substantial point and nonpoint sources of ammonia-N upstream of the SRWTP in the
16 Sacramento River watershed, in the watersheds of the eastern tributaries (Cosumnes, Mokelumne,
17 and Calaveras Rivers), or upstream of the Delta in the San Joaquin River watershed. Consequently,
18 any modified reservoir operations and subsequent changes in river flows under Alternative 9,
19 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
20 ammonia-N concentrations upstream of Freeport in the Sacramento River watershed and upstream
21 of the Delta in the San Joaquin River watershed.

22 Ammonia-N concentrations in the Sacramento River downstream of the SRWTP would be
23 substantially lower under Alternative 9, relative to Existing Conditions, due to upgrades to the
24 SRWTP that are assumed to be in place, and thus, ammonia concentrations for all areas of the Delta
25 that are influenced by Sacramento River water are expected to decrease. At locations which are not
26 influenced notably by Sacramento River water, concentrations are expected to remain relatively
27 unchanged, due to the similarity in SJR and BAY concentrations and the lack of expected changes in
28 either of these concentrations.

29 The assessment of effects on ammonia in the SWP/CVP Export Service Areas is based on assessment
30 of ammonia-N concentrations at Banks and Jones pumping plants. As discussed above for the Plan
31 Area, for areas of the Delta that are influenced by Sacramento River water, including Banks and
32 Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 9,
33 relative to Existing Conditions.

34 Based on the above, there would be no substantial, long-term increase in ammonia-N concentrations
35 in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the
36 CVP and SWP service areas under Alternative 9 relative to Existing Conditions. As such, this
37 alternative is not expected to cause additional exceedance of applicable water quality
38 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
39 on any beneficial uses of waters in the affected environment. Because ammonia concentrations are
40 not expected to increase substantially, no long-term water quality degradation is expected to occur
41 and, thus, no adverse effects on beneficial uses would occur. Ammonia is not 303(d) listed within the
42 affected environment and thus any minor increases that could occur in some areas would not make
43 any existing ammonia-related impairment measurably worse because no such impairments
44 currently exist. Because ammonia-N is not bioaccumulative, minor increases that could occur in

1 some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 2 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 3 significant. No mitigation is required.

4 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of CM2–**
 5 **CM21**

6 **NEPA Effects:** Effects of CM2–CM21 on ammonia under Alternative 9 would be the same as those
 7 discussed for Alternative 1A and are considered to be not adverse.

8 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 9 measures proposed under Alternative 1A. As such, effects on ammonia resulting from the
 10 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 11 This impact is considered to be less than significant. No mitigation is required.

12 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and**
 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 Effects of CM1 on boron under Alternative 9 in areas upstream of the Delta would be very similar to
 16 the effects discussed for Alternative 1A. There would be no expected change to the sources of boron
 17 in the Sacramento and eastside tributary watersheds, and resultant changes in flows from altered
 18 system-wide operations would have negligible, if any, effects on the concentration of boron in the
 19 rivers and reservoirs of these watersheds. The modeled long-term annual average lower San Joaquin
 20 River flow at Vernalis would decrease slightly compared to Existing Conditions (in association with
 21 changed operations, climate change, and increased water demands) and the No Action Alternative
 22 considering only changes due to Alternative 9 operations. The reduced flow would result in possible
 23 increases in long-term average boron concentrations of up to about 3% relative to the Existing
 24 Conditions (Appendix 8F, *Boron*, Table Bo-32). The increased boron concentrations would not
 25 increase the frequency of exceedances of any applicable objectives or criteria and would not be
 26 expected to cause further degradation at measurable levels in the lower San Joaquin River, and thus
 27 would not cause the existing impairment there to be discernibly worse. Consequently, Alternative 9
 28 would not be expected to cause exceedance of boron objectives/criteria or substantially degrade
 29 water quality with respect to boron, and thus would not adversely affect any beneficial uses of the
 30 Sacramento River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San
 31 Joaquin River.

32 ***Delta***

33 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 34 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 35 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 36 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 37 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 38 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 39 information.

40 Relative to the Existing Conditions and No Action Alternative, Alternative 9 would result in similar
 41 or reduced long-term average boron concentrations for the 16-year period modeled at northern and

1 eastern Delta locations, with a substantial reduction in boron concentrations in the San Joaquin
 2 River at Buckley Cove. Long-term average boron concentrations would increase at interior and
 3 western Delta locations (by as much as 66% at Franks Tract, 80% at Old River at Rock Slough, and
 4 9% at the Sacramento River at Emmaton) (Appendix 8F, *Boron*, Table Bo-22). The comparison to
 5 Existing Conditions reflects changes due to both Alternative 9 operations (including use of operable
 6 barriers and numerous other components of Operational Scenario G) and climate change/sea level
 7 rise. The comparison to the No Action Alternative reflects changes due only to operations.

8 Implementation of tidal habitat restoration under CM4 also may contribute to increased boron
 9 concentrations at western Delta assessment locations (more discussion of this phenomenon is
 10 included in Section 8.3.1.3), and thus would not be anticipated to substantially affect agricultural
 11 diversions which occur primarily at interior Delta locations. The long-term annual average and
 12 monthly average boron concentrations, for either the 16-year period or drought period modeled,
 13 would never exceed the 2,000 µg/L human health advisory objective (i.e., for children) or 500 µg/L
 14 agricultural objective at any of the eleven Delta assessment locations, which represents no change
 15 from the Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-3A). The
 16 increased concentrations at interior Delta locations would result in moderate reductions in the long-
 17 term average assimilative capacity of up to 33% at Franks Tract and up to 46% at Old River at Rock
 18 Slough locations (Appendix 8F, Table Bo-23). However, because the absolute boron concentrations
 19 would still be well below the lowest 500 µg/L objective for the protection of the agricultural
 20 beneficial use under Alternative 9, the levels of boron degradation would not be of sufficient
 21 magnitude to substantially increase the risk of exceeding objectives or cause adverse effects to
 22 municipal and agricultural water supply beneficial uses, or any other beneficial uses, in the Delta
 23 (Appendix 8F, Figure Bo-5).

24 ***SWP/CVP Export Service Areas***

25 Effects of CM1 on boron under Alternative 9 in the Delta would be similar to the effects discussed for
 26 Alternative 1A. Under Alternative 9, long-term average boron concentrations would decrease by as
 27 much as 18% at the Banks Pumping Plant and by as much as 31% at Jones Pumping Plant relative to
 28 Existing Conditions and No Action Alternative (Appendix 8F, *Boron*, Table Bo-22) as a result of
 29 export of a greater proportion of low-boron Sacramento River water. Commensurate with the
 30 decrease in exported boron concentrations, boron concentrations in the lower San Joaquin River
 31 may be reduced and would likely alleviate or lessen any expected increase in boron concentrations
 32 at Vernalis associated with flow reductions (see discussion of Upstream of the Delta), as well as
 33 locations in the Delta receiving a large fraction of San Joaquin River water. Reduced export boron
 34 concentrations also may contribute to reducing the existing 303(d) impairment in the lower San
 35 Joaquin River and associated TMDL actions for reducing boron loading.

36 Maintenance of SWP and CVP facilities under Alternative 9 would not be expected to create new
 37 sources of boron or contribute towards a substantial change in existing sources of boron in the
 38 affected environment. Maintenance activities would not be expected to cause any substantial
 39 increases in boron concentrations or degradation with respect to boron such that objectives would
 40 be exceeded more frequently, or any beneficial uses would be adversely affected anywhere in the
 41 affected environment.

42 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 9 would
 43 result in moderate increases in long-term average boron concentrations in the Delta and not
 44 appreciably change boron levels in the lower San Joaquin River. However, the predicted changes in

1 the Delta would not be expected to result in exceedances of applicable objectives or further water
2 quality degradation such that objectives would likely be exceeded or there would be substantially
3 increased risk of adverse effect on water quality.

4 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
5 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
6 purpose of making the CEQA impact determination for this constituent. For additional details on the
7 effects assessment findings that support this CEQA impact determination, see the effects assessment
8 discussion that immediately precedes this conclusion.

9 Boron is not a constituent of concern in the Sacramento River watershed upstream of the Delta, thus
10 river flow rate and reservoir storage reductions that would occur under the Alternative 9, relative to
11 Existing Conditions, would not be expected to result in a substantial adverse change in boron levels.
12 Additionally, relative to Existing Conditions, Alternative 9 would not result in reductions in river
13 flow rates (i.e., less dilution) or increased boron loading such that there would be any substantial
14 increases in boron concentration upstream of the Delta in the San Joaquin River watershed.

15 Moderate increased boron levels (i.e., up to 82% increased concentration) and degradation
16 predicted for interior and western Delta locations in response to a shift in the Delta source water
17 percentages and tidal habitat restoration under this alternative would not be expected to cause
18 exceedances of objectives. Alternative 9 maintenance also would not result in any substantial
19 increases in boron concentrations in the affected environment. Boron concentrations would be
20 reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus reflecting a
21 potential improvement to boron loading in the lower San Joaquin River.

22 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 9
23 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
24 Existing Conditions, Alternative 9 would not result in substantially increased boron concentrations
25 such that frequency of exceedances of municipal and agricultural water supply objectives would
26 increase. The levels of boron degradation that may occur under Alternative 9, while widespread in
27 particular at interior Delta locations, would not be of sufficient magnitude to cause substantially
28 increased risk for adverse effects to municipal or agricultural beneficial uses within the affected
29 environment. Long-term average boron concentrations would decrease in Delta water exports to the
30 SWP and CVP service area, which may contribute to reducing the existing 303(d) impairment of
31 agricultural beneficial uses in the lower San Joaquin River. Consequently, Alternative 9 would not be
32 expected to cause any substantial increases in boron concentrations or degradation with respect to
33 boron such that objectives would be exceeded more frequently, or any beneficial uses would be
34 adversely affected anywhere in the affected environment. Based on these findings, this impact is
35 determined to be less than significant. No mitigation is required.

36 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of CM2–CM21**

37 **NEPA Effects:** Effects of CM2–CM21 on boron under Alternative 9 would be the same as those
38 discussed for Alternative 1A and are determined to be not adverse.

39 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
40 measures proposed under Alternative 1A. As such, effects on boron resulting from the
41 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
42 This impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
2 **Maintenance (CM1)**

3 ***Upstream of the Delta***

4 Under Alternative 9 there would be no expected change to the sources of bromide in the Sacramento
5 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
6 and resultant changes in flows from altered system-wide operations under Alternative 9 would have
7 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
8 watersheds. Consequently, Alternative 9 would not be expected to adversely affect the MUN
9 beneficial use, or any other beneficial uses, of the Sacramento River, the eastside tributaries, or their
10 associated reservoirs upstream of the Delta.

11 Under Alternative 9, modeling indicates that long-term annual average flows on the San Joaquin
12 River would decrease by 6%, relative to Existing Conditions and would remain virtually the same
13 relative to the No Action Alternative (see Appendix 5A, *BDCP/California WaterFix FEIR/FEIS*
14 *Modeling Technical Appendix*). These decreases in flow would result in possible increases in long-
15 term average bromide concentrations of about 3% relative to Existing Conditions and less than <1%
16 relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 24). The small increases in lower
17 San Joaquin River bromide levels that could occur under Alternative 9, relative to existing and No
18 Action Alternative conditions would not be expected to adversely affect the MUN beneficial use, or
19 any other beneficial uses, of the lower San Joaquin River.

20 ***Delta***

21 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
22 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
23 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
24 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
25 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
26 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
27 information.

28 Using the mass-balance modeling approach for bromide (see Section 8.3.1.3), relative to Existing
29 Conditions, Alternative 9 would result in increases in long-term average bromide concentrations at
30 Buckley Cove (for the modeled drought period only), Emmaton, and Barker Slough, while long-term
31 average concentrations would decrease at the other assessment locations (Appendix 8E, *Bromide*,
32 Table 20). With regard to bromide, Emmaton is a suitable source of raw drinking water on a
33 seasonal basis. While the relative change in long-term average bromide concentration at Emmaton is
34 considerable ($\leq 32\%$), the increase in the average would be due to more frequent seasonal peak
35 concentrations in excess of 1,000 $\mu\text{g}/\text{L}$ relative to Existing Conditions, particularly during October
36 through December (Appendix 8E, *Bromide*, Figure 2). At Emmaton the predicted 50 $\mu\text{g}/\text{L}$ exceedance
37 frequency would increase only slightly from 82% under Existing Conditions to 86% under
38 Alternative 9 (98% to 100% for the modeled drought period), and the predicted 100 $\mu\text{g}/\text{L}$
39 exceedance frequency would increase from 72% under Existing Conditions to 81% under
40 Alternative 9 (93% to 97% for the modeled drought period), indicative of very small changes during
41 seasonally suitable periods of potential use. At Barker Slough, predicted long-term average bromide
42 concentrations would increase from 51 $\mu\text{g}/\text{L}$ to 61 $\mu\text{g}/\text{L}$ (19% relative increase) for the modeled 16-
43 year hydrologic period and 54 $\mu\text{g}/\text{L}$ to 100 $\mu\text{g}/\text{L}$ (88% relative increase) for the modeled drought
44 period. At Barker Slough, the predicted 50 $\mu\text{g}/\text{L}$ exceedance frequency would decrease from 49%

1 under Existing Conditions to 41% under Alternative 9, but would increase from 55% to 80% during
2 the drought period. At Barker Slough, the predicted 100 µg/L exceedance frequency would increase
3 from 0% under Existing Conditions to 16% under Alternative 9, and would increase from 0% to
4 42% during the drought period. At Buckley Cove, predicted long-term average bromide
5 concentrations would remain the same (i.e., 259 µg/L), but would increase from 272 µg/L to 330
6 µg/L (21% relative increase) for the modeled drought period. At Buckley Cove, the predicted 50
7 µg/L exceedance frequency would not change (i.e., 100% exceedance), but the modeled 100 µg/L
8 exceedance frequency would decrease from 100% under Existing Conditions to 90% under
9 Alternative 9 (100% to 87% for the modeled drought period). This comparison to Existing
10 Conditions reflects changes in bromide due to both Alternative 9 operations (including use of
11 operable barriers and numerous other components of Operational Scenario G) and climate
12 change/sea level rise.

13 Due to the relatively small differences between modeled Existing Conditions and No Action
14 baselines, changes in long-term average bromide concentrations and changes in exceedance
15 frequencies relative to the No Action Alternative would be generally of similar magnitude to those
16 previously described for the Existing Conditions comparison (Appendix 8E, *Bromide*, Table 20).
17 Modeled long-term average bromide concentration at Emmaton would increase by as much as 36%,
18 but change in 50 and 100 µg/L exceedance thresholds would be smaller than that described for the
19 Existing Conditions comparison, indicative of very small changes during seasonally suitable periods
20 of potential use. Modeled long-term average bromide concentration at Barker Slough is predicted to
21 increase by 23% (87% for the modeled drought period) relative to the No Action Alternative.
22 Modeled long-term average bromide concentration increases at Buckley Cove are predicted to
23 increase by 7% (36% for the modeled drought period) relative to the No Action Alternative. Unlike
24 the comparison to Existing Conditions, this comparison to the No Action Alternative reflects changes
25 in bromide due only to Alternative 9 operations.

26 At Barker Slough, modeled long-term average bromide concentrations for the various baseline
27 conditions are very similar ($\leq 4\%$) (Appendix 8E, *Bromide*, Table 20). Such similarity demonstrates
28 that the modeled Alternative 9 change in bromide is almost entirely due to Alternative 9 operations,
29 and not climate change/sea level rise. Therefore, operations are the primary driver of effects on
30 bromide at Barker Slough, regardless whether Alternative 9 is compared to Existing Conditions, or
31 compared to the No Action Alternative.

32 Results of the modeling approach which used relationships between EC and chloride and between
33 chloride and bromide (see Section 8.3.1.3) differed somewhat from what is presented above for the
34 mass-balance approach (see Appendix 8E, *Bromide*, Table 21). For most locations, the frequency of
35 exceedance of the 50 µg/L and 100 µg/L were similar. The greatest difference between the methods
36 was predicted for Barker Slough. The increases in frequency of exceedance of the 100 µg/L
37 threshold, relative to Existing Conditions and the No Action Alternative, were not as great using this
38 alternative EC to chloride and chloride to bromide relationship modeling approach as compared to
39 that presented above from the mass-balance modeling approach. However, there were still
40 substantial increases, resulting in 9% exceedance over the modeled period under Alternative 9, as
41 compared to 1% under Existing Conditions and 2% under the No Action Alternative. For the drought
42 period, exceedance frequency increased from 0% under Existing Conditions and the No Action
43 Alternative, to 23% under Alternative 9. Furthermore, concentrations predicted at Buckley Cove also
44 differed. The EC to chloride and chloride to bromide relationship modeling approach predicted that
45 concentrations at Buckley cove would decrease under Alternative 9 on both a long term basis and
46 under the modeled drought period, relative to Existing Conditions and the No Action Alternative.

1 This is in contrast to the mass-balance approach presented above, which predicted an increase in
2 concentrations under the drought period. Because the mass-balance approach predicts a greater
3 level of impact at Barker Slough, determination of impacts was based on the mass-balance results.

4 While the increase in long-term average bromide concentrations at Buckley Cove are relatively
5 small when modeled over a representative 16-year hydrologic period, increases during the modeled
6 drought period, principally the long-term average bromide concentration greater than 300 µg/L,
7 would represent a substantial change in source water quality to the City of Stockton during a season
8 of drought. Additionally, the increase in long-term average bromide concentrations predicted at
9 Barker Slough, principally the relative increase in 100 µg/L exceedance frequency, would result in a
10 substantial change in source water quality for existing drinking water treatment plants drawing
11 water from the North Bay Aqueduct. While the implications of such modeled changes in bromide
12 concentrations at Buckley Cove and Barker Slough is difficult to predict, the substantial modeled
13 increases could lead to adverse changes in the formation of disinfection byproducts such that
14 considerable treatment plant upgrades may be necessary in order to achieve equivalent levels of
15 health protection. Because many of the other modeled locations already frequently exceed the 100
16 µg/L threshold under Existing Conditions and the No Action Alternative, these locations likely
17 already require treatment plant technologies to achieve equivalent levels of health protection, and
18 thus no additional treatment technologies would be triggered by the small increases in the
19 frequency of exceeding the 100 µg/L threshold. Hence, no further impact on the drinking water
20 beneficial use would be expected at these locations.

21 The seasonal intakes at Mallard Slough and City of Antioch are infrequently used due to water
22 quality constraints related to sea water intrusion. On a long-term average basis, bromide at these
23 locations is in excess of 3,000 µg/L, but during seasonal periods of high Delta outflow can be <300
24 µg/L. Based on modeling using the mass-balance approach, use of the seasonal intakes at Mallard
25 Slough and City of Antioch under Alternative 9 would experience a period average increase in
26 bromide during the months when these intakes would most likely be utilized. For those wet and
27 above normal water year types where mass balance modeling would predict water quality typically
28 suitable for diversion, predicted long-term average bromide would increase from 103 µg/L to 140
29 µg/L (37% increase) at City of Antioch and would decrease from 150 µg/L to 146 µg/L (3%
30 decrease) at Mallard Slough relative to Existing Conditions (Appendix 8E, *Bromide*, Table 25).
31 Changes would be similar for the No Action Alternative comparison. Modeling results using the EC to
32 chloride and chloride to bromide relationships show increases during these months, but the relative
33 magnitude of the increases is much lower (Appendix 8E, *Bromide*, Table 26). Regardless of the
34 differences in the data between the two modeling approaches, the decisions surrounding the use of
35 these seasonal intakes is largely driven by acceptable water quality, and thus have historically been
36 opportunistic. Opportunity to use these intakes would remain, and the predicted increases in
37 bromide concentrations at the City of Antioch and Mallard Slough intake would not be expected to
38 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

39 Based on modeling using the mass-balance approach, relative to existing and No Action Alternative
40 conditions, Alternative 9 would lead to predicted improvements in long-term average bromide
41 concentrations at Staten Island, Franks Tract, Rock Slough, and Contra Costa PP No. 1, in addition to
42 Banks and Jones (discussed below). At Staten Island and Franks Tract, long-term average bromide
43 concentrations would be predicted to decrease by 4–21% depending on baseline comparison, while
44 at Rock Slough and Contra Costa PP No.1, long-term average bromide concentrations would be
45 predicted to decrease by 40–45%, depending on baseline comparison. Modeling results using the EC
46 to chloride and chloride to bromide relationships generally do not show similar decreases for Rock

1 Slough and Contra Costa PP No. 1, but rather, predict small increases. Based on the small magnitude
2 of increases predicted, these increases would not adversely affect beneficial uses at those locations.

3 Important to the results presented above is the assumed habitat restoration footprint on both the
4 temporal and spatial scales incorporated into the modeling. Modeling sensitivity analyses have
5 indicated that habitat restoration (which are reflected in the modeling—see Section 8.3.1.3), not
6 operations covered under CM1, are the driving factor in the modeled bromide increases. The timing,
7 location, and specific design of habitat restoration will have effects on Delta hydrodynamics, and any
8 deviations from modeled habitat restoration and implementation schedule will lead to different
9 outcomes. Although habitat restoration near Barker Slough is an important factor contributing to
10 modeled bromide concentrations at the North Bay Aqueduct, BDCP habitat restoration elsewhere in
11 the Delta can also have large effects. Because of these uncertainties, and the possibility of adaptive
12 management changes to BDCP restoration activities, including location, magnitude, and timing of
13 restoration, the estimates are not predictive of the bromide levels that would actually occur in
14 Barker Slough or elsewhere in the Delta.

15 ***SWP/CVP Export Service Areas***

16 Under Alternative 9, improvement in long-term average bromide concentrations would occur at the
17 Banks and Jones pumping plants, with exception to the modeled drought period when compared the
18 No Action Alternative. Long-term average bromide concentrations for the modeled 16-year
19 hydrologic period at these locations would decrease by as much as 21% relative to Existing
20 Conditions and 9% relative to the No Action Alternative (Appendix 8E, *Bromide*, Table 20). However,
21 during the modeled drought period, long-term average bromide concentrations would increase by
22 as much as 12% relative to the No Action Alternative. Exceedances of the 50 µg/L assessment
23 threshold would remain virtually the same for both Banks and Jones, but exceedance of the 100
24 µg/L assessment threshold would decrease, from 100% to 81% at Banks and from 100% to 80% at
25 Jones (100% to 77% for the modeled drought period at both Banks and Jones). Lower long-term
26 average bromide concentrations at Banks and Jones would result in overall improvement in Export
27 Service Areas water quality respective to bromide. Commensurate with the decrease in exported
28 bromide, an improvement in lower San Joaquin River bromide would also be observed since
29 bromide in the lower San Joaquin River is principally related to irrigation water deliveries from the
30 Delta. While the magnitude of this expected lower San Joaquin River improvement in bromide is
31 difficult to predict, the relative decrease in overall loading of bromide to the Export Service Areas
32 would likely alleviate or lessen any expected increase in bromide concentrations at Vernalis (see
33 discussion of Upstream of the Delta) as well as locations in the Delta receiving a large fraction of San
34 Joaquin River water, such as much of the south Delta.

35 The discussion above is based on results of the mass-balance modeling approach. Results of the
36 modeling approach which used relationships between EC and chloride and between chloride and
37 bromide (see Section 8.3.1.3) were consistent with the discussion above, and assessment of bromide
38 using these data results in the same conclusions as are presented above for the mass-balance
39 approach (see Appendix 8E, *Bromide*, Table 21).

40 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
41 facilities under Alternative 9 would not be expected to create new sources of bromide or contribute
42 towards a substantial change in existing sources of bromide in the affected environment.
43 Maintenance activities would not be expected to cause any substantial change in bromide such that

1 MUN beneficial uses, or any other beneficial use, would be adversely affected anywhere in the
2 affected environment.

3 **NEPA Effects:** In summary, Alternative 9 operations and maintenance, relative to the No Action
4 Alternative, would result in small increases (i.e., <1%) in long-term average bromide concentrations
5 at Vernalis related to relatively small declines in long-term average flow on the San Joaquin River.
6 However, Alternative 9 operation and maintenance activities would cause substantial degradation
7 to water quality with respect to bromide at Barker Slough, source of the North Bay Aqueduct.
8 Resultant substantial change in long-term average bromide at Barker Slough could necessitate
9 changes in water treatment plant operations or require treatment plant upgrades in order to
10 maintain DBP compliance, and thus would constitute an adverse effect on water quality. Mitigation
11 Measure WQ-5 is available to reduce these effects (implementation of this measure along with a
12 separate other commitment as set forth in Appendix 3B, *Environmental Commitments, AMMs, and*
13 *CMs*, relating to the potential increased treatment costs associated with bromide-related changes
14 would reduce these effects).

15 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
16 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
17 purpose of making the CEQA impact determination for this constituent. For additional details on the
18 effects assessment findings that support this CEQA impact determination, see the effects assessment
19 discussion that immediately precedes this conclusion.

20 Under Alternative 9 there would be no expected change to the sources of bromide in the Sacramento
21 and eastside tributary watersheds. Bromide loading in these watersheds would remain unchanged
22 and resultant changes in flows from altered system-wide operations under Alternative 9 would have
23 negligible, if any, effects on the concentration of bromide in the rivers and reservoirs of these
24 watersheds. However, south of the Delta, the San Joaquin River is a substantial source of bromide,
25 primarily due to the use of irrigation water imported from the southern Delta. Concentrations of
26 bromide at Vernalis are inversely correlated to net river flow. Under Alternative 9, long-term
27 average flows at Vernalis would decrease only slightly, resulting in less than substantial predicted
28 increases in long-term average bromide of about 3% relative to Existing Conditions.

29 Relative to Existing Conditions, Alternative 9 would result in modeled increases in long-term
30 average bromide concentration at Buckley Cove (for the drought period only), Barker Slough, and
31 Emmaton. While the relative change in long-term average bromide concentration at Emmaton is
32 considerable ($\leq 32\%$), the increase in the average would be due to more frequent seasonal peak
33 concentrations in excess of 1,000 $\mu\text{g}/\text{L}$ relative to Existing Conditions, rather than substantial
34 increases during seasonally suitable periods of potential use. However, substantial increases in long-
35 term average bromide at Barker Slough and Buckley Cove (i.e., vicinity of the City of Stockton's
36 drinking water intake) during a season of drought could lead to adverse changes in the formation of
37 disinfection byproducts at drinking water treatment plants such that considerable water treatment
38 plant upgrades would be necessary in order to achieve equivalent levels of drinking water health
39 protection.

40 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
41 of changes in bromide concentrations at Banks and Jones pumping plants. Under Alternative 9,
42 substantial improvement would occur at the Banks and Jones pumping plants, where predicted
43 long-term average bromide concentrations are predicted to decrease by as much as 21% relative to

1 Existing Conditions. An overall improvement in bromide-related water quality would be predicted
2 in the SWP/CVP Export Service Areas.

3 Based on the above, Alternative 9 operation and maintenance would not result in any substantial
4 change in long-term average bromide concentration upstream of the Delta. Furthermore, under
5 Alternative 9, water exported from the Delta to the SWP/CVP service area would be substantially
6 improved relative to bromide. Bromide is not bioaccumulative, therefore change in long-term
7 average bromide concentrations would not directly cause bioaccumulative problems in aquatic life
8 or humans. Additionally, bromide is not a constituent related to any 303(d) listings. Alternative 9
9 operation and maintenance activities would not cause substantial long-term degradation to water
10 quality respective to bromide with the exception of water quality at Buckley Cove (drought period
11 only) and Barker Slough. At Buckley Cove, modeled long-term annual average concentrations of
12 bromide would increase from 272 µg/L to 330 µg/L (21% relative increase) during the modeled
13 drought period. At Barker Slough, modeled long-term annual average concentrations of bromide
14 would increase from 54 µg/L to 100 µg/L (88% relative increase) for the modeled drought period.
15 Furthermore, for Barker Slough the frequency of predicted bromide concentrations exceeding 100
16 µg/L would increase from 0% under Existing Conditions to 16% under Alternative 9 (0% to 42% for
17 the modeled drought period). Substantial changes in long-term average bromide at these locations
18 could necessitate changes in treatment plant operation or require treatment plant upgrades in order
19 to maintain DBP compliance. The model predicted change at Buckley Cove during the drought
20 period and at Barker Slough is substantial and, therefore, would represent a substantially increased
21 risk for adverse effects on existing MUN beneficial uses should treatment upgrades not be
22 undertaken. The impact is considered significant. However, there is no feasible mitigation available
23 for identified impacts at Buckley Cove, which would remain significant and unavoidable during
24 drought periods.

25 Implementation of Mitigation Measure WQ-5 along with a separate other commitment relating to
26 the potential increased treatment costs associated with bromide-related changes would reduce
27 these effects. While mitigation measures to reduce these water quality effects in affected water
28 bodies to less-than-significant levels are not available, implementation of Mitigation Measure WQ-5
29 is recommended to attempt to reduce the effect that increased bromide concentrations may have on
30 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
31 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
32 significant and unavoidable. Please see Mitigation Measure WQ-5 under Impact WQ-5 in the
33 discussion of Alternative 1A.

34 In addition to and to supplement Mitigation Measure WQ-5, the BDCP proponents have incorporated
35 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
36 separate othercommitment to address the potential increased water treatment costs that could
37 result from bromide-related concentration effects on municipal water purveyor operations.
38 Potential options for making use of this financial commitment include funding or providing other
39 assistance towards implementation of the North Bay Aqueduct AIP, acquiring alternative water
40 supplies, or other actions to indirectly reduce the effects of elevated bromide and DOC in existing
41 water supply diversion facilities. Please refer to Appendix 3B for the full list of potential actions that
42 could be taken pursuant to this commitment in order to reduce the water quality treatment costs
43 associated with water quality effects relating to chloride, electrical conductivity, and bromide.

1 **Mitigation Measure WQ-5: Avoid, Minimize, or Offset, as Feasible, Adverse Water Quality**
 2 **Conditions**

3 Please see Mitigation Measure WQ-5 under Impact WQ-5 in the discussion of Alternative 1A.

4 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of CM2–**
 5 **CM21**

6 **NEPA Effects:** CM2–CM21 under Alternative 9 would be similar to conservation measures under
 7 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. As
 8 discussed for Alternative 1A, implementation of CM2–CM21 would not present new or substantially
 9 changed sources of bromide to the study area. Some conservation measures may replace or
 10 substitute for existing irrigated agriculture in the Delta. This replacement or substitution is not
 11 expected to substantially increase or present new sources of bromide. CM2–CM21 would not be
 12 expected to cause any substantial change in bromide such that MUN beneficial uses, or any other
 13 beneficial use, would be adversely affected anywhere in the affected environment.

14 In summary, implementation of CM2–CM21 under Alternative 9, relative to the No Action
 15 Alternative, would have negligible, if any, effects on bromide concentrations. The effects on bromide
 16 from implementing CM2–CM21 are determined to not be adverse.

17 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 18 measures proposed under Alternative 1A. As discussed for Alternative 1A, implementation of CM2–
 19 CM21 would not present new or substantially changed sources of bromide to the study area. As
 20 such, effects on bromide resulting from the implementation of CM2–CM21 would be similar to those
 21 previously discussed for Alternative 1A. This impact is considered to be less than significant. No
 22 mitigation is required.

23 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
 24 **Maintenance (CM1)**

25 ***Upstream of the Delta***

26 Under Alternative 9 there would be no expected change to the sources of chloride in the Sacramento
 27 and eastside tributary watersheds. Chloride loading in these watersheds would remain unchanged
 28 and resultant changes in flows from altered system-wide operations would have negligible, if any,
 29 effects on the concentration of chloride in the rivers and reservoirs of these watersheds. The
 30 modeled long-term annual average flows on the lower San Joaquin River at Vernalis would decrease
 31 slightly compared to Existing Conditions and be similar compared to the No Action Alternative (as a
 32 result of climate change). The reduced flow would result in possible increases in long-term average
 33 chloride concentrations of about 2%, relative to the Existing Conditions and no change relative to No
 34 Action Alternative (Appendix 8G, *Chloride*, Table Cl-62). Consequently, Alternative 9 would not be
 35 expected to cause exceedance of chloride objectives/criteria or substantially degrade water quality
 36 with respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento
 37 River, the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

38 ***Delta***

39 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 40 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 41 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are

1 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
2 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
3 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
4 information.

5 Relative to the Existing Conditions and No Action Alternative, Alternative 9 would result in similar
6 or reduced long-term average chloride concentrations for the 16-year period modeled at some of
7 the assessment locations, and, depending on the modeling approach (see Section 8.3.1.3), increased
8 concentrations at the North Bay Aqueduct at Barker Slough (i.e., up to 20% compared to No Action
9 Alternative), Contra Costa Canal at Pumping Plant #1 (i.e., up to 23% compared to No Action
10 Alternative), Rock Slough (i.e., up to 20% compared to No Action Alternative), Franks Tract (i.e., up
11 to 29% compared to No Action Alternative), Sacramento River at Emmaton (i.e., up to 25%
12 compared to No Action Alternative), Sacramento River at Mallard Island (i.e., up to 6% compared to
13 No Action Alternative), and North Bay Aqueduct at Barker Slough (i.e., up to 18% compared to No
14 Action Alternative)(Appendix 8G, *Chloride*, Tables Cl-55 and Cl-56). Moreover, the direction and
15 magnitude of predicted changes for Alternative 9 are similar between the alternatives, thus, the
16 effects relative to Existing Conditions and the No Action Alternative are discussed together.
17 Additionally, implementation of tidal habitat restoration under CM4 would increase the tidal
18 exchange volume in the Delta, and thus may contribute to increased chloride concentrations in the
19 Bay source water as a result of increased salinity intrusion. More discussion of this phenomenon is
20 included in Section 8.3.1.3. Consequently, while uncertain, the magnitude of chloride increases may
21 be greater than indicated herein and would affect the western Delta assessment locations the most
22 which are influenced to the greatest extent by the Bay source water. The comparison to Existing
23 Conditions reflects changes in chloride due to both Alternative 9 operations (including use of
24 operable barriers and numerous other components of Operational Scenario G) and climate
25 change/sea level rise. The comparison to the No Action Alternative reflects changes in chloride due
26 only to operations. The following outlines the modeled chloride changes relative to the applicable
27 objectives and beneficial uses of Delta waters.

28 *Municipal Beneficial Uses*

29 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
30 (see Section 8.3.1.3) were used to evaluate the 150 mg/L Bay-Delta WQCP objective for municipal
31 and industrial beneficial uses on a basis of the percentage of years the chloride objective is exceeded
32 for the modeled 16-year period. The objective is exceeded if chloride concentrations exceed 150
33 mg/L for a specified number of days in a given water year at both the Antioch and Contra Costa
34 Pumping Plant #1 locations. For Alternative 9, the modeled frequency of objective exceedance
35 would increase from 7% of years under Existing Conditions and 0% under the No Action Alternative
36 to 13% of years under Alternative 9 (Appendix 8G, *Chloride*, Table Cl-64).

37 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
38 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
39 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
40 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
41 year period. For Alternative 9, the modeled frequency of objective exceedance would decrease, from
42 6% of modeled days under Existing Conditions and 5% under the No Action Alternative to 1% of
43 modeled days under Alternative 9 (Appendix 8G, *Chloride*, Table Cl-63).

1 Given the limitations inherent to estimating future chloride concentrations (see Section 8.3.1.3),
2 estimation of chloride concentrations through both an mass balance approach and an EC-chloride
3 relationship approach was used to evaluate the 250 mg/L Bay-Delta WQCP objectives in terms of
4 both frequency of exceedance and use of assimilative capacity. When utilizing the mass balance
5 approach to model monthly average chloride concentrations for the 16-year period, the predicted
6 frequency of exceeding the 250 mg/L objective would be eliminated at the Contra Costa Canal at
7 Pumping Plant #1 (24% for Existing Conditions to 0% under Alternative 9), thus indicating
8 complete compliance with this objective would be achieved (Appendix 8G, *Chloride*, Table Cl-57 and
9 Figure Cl-13). Compared to Existing Conditions, the frequency of exceedances would not change
10 substantially at the San Joaquin River at Antioch (i.e., increase of 2% from 66% to 68%) or at
11 Mallard Island (i.e., increase 6% from 77% to 83%) and would be similar, or decrease, compared to
12 the No Action Alternative (Appendix 8G, Table Cl-57), and there would be no substantial long-term
13 degradation (Appendix 8G, Table Cl-59).

14 In comparison, when utilizing the chloride-EC relationship to model monthly average chloride
15 concentrations for the 16-year period, trends in frequency of exceedance generally agreed, but use
16 of assimilative capacity were predicted to be larger at some locations (Appendix 8G, *Chloride*, Tables
17 Cl-58 and Cl-60). Specifically, while the model predicted exceedance frequency would decrease at
18 the Contra Costa Canal at Pumping Plant #1, Rock Slough, and Franks Tract locations, use of
19 assimilative capacity would increase substantially for the months of February through July at Rock
20 at the Contra Costa Canal at Pumping Plant #1 (i.e., maximum of 79% in March and April for the
21 modeled drought period) and at the San Joaquin River in March and April (i.e., 13% and 14%,
22 respectively). Due to such seasonal long-term average water quality degradation at these locations,
23 the potential exists for substantial adverse effects on the municipal and industrial beneficial uses
24 through reduced opportunity for diversion of water with acceptable chloride levels. Moreover, due
25 to the increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective, the potential
26 exists for adverse effects on the municipal and industrial beneficial uses at Contra Costa Pumping
27 Plant #1 and Antioch.

28 *303(d) Listed Water Bodies*

29 With respect to the 303(d) listing for chloride in Tom Paine Slough, the monthly average chloride
30 concentrations for the 16-year period modeled at Old River at Tracy Road, which represents the
31 nearest DSM2-modeled location to Tom Paine in the south Delta, would generally be similar
32 compared to Existing Conditions and No Action Alternative, and thus, would not be further degraded
33 on a long-term basis (Appendix 8G, Figure Cl-14).

34 With respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
35 modeled would generally increase compared to Existing Conditions and No Action Alternative in
36 some months during October through May at the Sacramento River at Collinsville (Appendix 8G,
37 Figure Cl-15), Mallard Island (Appendix 8G, Figure Cl-13), and increase substantially at Montezuma
38 Slough at Beldon's Landing (i.e., over a doubling of concentration in December through February)
39 (Appendix 8G, Figure Cl-16). Although modeling of Alternative 9 assumed no operation of the
40 Montezuma Slough Salinity Control Gates, the project description assumes continued operation of
41 the Salinity Control Gates, consistent with assumptions included in the No Action Alternative. A
42 sensitivity analysis modeling run conducted for Alternative 4 with the gates operational consistent
43 with the No Action Alternative resulted in substantially lower EC levels than indicated in the original
44 Alternative 4 modeling results for Suisun Marsh, but EC levels were still somewhat higher than EC
45 levels under Existing Conditions for several locations and months. Although chloride was not

1 specifically modeled in this sensitivity analysis, it is expected that chloride concentrations would be
2 nearly proportional to EC levels in Suisun Marsh. Another modeling run with the gates operational
3 and restoration areas removed resulted in EC levels nearly equivalent to Existing Conditions,
4 indicating that design and siting of restoration areas has notable bearing on EC levels at different
5 locations within Suisun Marsh (see Appendix 8H, Attachment 1, for more information on these
6 sensitivity analyses). These analyses also indicate that increases in salinity are related primarily to
7 the hydrodynamic effects of CM4, not operational components of CM1. Based on the sensitivity
8 analyses, optimizing the design and siting of restoration areas may limit the magnitude of long-term
9 chloride increases in the Marsh. However, the chloride concentration increases at certain locations
10 could be substantial, depending on siting and design of restoration areas. Thus, these increased
11 chloride levels in Suisun Marsh are considered to contribute to additional, measureable long-term
12 degradation that potentially would adversely affect the necessary actions to reduce chloride loading
13 for any TMDL that is developed.

14 ***SWP/CVP Export Service Areas***

15 Under Alternative 9, long-term average chloride concentrations based on the mass balance analysis
16 of modeling results for the 16-year period modeled at the Banks and Jones pumping plants would
17 decrease by as much as 21% relative to Existing Conditions and 10% compared to No Action
18 Alternative (Appendix 8G, *Chloride*, Table Cl-55). The modeled frequency of exceedances of
19 applicable water quality objectives/criteria would decrease relative to Existing Conditions and No
20 Action Alternative, for both the 16-year period and the drought period modeled (Appendix 8G,
21 *Chloride*, Table Cl-57). Consequently, water exported into the SWP/CVP service area would
22 generally be of similar or better quality with regards to chloride relative to Existing Conditions and
23 the No Action Alternative conditions.

24 Results of the modeling approach which used relationships between EC and chloride (see Section
25 8.3.1.3) were consistent with the discussion above, and assessment of chloride using these data
26 results in the same conclusions as are presented above for the mass-balance approach (Appendix
27 8G, Tables Cl-56 and Cl-58).

28 Commensurate with the reduced chloride concentrations in water exported to the service area,
29 reduced chloride loading in the lower San Joaquin River would be anticipated which would likely
30 alleviate or lessen any expected increase in chloride at Vernalis related to decreased annual average
31 San Joaquin River flows (see discussion of Upstream of the Delta).

32 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
33 contribute towards a substantial change in existing sources of chloride in the affected environment.
34 Maintenance activities would not be expected to cause any substantial change in chloride such that
35 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
36 affected anywhere in the affected environment.

37 ***NEPA Effects:*** In summary, relative to the No Action Alternative conditions, Alternative 9 would
38 result in additional exceedances of the 150 mg/L Bay-Delta WCCP objective at Contra Costa
39 Pumping Plant #1 and Antioch, substantial seasonal use of assimilative capacity at Contra Costa
40 Pumping Plant #1, Rock Slough and Franks Tract, and potentially measureable water quality
41 degradation relative to the 303(d) impairment in Suisun Marsh. The predicted chloride increases
42 constitute an adverse effect on water quality (see Mitigation Measure WQ-7; implementation of this
43 measure along with a separate other commitment relating to the potential increased chloride
44 treatment costs would reduce these effects). Additionally, the predicted changes relative to the No

1 Action Alternative conditions indicate that in addition to the effects of climate change/sea level rise,
2 implementation of CM1 and CM4 under Alternative 9 would contribute substantially to the adverse
3 water quality effects.

4 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
5 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
6 purpose of making the CEQA impact determination for this constituent. For additional details on the
7 effects assessment findings that support this CEQA impact determination, see the effects assessment
8 discussion that immediately precedes this conclusion.

9 Chloride is not a constituent of concern in the Sacramento River watershed upstream of the Delta,
10 thus river flow rate and reservoir storage reductions that would occur under the Alternative 9,
11 relative to Existing Conditions, would not be expected to result in a substantial adverse change in
12 chloride levels. Additionally, relative to Existing Conditions, the Alternative 9 would not result in
13 reductions in river flow rates (i.e., less dilution) or increased chloride loading such that there would
14 be any substantial increase in chloride concentrations upstream of the Delta in the San Joaquin River
15 watershed.

16 Relative to Existing Conditions, Alternative 9 operations would result in substantially reduced
17 chloride concentrations in the Delta such that exceedances of the 250 mg/L Bay-Delta WQCP
18 objective at the San Joaquin River at Antioch and Mallard Slough would be reduced. Nevertheless,
19 due to the predicted increased frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at
20 Contra Costa Pumping Plant #1 and Antioch as well as substantial seasonal use of assimilative
21 capacity at Contra Costa Pumping Plant #1 and Antioch, the potential exists for adverse effects on the
22 municipal and industrial beneficial uses (see Mitigation Measure WQ-7; implementation of this
23 measure along with a separate other commitment relating to the potential increased chloride
24 treatment costs would reduce these effects). Moreover, the modeled increased chloride
25 concentrations and degradation in the western Delta could further contribute, at measurable levels,
26 to the existing 303(d) listed impairment due to chloride in Suisun Marsh for the protection of fish
27 and wildlife.

28 Chloride concentrations would be reduced in water exported from the Delta to the CVP/SWP Export
29 Service Areas, thus reflecting a potential improvement to chloride loading in the lower San Joaquin
30 River.

31 Chloride is not a bioaccumulative constituent, thus any increased concentrations under Alternative
32 9 would not result in substantial chloride bioaccumulation impacts on aquatic life or humans.
33 Alternative 9 maintenance would not result in any substantial changes in chloride concentration
34 upstream of the Delta or in the SWP/CVP Export Service Areas. However, based on these findings,
35 this impact is determined to be significant due to increased chloride concentrations and frequency
36 of objective exceedance in the western Delta, as well as potential adverse effects on fish and wildlife
37 beneficial uses in Suisun Marsh.

38 While mitigation measures to reduce these water quality effects in affected water bodies to less-
39 than-significant levels are not available, implementation of Mitigation Measure WQ-7 is
40 recommended to attempt to reduce the effect that increased chloride concentrations may have on
41 Delta beneficial uses. However, because the effectiveness of this mitigation measure to result in
42 feasible measures for reducing water quality effects is uncertain, this impact is considered to remain
43 significant and unavoidable. Please see Mitigation Measure WQ-7 under Impact WQ-7 in the
44 discussion of Alternative 1A.

1 In addition to and to supplement Mitigation Measure WQ-7, the BDCP proponents have incorporated
 2 into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments, AMMs, and CMs*, a
 3 separate other commitment to address the potential increased water treatment costs that could
 4 result from chloride concentration effects on municipal, industrial and agricultural water purveyor
 5 operations. Potential options for making use of this financial commitment include funding or
 6 providing other assistance towards acquiring alternative water supplies or towards modifying
 7 existing operations when chloride concentrations at a particular location reduce opportunities to
 8 operate existing water supply diversion facilities. Please refer to Appendix 3B for the full list of
 9 potential actions that could be taken pursuant to this commitment in order to reduce the water
 10 quality treatment costs associated with water quality effects relating to chloride, electrical
 11 conductivity, and bromide.

12 **Mitigation Measure WQ-7: Conduct Additional Evaluation and Modeling of Increased**
 13 **Chloride Levels and Develop and Implement Phased Mitigation Actions**

14 Please see Mitigation Measure WQ-7 under Impact WQ-7 in the discussion of Alternative 1A.

15 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of CM2–**
 16 **CM21**

17 **NEPA Effects:** Under Alternative 9, the types and geographic extent of effects on chloride
 18 concentrations in the Delta as a result of implementation of the other conservation measures (i.e.,
 19 CM2–CM21) would be similar to, and undistinguishable from, those effects previously described for
 20 Alternative 1A. The conservation measures would present no new direct sources of chloride to the
 21 affected environment. Moreover, some habitat restoration conservation measures (CM4–10) would
 22 occur on lands within the Delta currently used for irrigated agriculture, thus replacing agricultural
 23 land uses with restored tidal wetlands, floodplain, and related channel margin and off-channel
 24 habitats. The potential reduction in irrigated lands within the Delta may result in reduced
 25 discharges of agricultural field drainage with elevated chloride concentrations, which would be
 26 considered an improvement compared to Existing Conditions and No Action Alternative conditions.

27 In summary, based on the discussion above, the effects on chloride from implementing CM2-CM21
 28 are considered to be not adverse.

29 **CEQA Conclusion:** Implementation of the CM2–CM21 for Alternative 9 would not present new or
 30 substantially changed sources of chloride to the affected environment upstream of the Delta, within
 31 Delta, or in the SWP/CVP service area. Replacement of irrigated agricultural land uses in the Delta
 32 with habitat restoration conservation measures may result in some reduction in discharge of
 33 agricultural field drainage with elevated chloride concentrations, thus resulting in improved water
 34 quality conditions. Based on these findings, this impact is considered to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 37 **Maintenance (CM1)**

38 **NEPA Effects:** Effects of CM1 on DO under Alternative 9 would be the same as those discussed for
 39 Alternative 1A and are determined to be not adverse.

40 **CEQA Conclusion:** Effects of CM1 on DO under Alternative 9 would be similar to those discussed for
 41 Alternative 1A, and are summarized here, then compared to the CEQA thresholds of significance

1 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 2 constituent. For additional details on the effects assessment findings that support this CEQA impact
 3 determination, see the effects assessment discussion under Alternative 1A.

4 Reservoir storage reductions that would occur under Alternative 9, relative to Existing Conditions,
 5 would not be expected to result in a substantial adverse change in DO levels in the reservoirs,
 6 because oxygen sources (surface water aeration, aerated inflows, vertical mixing) would remain.
 7 Similarly, river flow rate reductions that would occur would not be expected to result in a
 8 substantial adverse change in DO levels in the rivers upstream of the Delta, given that mean monthly
 9 flows would remain within the ranges historically seen under Existing Conditions and the affected
 10 river are large and turbulent. Any reduced DO saturation level that may be caused by increased
 11 water temperature would not be expected to cause DO levels to be outside of the range seen
 12 historically. Finally, amounts of oxygen demanding substances and salinity would not be expected to
 13 change sufficiently to affect DO levels.

14 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 15 Delta source water percentages under this alternative or substantial degradation of these water
 16 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state has
 17 begun to aggressively regulate the discharges of, and this loading would not be expected to lower DO
 18 levels relative to Existing Conditions based on historical DO levels. Further, the anticipated changes
 19 in salinity would have relatively minor effects on DO levels, and tidal exchange, which contribute to
 20 the reaeration of Delta waters would not be expected to change substantially.

21 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 22 Export Service Areas waters under Alternative 9, relative to Existing Conditions. Because the
 23 biochemical oxygen demand of the exported water would not be expected to substantially differ
 24 from that under Existing Conditions (due to ever increasing water quality regulations), canal
 25 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 26 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 27 downstream reservoirs.

28 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 29 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 30 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 31 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 32 uses would not be adversely affected. Various Delta waterways are 303(d)-listed for low DO, but
 33 because no substantial decreases in DO levels would be expected, greater degradation and DO-
 34 related impairment of these areas would not be expected. This impact would be less than significant.
 35 No mitigation is required.

36 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of CM2–CM21**

37 **NEPA Effects:** Effects of CM2–CM21 on DO under Alternative 9 would be the same as those
 38 discussed for Alternative 1A and are determined to be not adverse.

39 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 40 measures proposed under Alternative 1A. As such, effects on DO resulting from the implementation
 41 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
 42 considered to be less than significant. No mitigation is required.

1 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 2 **Operations and Maintenance (CM1)**

3 ***Upstream of the Delta***

4 For the same reasons stated for the No Action Alternative, EC levels (highs, lows, typical conditions)
 5 in the Sacramento River and its tributaries, the eastside tributaries, their associated reservoirs, and
 6 the San Joaquin River upstream of the Delta under Alternative 9 are not expected to be outside the
 7 ranges occurring under Existing Conditions or would occur under the No Action Alternative. Any
 8 minor changes in EC levels that could occur under Alternative 9 in water bodies upstream of the
 9 Delta would not be of sufficient magnitude, frequency and geographic extent that would cause
 10 adverse effects on beneficial uses or substantially degrade water quality with regard to EC.

11 ***Delta***

12 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 13 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 14 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 15 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 16 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 17 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 18 information.

19 Relative to Existing Conditions, Alternative 9 would result in an increase in the number of days the
 20 Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton, and the San
 21 Joaquin River at San Andreas Landing and Jersey Point (Appendix 8H, *Electrical Conductivity*, Table
 22 EC-9).

23 The percentage of days the Emmaton EC objective would be exceeded for the entire period modeled
 24 (1976–1991) would increase from 6% under Existing Conditions to 18% under Alternative 9, and
 25 the percentage of days out of compliance would increase from 11% under Existing Conditions to
 26 31% under Alternative 9.

27 The percentage of days the Jersey Point EC objective would be exceeded and the percentage of days
 28 out of compliance would increase from 0% under Existing Conditions to 2% under Alternative 9.
 29 The increase in percentage of days the San Andreas Landing EC objective would be exceeded and the
 30 percentage of days out of compliance would be <1%. These increases are minimal, and are not
 31 considered substantial, in light of overall modeling uncertainty.

32 Average EC levels at the western and southern Delta compliance locations, except at Emmaton in the
 33 western Delta, and S. Fork Mokelumne River at Terminous (an interior Delta location) would
 34 decrease from 1–33% for the entire period modeled and 2–33% during the drought period modeled
 35 (1987–1991) (Appendix 8H, *Electrical Conductivity*, Table EC-20). In the Sacramento River at
 36 Emmaton, average EC would increase 22% for the entire period modeled and 36% during the
 37 drought period modeled. In the San Joaquin River at San Andreas Landing, average EC would
 38 increase 16% for the entire period modeled and 33% during the drought period modeled. Average
 39 EC in the Sacramento River at Emmaton and San Joaquin River at San Andreas Landing would
 40 increase during all months (Appendix 8H, Table EC-20). In the San Joaquin River at Prisoners Point,
 41 average EC would increase 2% for the entire period modeled and 16% during the drought period
 42 modeled. Average EC at Prisoners Point would increase in September through December (Appendix

1 8H, Table EC-20). The western portion of the Delta—which is Clean Water Act section 303(d) listed
2 as impaired due to elevated EC—would have an increased frequency of exceedance of the Bay-Delta
3 WQCP objectives (Appendix 8H, Table EC-9) and long-term average EC levels at compliance
4 locations in this region would increase relative to Existing Conditions (Appendix 8H, Table EC-20).
5 Thus, Alternative 9 could contribute to additional impairment and potentially adversely affect
6 beneficial uses for section 303(d) listed Delta waterways, relative to Existing Conditions. The
7 comparison to Existing Conditions reflects changes in EC due to both Alternative 9 operations
8 (including use of operable barriers and numerous other components of Operational Scenario G) and
9 climate change/sea level rise.

10 Relative to the No Action Alternative, the change in percentage compliance with Bay-Delta WQCP EC
11 objectives under Alternative 9 would be similar to that described above relative to Existing
12 Conditions, except there would not be an increase in objective exceedance in the San Joaquin River
13 at Jersey Point. For the entire period modeled, average EC levels would increase in the Sacramento
14 River at Emmaton, and San Joaquin River at San Andreas Landing and Prisoners Point. The greatest
15 average EC increase would occur in the San Joaquin River at San Andreas Landing (22%); the
16 increase at Emmaton would be 21% and at Prisoners Point would be 12% (Appendix 8H, *Electrical*
17 *Conductivity*, Table EC-20). Similarly, during the drought period modeled, average EC would increase
18 at these locations. The greatest average EC increase during the drought period modeled also would
19 occur in the San Joaquin River at San Andreas Landing (33%); the average EC increase at Emmaton
20 would be 24% and at Prisoners Point would be 25% (Appendix 8H, Table EC-20). The western
21 portion of the Delta—which is Clean Water Act section 303(d) listed as impaired due to elevated EC—
22 would have an increased frequency of exceedance of the Bay-Delta WQCP objectives (Appendix 8H,
23 Table EC-9) and long-term average EC levels at this compliance location would increase relative to
24 the No Action Alternative (Appendix 8H, Table EC-20). Thus, Alternative 9 could contribute to
25 additional impairment and potentially adversely affect beneficial uses for section 303(d) listed Delta
26 waterways, relative to the No Action Alternative. The comparison to the No Action Alternative
27 reflects changes in EC due only to Alternative 9 operations (including use of operable barriers and
28 numerous other components of Operational Scenario G).

29 For Suisun Marsh, October–May is the period when Bay-Delta WQCP EC objectives for protection of
30 fish and wildlife apply. Long-term average EC would increase under Alternative 9, relative to
31 Existing Conditions, during the months of December through May by 0.2–0.4 mS/cm in the
32 Sacramento River at Collinsville (Appendix 8H, *Electrical Conductivity*, Table EC-21). In Montezuma
33 Slough at National Steel during January and February, long-term average EC would increase 0.1–0.2
34 mS/cm (Appendix 8H, Table EC-22). The most substantial increase would occur near Beldon
35 Landing, with long-term average EC levels increasing by 1.5–6.3 mS/cm, depending on the month,
36 nearly doubling and tripling during some months the long-term average EC relative to Existing
37 Conditions (Appendix 8H, Table EC-23). Sunrise Duck Club and Volanti Slough also would have long-
38 term average EC increases during February–May of 1.5–3.9 mS/cm (Appendix 8H, Tables EC-24 and
39 EC-25). Modeling of this alternative assumed no operation of the Montezuma Slough Salinity Control
40 Gates, but the project description assumes continued operation of the Salinity Control Gates,
41 consistent with assumptions included in the No Action Alternative. A sensitivity analysis modeling
42 run conducted for Alternative 4 Scenario H3 with the gates operational consistent with the No
43 Action Alternative resulted in substantially lower EC levels than indicated in the original Alternative
44 4 modeling results, but EC levels were still somewhat higher than EC levels under Existing
45 Conditions and the No Action Alternative for several locations and months. Another modeling run
46 with the gates operational and restoration areas removed resulted in EC levels nearly equivalent to

1 Existing Conditions and the No Action Alternative, indicating that design and siting of restoration
2 areas has notable bearing on EC levels at different locations within Suisun Marsh (see Appendix 8H,
3 Attachment 1, for more information on these sensitivity analyses). These analyses also indicate that
4 increases are related primarily to the hydrodynamic effects of CM4, not operational components of
5 CM1. Based on the sensitivity analyses, optimizing the design and siting of restoration areas may
6 limit the magnitude of long-term EC increases to be on the order of 1 mS/cm or less. Due to
7 similarities in the nature of the EC increases between alternatives, the findings from these analyses
8 can be extended to this alternative as well.

9 The degree to which the long-term average EC increases in Suisun Marsh would cause exceedance of
10 Bay-Delta WQCP objectives is unknown, because these objectives are expressed as a monthly
11 average of daily high tide EC, which does not have to be met if it can be demonstrated “equivalent or
12 better protection will be provided at the location” (State Water Resources Control Board 2006:14).
13 The long-term average EC increase may, or may not, contribute to adverse effects on beneficial uses,
14 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
15 water is managed, and future actions taken with respect to the marsh. However, the EC increases at
16 certain locations could be substantial, depending on siting and design of restoration areas, and it is
17 uncertain the degree to which current management plans for the Suisun Marsh would be able to
18 address these substantially higher EC levels and protect beneficial uses. Thus, these increased EC
19 levels in Suisun Marsh are considered to have a potentially adverse effect on marsh beneficial uses.
20 Long-term average EC increases in Suisun Marsh under Alternative 9 relative to the No Action
21 Alternative would be similar to the increases relative to Existing Conditions. Suisun Marsh is section
22 303(d) listed as impaired due to elevated EC, and the potential increases in long-term average EC
23 concentrations could contribute to additional impairment.

24 ***SWP/CVP Export Service Areas***

25 At the Banks and Jones pumping plants, Alternative 9 would result in no exceedances of the Bay-
26 Delta WQCP’s 1,000 $\mu\text{mhos/cm}$ EC objective for the entire period modeled (Appendix 8H, *Electrical*
27 *Conductivity*, Table EC-10). Thus, there would be no adverse effect on the beneficial uses in the
28 SWP/CVP Export Service Areas using water pumped at this location under the Alternative 9.

29 At the Banks pumping plant, relative to Existing Conditions, average EC levels under Alternative 9
30 would decrease substantially on average: 56% for the entire period modeled and 62% during the
31 drought period modeled. Relative to the No Action Alternative, average EC levels would decrease by
32 53% for the entire period modeled and 60% during the drought period modeled (Appendix 8H,
33 Table EC-20).

34 At the Jones pumping plant, relative to Existing Conditions, average EC levels under Alternative 9
35 would also decrease on average, but to a lesser degree: 22% for the entire period modeled and 18%
36 during the drought period modeled. Relative to the No Action Alternative, average EC levels would
37 decrease by 18% for the entire period modeled and 14% during the drought period modeled
38 (Appendix 8H, Table EC-20).

39 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
40 pumping plants, Alternative 9 would not cause degradation of water quality with respect to EC in
41 the SWP/CVP Export Service Areas; rather, Alternative 9 would improve long-term average EC
42 conditions in the SWP/CVP Export Service Areas.

1 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
2 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
3 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
4 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
5 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
6 increase in EC at Vernalis related to decreased annual average San Joaquin River flows (see EC
7 impact discussion under the No Action Alternative).

8 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
9 elevated EC. Alternative 9 would result in lower long-term average EC levels relative to Existing
10 Conditions and the No Action Alternative and, thus, would not contribute to additional beneficial use
11 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

12 **NEPA Effects:** In summary, the increased long-term and drought period average EC levels that
13 would occur in the San Joaquin River at San Andreas Landing (interior Delta), and the increased
14 frequency of exceedance of EC objectives in the Sacramento River at Emmaton under Alternative 9,
15 relative to the No Action Alternative, would contribute to adverse effects on the agricultural
16 beneficial uses. Given that the western Delta is Clean Water Act section 303(d) listed as impaired
17 due to elevated EC, the increased frequency of exceedance of the Bay-Delta WQCP objectives and
18 long-term average EC levels at this compliance location could contribute to additional impairment
19 and potentially adversely affect beneficial uses for section 303(d) listed Delta waterways, relative to
20 the No Action Alternative. The increases in long-term average EC levels that could occur in Suisun
21 Marsh would further degrade existing EC levels and could contribute additional to adverse effects on
22 the fish and wildlife beneficial uses. Suisun Marsh is section 303(d) listed as impaired due to
23 elevated EC, and the potential increases in long-term average EC levels could contribute to
24 additional beneficial use impairment. These increases in EC constitute an adverse effect on water
25 quality. Mitigation Measure WQ-11 would be available to reduce these effects. Implementation of
26 this measure along with a separate other commitment as set forth in Appendix 3B, *Environmental*
27 *Commitments, AMMs, and CMs*, relating to the potential EC-related changes would reduce these
28 effects.

29 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
30 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
31 purpose of making the CEQA impact determination for this constituent. For additional details on the
32 effects assessment findings that support this CEQA impact determination, see the effects assessment
33 discussion that immediately precedes this conclusion.

34 River flow rate and reservoir storage reductions that would occur under Alternative 9, relative to
35 Existing Conditions, would not be expected to result in a substantial adverse change in EC levels in
36 the reservoirs and rivers upstream of the Delta, given that: changes in the quality of watershed
37 runoff and reservoir inflows would not be expected to occur in the future; the state's aggressive
38 regulation of point-source discharge effects on Delta salinity-elevating parameters and the expected
39 further regulation as salt management plans are developed; the salt-related TMDLs adopted and
40 being developed for the San Joaquin River; and the expected improvement in lower San Joaquin
41 River average EC levels commensurate with the lower EC of the irrigation water deliveries from the
42 Delta.

43 Relative to Existing Conditions, Alternative 9 would not result in any substantial increases in long-
44 term average EC levels in the SWP/CVP Export Service Areas. There would be no exceedance of the

1 EC objective at the Jones and Banks pumping plants. Average EC levels for the entire period modeled
2 would decrease at both plants and, thus, this alternative would not contribute to additional
3 beneficial use impairment related to elevated EC in the SWP/CVP Export Service Areas waters.
4 Rather, this alternative would improve long-term EC levels in the SWP/CVP Export Service Areas,
5 relative to Existing Conditions.

6 In the Plan Area, Alternative 9 would result in an 12% increase in the frequency with which the Bay-
7 Delta WQCP EC objectives are exceeded at Emmaton (western Delta), a 2% increase in the frequency
8 with which fish and wildlife EC objectives are exceeded in the San Joaquin River at Jersey Point for
9 the entire period modeled (1976–1991). Further, average EC levels at Emmaton would increase by
10 22% for the entire period modeled and 36% during the drought period modeled, and EC levels at
11 San Andreas Landing would increase by 16% for the entire period modeled and 33% during the
12 drought period modeled. Because EC is not bioaccumulative, the increases in long-term average EC
13 levels would not directly cause bioaccumulative problems in aquatic life or humans. The interior
14 Delta is not Clean Water Act section 303(d) listed for elevated EC, however, the western Delta is. The
15 increases in long-term and drought period average EC levels and increased frequency of exceedance
16 of EC objectives that would occur in the Sacramento River at Emmaton and San Joaquin River at San
17 Andreas would potentially contribute to adverse effects on the agricultural beneficial uses in the
18 interior Delta. This impact is considered to be significant.

19 Further, relative to Existing Conditions, Alternative 9 could result in substantial increases in long-
20 term average EC during the months of October through May in Suisun Marsh. The increases in long-
21 term average EC levels that would occur in Suisun Marsh could further degrade existing EC levels
22 and thus contribute additionally to adverse effects on the fish and wildlife beneficial uses. Because
23 EC is not bioaccumulative, the increases in long-term average EC levels would not directly cause
24 bioaccumulative problems in wildlife. Suisun Marsh is Clean Water Act section 303(d) listed for
25 elevated EC and the increases in long-term average EC that would occur in the marsh could make
26 beneficial use impairment measurably worse. This impact is considered to be significant.

27 Implementation of Mitigation Measure WQ-11 along with a separate other commitment relating to
28 the potential increased costs associated with EC-related changes would reduce these effects. While
29 mitigation measures to reduce these water quality effects in affected water bodies to less-than-
30 significant levels are not available, implementation of Mitigation Measure WQ-11 is recommended
31 to attempt to reduce the effect that increased EC concentrations may have on Delta beneficial uses.
32 However, because the effectiveness of this mitigation measure to result in feasible measures for
33 reducing water quality effects is uncertain, this impact is considered to remain significant and
34 unavoidable. Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of
35 Alternative 1A.

36 In addition to and to supplement Mitigation Measure WQ-11, the BDCP proponents have
37 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments*
38 *AMMs, and CMs*, a separate other commitment to address the potential increased water treatment
39 costs that could result from EC concentration effects on municipal, industrial and agricultural water
40 purveyor operations. Potential options for making use of this financial commitment include funding
41 or providing other assistance towards acquiring alternative water supplies or towards modifying
42 existing operations when EC concentrations at a particular location reduce opportunities to operate
43 existing water supply diversion facilities. Please refer to Appendix 3B for the full list of potential
44 actions that could be taken pursuant to this commitment in order to reduce the water quality

1 treatment costs associated with water quality effects relating to chloride, electrical conductivity, and
2 bromide.

3 **Mitigation Measure WQ-11: Avoid, Minimize, or Offset, as Feasible, Reduced Water**
4 **Quality Conditions**

5 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 1A.

6 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of CM2–**
7 **CM21**

8 **NEPA Effects:** Effects of CM2–CM21 on EC under Alternative 9 would be the same as those discussed
9 for Alternative 1A and are considered not to be adverse.

10 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
11 measures proposed under Alternative 1A. As such, effects on EC resulting from the implementation
12 of CM2–CM21 would be similar to those previously discussed for Alternative 1A. This impact is
13 considered to be less than significant. No mitigation is required.

14 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
15 **Maintenance (CM1)**

16 ***Upstream of the Delta***

17 Under Alternative 9, the magnitude and timing of reservoir releases and river flows upstream of the
18 Delta in the Sacramento River watershed and eastside tributaries would be altered, relative to
19 Existing Conditions and the No Action Alternative.

20 The Sacramento River at Freeport and San Joaquin River at Vernalis (as summarized for water
21 quality average concentrations in Tables 8-48 and 8-49) were examined for flow/concentration
22 relationships for mercury and methylmercury. No significant, predictive regression relationships
23 were discovered for mercury or methylmercury, except for total mercury with flow at Freeport
24 (monthly or annual) (Appendix 8I, *Mercury*, Figures I-10 through I-13). Such a positive relationship
25 between total mercury and flow is to be expected based on the association of mercury with
26 suspended sediment and the mobilization of sediments during storm flows. However, the changes in
27 flow in the Sacramento River under Alternative 9 relative to Existing Conditions and the No Action
28 Alternative are not of the magnitude of storm flows, in which substantial sediment-associated
29 mercury is mobilized. Therefore mercury loading should not be substantially different due to
30 changes in flow. In addition, even though it may be flow-affected, total mercury concentrations
31 remain well below criteria at upstream locations. Any negligible changes in mercury concentrations
32 that may occur in the water bodies of the affected environment located upstream of the Delta would
33 not be of frequency, magnitude, and geographic extent that would adversely affect any beneficial
34 uses or substantially degrade the quality of these water bodies as related to mercury. Both
35 waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations are
36 expected to remain above guidance levels at upstream of Delta locations, but will not change
37 substantially relative to Existing Conditions or the No Action Alternative due to changes in flows
38 under Alternative 9.

39 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
40 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
41 Mercury Control Program. These projects will target specific sources of mercury and methylation

1 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
2 The implementation of these projects could help to ensure that upstream of Delta environments will
3 not be substantially degraded for water quality with respect to mercury or methylmercury.

4 ***Delta***

5 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
6 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
7 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
8 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
9 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
10 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
11 information.

12 The water quality impacts of waterborne concentrations of mercury and methylmercury and fish
13 tissue mercury concentrations were evaluated for 9 Delta locations. The analysis of percentage
14 change in assimilative capacity of waterborne total mercury of Alternative 9 relative to the 25 ng/L
15 ecological risk benchmark as compared to Existing Conditions showed the greatest decrease of
16 10.2% at Old River at Rock Slough, and a 10.1% reduction relative to the No Action Alternative at
17 that location (Figures 8-53a and 8-54a). Similarly, increases in long term annual average
18 methylmercury concentration are expected to be greatest (approximately 30%) at the Contra Costa
19 Pumping Plant as compared to Existing Conditions and the No Action Alternative (Appendix 8I,
20 *Mercury*, Figure I-9, Table I-6). The concentration of methylmercury is estimated to be 0.163 ng/L at
21 that location, which is greater than Existing Conditions (0.121 ng/L) and the No Action Alternative
22 (0.122 ng/L). All modeled input concentrations exceeded the methylmercury TMDL guidance
23 objective of 0.06 ng/L, therefore percentage change in assimilative capacity was not evaluated for
24 methylmercury.

25 Fish tissue estimates show some substantial percentage increases in concentration and exceedance
26 quotients for mercury at some Delta locations. The greatest change in exceedance quotients are
27 expected for Old River at Rock Slough with changes of 66% over Existing Conditions, and 59% over
28 the No Action Alternative (Figures 8-55a and 8-55b; Appendix 8I, *Mercury*, Table I-16b). The Contra
29 Costa Pumping Plant values shows a 62% increase in fish tissue concentrations over Existing
30 Conditions, and 59% over the No Action Alternative (Appendix 8I, Table I-16b). Because these
31 increases are substantial, and it is evident that substantive increases are expected at numerous
32 locations throughout the Delta, these changes may be measurable in the environment. See Appendix
33 8I for a discussion of the uncertainty associated with the fish tissue estimates.

34 ***SWP/CVP Export Service Areas***

35 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
36 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
37 methylmercury concentrations for Alternative 9 are projected to be lower than Existing Conditions
38 and the No Action Alternative at the Jones and Banks pumping plants (Appendix 8I, Figures I-7 and I-
39 9). Therefore, mercury shows an increased assimilative capacity at these locations (Figures 8-53a
40 and 8-54a). Bass tissue mercury concentrations are also improved under Alternative 9, relative to
41 Existing Conditions and the No Action Alternative (Figures 8-55a and 8-55b; Appendix 8I, Tables I-
42 16a and I-16b).

1 **NEPA Effects:** Based on the above discussion, the effects of mercury and methylmercury in
 2 comparison of Alternative 9 to the No Action Alternative (as waterborne and bioaccumulated forms)
 3 are considered to be adverse for the case of fish tissue bioaccumulation at some locations.

4 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
 5 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 6 purpose of making the CEQA impact determination for this constituent. For additional details on the
 7 effects assessment findings that support this CEQA impact determination, see the effects assessment
 8 discussion that immediately precedes this conclusion.

9 Under Alternative 9, greater water demands and climate change would alter the magnitude and
 10 timing of reservoir releases and river flows upstream of the Delta in the Sacramento River
 11 watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury and
 12 methylmercury upstream of the Delta will not be substantially different relative to Existing
 13 Conditions due to the lack of important relationships between mercury/methylmercury
 14 concentrations and flow for the major rivers.

15 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
 16 capacity exists. Monthly average waterborne concentrations of total and methylmercury, over the
 17 period of record, are very similar to Existing Conditions, but showed notable increases at some
 18 locations. Estimates of fish tissue mercury concentrations show substantial increases would occur
 19 for several sites for Alternative 9 as compared to Existing Conditions for Delta sites.

20 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
 21 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
 22 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
 23 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 9 as
 24 compared to Existing Conditions.

25 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 26 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 27 on any beneficial uses of waters in the affected environment. However, increases in fish tissue
 28 mercury concentrations are substantial, and changes in fish tissue mercury concentrations would
 29 make existing mercury-related impairment in the Delta measurably worse. In comparison to
 30 Existing Conditions, Alternative 9 would increase levels of mercury by frequency, magnitude, and
 31 geographic extent such that the affected environment would be expected to have measurably higher
 32 body burdens of mercury in aquatic organisms, thereby substantially increasing the health risks to
 33 wildlife (including fish) or humans consuming those organisms. This impact is considered to be
 34 significant. Feasible or effective actions to reduce the effects on mercury resulting from CM1 are
 35 unknown. General mercury management measures through CM12, or actions taken by other entities
 36 or programs such as TMDL implementation, may minimize or reduce sources and inputs of mercury
 37 to the Delta and methylmercury formation. However, it is uncertain whether this impact would be
 38 reduced to a level that would be less than significant as a result of CM12 or other future actions.
 39 Therefore, the impact would be significant and unavoidable.

40 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of CM2-
 41 CM21**

42 **NEPA Effects:** Some habitat restoration activities under Alternative 9 would occur on lands in the
 43 Delta formerly used for irrigated agriculture. Tidal and other restoration proposed under

1 Alternative 9 have the potential to increase water residence times and increase accumulation of
 2 organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 3 restored habitat. Therefore, increases in mercury methylation in the habitat restoration areas is
 4 possible but uncertain depending on the specific restoration design implemented at a particular
 5 Delta location. Models to estimate the potential for methylmercury formation in restored areas are
 6 not currently available. However, DSM2 modeling for Alternative 9 operations does incorporate
 7 assumptions for certain habitat restoration activities proposed under CM2 and CM4 (see Section
 8 8.3.1.3) that result in changes to Delta hydrodynamics compared to the No Action Alternative. These
 9 modeled restoration assumptions provide some insight into potential hydrodynamic changes that
 10 could be expected related to implementing CM2 and CM4 and are considered in the evaluation of the
 11 potential for increased mercury and methylmercury concentrations under Alternative 9.

12 CM12 addresses the potential for methylmercury bioaccumulation associated with restoration
 13 activities and acknowledges the uncertainties associated with mitigating or minimizing this
 14 potential effect. CM12 proposes project-specific mercury management plans for restoration actions
 15 that will incorporate relevant approaches recommended in Phase 1 Methylmercury TMDL control
 16 studies. Specific approaches recommended under CM12 that are intended to minimize or mitigate
 17 for potential increases in methylmercury bioaccumulation at future restoration sites include:

- 18 • Characterizing mercury, methylmercury, organic carbon, iron, and sulfate concentrations to
 19 better inform restoration design,
- 20 • Sequestering methylmercury at restoration sites using low intensity chemical dosing
 21 techniques,
- 22 • Minimizing microbial methylation associated with anoxic conditions by reducing the amount of
 23 organic material at a restoration site,
- 24 • Designing restoration sites to enhance photo degeneration that converts methylmercury into a
 25 biologically unavailable, inorganic form of mercury,
- 26 • Remediating restoration site soils with iron to reduce methylation in sulfide rich soils, and
 27 • Considering capping mercury laden sediments, where possible to reduce methylation potential
 28 at a site.

29 Because of the uncertainties associated with site-specific estimates of methylmercury
 30 concentrations and the uncertainties in source modeling and tissue modeling, the effectiveness of
 31 methylmercury management proposed under CM12 to reduce methylmercury concentrations would
 32 need to be evaluated separately for each restoration effort, as part of design and implementation.
 33 Because of this uncertainty and the known potential for methylmercury creation in the Delta this
 34 potential effect of implementing CM2-CM21 is considered adverse.

35 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 36 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 37 the CVP and SWP service areas due to implementation of CM2–CM21 relative to Existing Conditions.
 38 However, uptake of mercury from water and/or methylation of inorganic mercury may increase to
 39 an unquantified degree as part of the creation of new, marshy, shallow, or organic-rich restoration
 40 areas. Methylmercury is 303(d)-listed within the affected environment, and therefore any potential
 41 measurable increase in methylmercury concentrations would make existing mercury-related
 42 impairment measurably worse. Because mercury is bioaccumulative, increases in water-borne
 43 mercury or methylmercury that could occur in some areas could bioaccumulate to somewhat

1 greater levels in aquatic organisms and would, in turn, pose health risks to fish, wildlife, or humans.
 2 Design of restoration sites under Alternative 9 would be guided by CM12 which requires
 3 development of site specific mercury management plans as restoration actions are implemented.
 4 The effectiveness of minimization and mitigation actions implemented according to the mercury
 5 management plans is not known at this time although the potential to reduce methylmercury
 6 concentrations exists based on current research. Although the BDCP will implement CM12 with the
 7 goal to reduce this potential effect the uncertainties related to site specific restoration conditions
 8 and the potential for increases in methylmercury concentrations in the Delta result in this potential
 9 impact being considered significant. No mitigation measures would be available until specific
 10 restoration actions are proposed. Therefore this programmatic impact is considered significant and
 11 unavoidable.

12 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 13 **Maintenance (CM1)**

14 ***Upstream of the Delta***

15 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
 16 any, impact on nitrate concentrations in the rivers and reservoirs upstream of the Delta in the
 17 Sacramento River watershed relative to Existing Conditions and the No Action Alternative.

18 Under Alternative 9, modeling indicates that long-term annual average flows on the San Joaquin
 19 River would decrease by an estimated 6% relative to Existing Conditions, and would remain
 20 virtually the same relative to the No Action Alternative (see Appendix 5A, *BDCP/California WaterFix*
 21 *FEIR/FEIS Modeling Technical Appendix*). Given these relatively small decreases in flows and the
 22 weak correlation between nitrate and flows in the San Joaquin River (see Appendix 8J, *Nitrate*,
 23 Figure 2), it is expected that nitrate concentrations in the San Joaquin River would be minimally
 24 affected, if at all, by changes in flow rates under Alternative 9.

25 Any negligible changes in nitrate-N concentrations that may occur in the water bodies of the affected
 26 environment located upstream of the Delta would not be of frequency, magnitude and geographic
 27 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
 28 water bodies, with regards to nitrate.

29 ***Delta***

30 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 31 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
 32 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 33 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 34 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
 35 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
 36 information.

37 Results of the mixing calculations indicate that under Alternative 9, relative to Existing Conditions,
 38 and the No Action Alternative, nitrate concentrations throughout the Delta are anticipated to remain
 39 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Tables 31 and 32). Long-
 40 term average nitrate concentrations are anticipated to increase at most locations in the Delta. The
 41 increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
 42 Plant #1 (all >100% increase). Long-term average concentrations were estimated to increase to

1 0.96, 1.32, and 1.38 mg/L-N for Franks Tract, Old River at Rock Slough, and Contra Costa Pumping
 2 Plant#1, respectively, due primarily to increased San Joaquin River water percentage at these
 3 locations (see Appendix 8D, *Source Water Fingerprinting Results*). Although changes at specific Delta
 4 locations and for specific months may be substantial on a relative basis, the absolute concentration
 5 of nitrate in Delta waters would remain low (<1.4 mg/L-N) in relation to the drinking water MCL of
 6 10 mg/L-N, as well as all other thresholds identified in Table 8-50. No additional exceedances of the
 7 MCL are anticipated at any location (Appendix 8J, *Nitrate*, Table 31). On a monthly average basis and
 8 on a long term annual average basis, for all modeled years and for the drought period (1987–1991)
 9 only, use of assimilative capacity available under Existing Conditions and the No Action Alternative,
 10 relative to the drinking water MCL of 10 mg/L-N, was up to approximately 13% at Old River at Rock
 11 Slough and Contra Costa Pumping Plant #1, and averaged approximately 9% on a long-term average
 12 basis (Appendix 8J, Table 33). Similarly, the use of available assimilative capacity at Franks Tract
 13 was up to approximately 10%, and averaged approximately 6% over the long term. The
 14 concentrations estimated for these locations would not increase the likelihood of exceeding the 10
 15 mg/L-N MCL, nor would they increase the risk for adverse effects to beneficial uses. At all other
 16 locations, use of assimilative capacity was negligible (<5%) (Appendix 8J, Table 33).

17 Nitrate concentrations will likely be higher than the modeling results indicate in certain locations.
 18 This includes in the Sacramento River between Freeport and Mallard Island and other areas in the
 19 Delta downstream of Freeport that are influenced by Sacramento River water. These increases are
 20 associated with ammonia and nitrate that are discharged from the SRWTP, which are not included in
 21 the modeling.

- 22 • Under Existing Conditions, most of the ammonia discharged from the SRWTP is converted to
 23 nitrate downstream of the facility's discharge at Freeport, and thus, nitrate concentrations
 24 under Existing Conditions in these areas are expected to be higher than the modeling predicts,
 25 the increase becoming greater with increasing distance downstream. However, the increase in
 26 nitrate concentrations downstream of the SRWTP is expected to be small—the existing increase
 27 appears to be from approximately 0.1 mg/L-N to approximately 0.4–0.5 mg/L-N over this reach,
 28 due to approximately a 1:1 conversion of ammonia-N to nitrate-N (Central Valley Water Board
 29 2010a:32).
- 30 • Under Alternative 9, the planned upgrades to the SRWTP, which include nitrification/partial
 31 denitrification, would substantially decrease ammonia concentrations in the discharge, but
 32 would increase nitrate concentrations in the discharge up to 10 mg/L-N, which is substantially
 33 higher than under Existing Conditions.
- 34 • Overall, under Alternative 9, the nitrogen load from the SRWTP discharge is expected to
 35 decrease (by up to 50%), relative to Existing Conditions, due to nitrification/partial
 36 denitrification upgrades at the SRWTP facility. Thus, while concentrations of nitrate downstream
 37 of the facility are expected to be higher than modeling results indicate for both Existing
 38 Conditions and Alternative 9, the increase is expected to be greater under Existing Conditions
 39 than for Alternative 9 due to the upgrades that are assumed under Alternative 9.

40 The other areas in which nitrate concentrations will be higher than the modeling results indicate are
 41 immediately downstream of other wastewater treatment plants that practice nitrification, but not
 42 denitrification (e.g., City of Rio Vista Beach WWTF, Town of Discovery Bay WWTF, City of Stockton
 43 RWCF). For all such facilities in the Delta, the Regional Water Boards have issued NPDES permits
 44 that allow discharge of wastewater containing nitrate into the Delta, and under these permits, the
 45 State has determined that no beneficial uses are adversely affected by the discharge, and that the

1 discharger's use of available assimilative capacity of the water body is acceptable. When dilution is
2 necessary in order for the discharge to be in compliance with the Basin Plans (which incorporate the
3 10 mg/L-N MCL by reference), not all of the assimilative capacity of the receiving water is granted to
4 the discharger. Thus, limited decreases in flows are not anticipated to result in systemic
5 exceedances of the MCLs by these POTWs. Furthermore, NPDES permits are renewed on a 5-year
6 basis, and thus, if under changes in flows, dilution was no longer sufficient to maintain nitrate below
7 the MCL in the receiving water, the NPDES permit renewal process would address such cases.

8 Therefore, any increases in nitrate-N concentrations that may occur at certain locations within the
9 Delta would not be of frequency, magnitude and geographic extent that would adversely affect any
10 beneficial uses or substantially degrade the water quality at these locations, with regards to nitrate.

11 ***SWP/CVP Export Service Areas***

12 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
13 nitrate-N at the Banks and Jones pumping plants.

14 Results of the mixing calculations indicate that under Alternative 9, relative to Existing Conditions
15 and the No Action Alternative, nitrate concentrations at Banks and Jones pumping plants are
16 anticipated to decrease on a long-term average annual basis (Appendix 8J, *Nitrate*, Table 31 and 32).
17 No additional exceedances of the MCL are anticipated (Appendix 8J, Table 31). On a monthly average
18 basis and on a long term annual average basis, for all modeled years and for the drought period
19 (1987–1991) only, use of assimilative capacity available under Existing Conditions and the No
20 Action Alternative, relative to the 10 mg/L-N MCL, was negligible for both Banks and Jones pumping
21 plants (Appendix 8J, Table 33).

22 Therefore, implementation of this alternative is not expected to result in adverse effects to beneficial
23 uses or substantially degrade the quality of exported water, with regards to nitrate.

24 ***NEPA Effects:*** In summary, based on the discussion above, the effects on nitrate from implementing
25 CM1 are considered to be not adverse.

26 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
27 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
28 purpose of making the CEQA impact determination for this constituent. For additional details on the
29 effects assessment findings that support this CEQA impact determination, see the effects assessment
30 discussion that immediately precedes this conclusion.

31 Nitrate-N concentrations are generally low in the reservoirs and rivers of the watersheds, owing to
32 substantial dilution available for point sources and the lack of substantial nonpoint sources of
33 nitrate-N upstream of the SRWTP in the Sacramento River watershed, and in the watersheds of the
34 eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although higher in the San
35 Joaquin River watershed, nitrate-N concentrations are not well-correlated with flow rates.
36 Consequently, any modified reservoir operations and subsequent changes in river flows under
37 Alternative 9, relative to Existing Conditions, are expected to have negligible, if any, effects on
38 reservoir and river nitrate-N concentrations upstream of Freeport in the Sacramento River
39 watershed and upstream of the Delta in the San Joaquin River watershed.

40 In the Delta, results of the mixing calculations indicate that under Alternative 9, relative to Existing
41 Conditions, long-term average nitrate concentrations are anticipated to increase at most locations.
42 The increase would be greatest at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping

1 Plant #1 (all >100% increase), due primarily to increased San Joaquin River water percentage at
 2 these locations. However, nitrate concentrations throughout the Delta are anticipated to remain low
 3 (<1.4 mg/L-N) relative to adopted objectives, and no additional exceedances of the MCL are
 4 anticipated at any location. Use of assimilative capacity at locations throughout the Delta (up to
 5 13%) did not result in concentrations that would increase the likelihood of exceeding the 10 mg/L-N
 6 MCL, nor would they increase the risk for adverse effects to beneficial uses.

7 Assessment of effects of nitrate in the SWP and CVP Export Service Areas is based on effects on
 8 nitrate-N concentrations at the Banks and Jones pumping plants. Results of the mixing calculations
 9 indicate that under Alternative 9, relative to Existing Conditions, long-term average nitrate
 10 concentrations at Banks and Jones pumping plants are anticipated to decrease. No additional
 11 exceedances of the MCL are anticipated, and use of assimilative capacity available under Existing
 12 Conditions, relative to the MCL, for both Banks and Jones pumping plants was negligible for all
 13 months.

14 Based on the above, this alternative is not expected to cause additional exceedance of applicable
 15 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 16 adverse effects on any beneficial uses of waters in the affected environment. No long-term water
 17 quality degradation is expected to occur such that exceedance of criteria is more likely or such that
 18 there is an increased risk of adverse impacts to beneficial uses. Nitrate is not 303(d) listed within
 19 the affected environment and thus any increases that may occur in some areas and months would
 20 not make any existing nitrate-related impairment measurably worse because no such impairments
 21 currently exist. Because nitrate is not bioaccumulative, increases that may occur in some areas and
 22 months would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 23 substantial health risks to fish, wildlife, or humans. This impact is considered to be less than
 24 significant. No mitigation is required.

25 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of CM2–** 26 **CM21**

27 *NEPA Effects:* Effects of CM2–CM21 on nitrate under Alternative 9 would be the same as those
 28 discussed for Alternative 1A and are considered not to be adverse.

29 *CEQA Conclusion:* CM2–CM21 proposed under Alternative 9 would be similar to conservation
 30 measures proposed under Alternative 1A. As such, effects on nitrate resulting from the
 31 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 32 This impact is considered to be less than significant. No mitigation is required.

33 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 34 **Operations and Maintenance (CM1)**

35 ***Upstream of the Delta***

36 Under Alternative 9, there would be no substantial change to the sources of DOC within the
 37 watersheds upstream of the Delta. Moreover, long-term average flow and DOC levels in the
 38 Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus changes in
 39 system operations and resulting reservoir storage levels and river flows would not be expected to
 40 cause a substantial long-term change in DOC concentrations in the water bodies upstream of the
 41 Delta. Any negligible changes in DOC levels in water bodies upstream of the Delta under Alternative
 42 9, relative to Existing Conditions and the No Action Alternative, would not be of sufficient frequency,

1 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
2 degrade the quality of these water bodies, with regards to DOC.

3 **Delta**

4 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
5 and CM4) would affect Delta hydrodynamics, To the extent that restoration actions alter
6 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
7 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
8 CM2–CM21 not attributable to hydrodynamics, for example, additional loading of a constituent to
9 the Delta, are discussed within the impact header for CM2–CM21. See section 8.3.1.3 for more
10 information.

11 Under Alternative 9, the geographic extent of effects pertaining to long-term average DOC
12 concentrations in the Delta would be similar to that previously described for Alternative 1A,
13 although the magnitude of predicted long-term increase and relative frequency of concentration
14 threshold exceedances would be substantially greater. Modeled effects would be greatest at Franks
15 Tract, Rock Slough, and Contra Costa PP No. 1., where for the 16-year hydrologic period and the
16 modeled drought period, long-term average concentration increases ranging from 0.6–1.0 mg/L
17 would be predicted ($\leq 28\%$ net increase), resulting in long-term average DOC concentrations greater
18 than 4 mg/L at Rock Slough and Contra Costa PP No. 1 (Appendix 8K, *Organic Carbon*, DOC Table
19 10). Increases in long-term average concentrations would correspond to more frequent
20 concentration threshold exceedances, with the greatest change occurring at Rock Slough and Contra
21 Costa PP No. 1 locations. For Rock Slough, long-term average DOC concentrations exceeding 3 mg/L
22 would increase from 52% under Existing Conditions to 99% under the Alternative 9 (an increase
23 from 47% to 100% for the drought period), and concentrations exceeding 4 mg/L would increase
24 from 30% to 44% (32% to 67% for the drought period). For Contra Costa PP No. 1, long-term
25 average DOC concentrations exceeding 3 mg/L would increase from 52% under Existing Conditions
26 to 100% under Alternative 9 (45% to 100% for the drought period), and concentrations exceeding 4
27 mg/L would increase from 32% to 45% (35% to 65% for the drought period). Relative change in
28 frequency of threshold exceedance for other assessment locations would be similar or less. This
29 comparison to Existing Conditions reflects changes in DOC due to both Alternative 9 operations
30 (including use of operable barriers and numerous other components of Operational Scenario G) and
31 climate change/sea level rise.

32 In comparison, Alternative 9 relative to the No Action Alternative would generally result in a
33 magnitude of change similar to that discussed for the comparison to Existing Conditions. Maximum
34 increases of 0.6–0.9 mg/L DOC (i.e., $\leq 24\%$) would be predicted at Franks Tract, Rock Slough, and
35 Contra Costa PP No. 1 relative to No Action Alternative (Appendix 8K, *Organic Carbon*, DOC Table
36 10). Threshold concentration exceedance frequency trends would also be similar to those discussed
37 for the Existing Conditions comparison, with exception to the predicted 4 mg/L exceedance
38 frequency at Buckley Cove. In comparison to the No Action Alternative, the frequency which long-
39 term average DOC concentrations exceeded 4 mg/L at Buckley Cove would increase from 27% to
40 39% (42% to 50% for the modeled drought period). Unlike the comparison to Existing Conditions,
41 this comparison to the No Action Alternative reflects changes in DOC due only to Alternative 9
42 operations.

43 The increases in long-term average DOC concentrations estimated to occur at Franks Tract, Rock
44 Slough, and Contra Costa PP No. 1 are considered substantial and could potentially trigger

1 significant changes in drinking water treatment plant design or operations. In particular, assessment
 2 locations at Rock Slough and Contra Costa PP No. 1 represent municipal intakes servicing existing
 3 drinking water treatment plants. Under Alternative 9, drinking water treatment plants obtaining
 4 water from these interior Delta locations would likely need to upgrade existing treatment systems in
 5 order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. While
 6 treatment technologies sufficient to achieve the necessary DOC removals exist, implementation of
 7 such technologies would likely require substantial investment in new or modified infrastructure.

8 Relative to existing and No Action Alternative conditions, Alternative 9 would lead to predicted
 9 improvements in long-term average DOC concentrations at Barker Slough and Staten Island, as well
 10 Banks and Jones pumping plants (discussed below). Predicted long-term average DOC
 11 concentrations at Barker Slough and Staten Island would decrease <0.1–0.2 mg/L, depending on
 12 baseline conditions comparison and modeling period.

13 ***SWP/CVP Export Service Areas***

14 Under Alternative 9, modeled long-term average DOC concentrations would decrease at Banks and
 15 Jones pumping plants for both the modeled 16-year hydrologic period and the modeled drought
 16 period. Modeled decreases would generally be similar between Existing Conditions and the No
 17 Action Alternative. Relative to Existing Conditions, long-term average DOC concentrations at Banks
 18 would be predicted to decrease by 1.5 mg/L (1.8 mg/L during drought period) (Appendix 8K,
 19 *Organic Carbon*, DOC Table 10). At Jones, long-term average DOC concentrations would be predicted
 20 to decrease by 1.5 mg/L (1.7 mg/L during drought period). Such substantial improvement in long-
 21 term average DOC concentrations would include fewer exceedances of concentration thresholds. At
 22 both Banks and Jones, average DOC concentrations exceeding the 2 mg/L concentration threshold
 23 would decrease from 100% under Existing Conditions and the No Action Alternative to 39% under
 24 Alternative 9 (100% to 32% during the drought period), while concentrations exceeding 4 mg/L
 25 would nearly be eliminated (i.e., ≤10% exceedance frequency). Such modeled improvement would
 26 correspond to substantial improvement in Export Service Areas water quality, respective to DOC.

27 Similar to the discussion pertaining to the No Action Alternative, maintenance of SWP and CVP
 28 facilities under Alternative 9 would not be expected to create new sources of DOC or contribute
 29 towards a substantial change in existing sources of DOC in the affected area. Maintenance activities
 30 would not be expected to cause any substantial change in long-term average DOC concentrations
 31 such that MUN beneficial uses, or any other beneficial use, would be adversely affected.

32 ***NEPA Effects:*** In summary, Alternative 9, relative to the No Action Alternative, would not cause a
 33 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta.
 34 Long-term average DOC concentrations at Banks and Jones pumping plants are predicted to
 35 decrease by as much as 1.9 mg/L, while long-term average DOC concentrations for some Delta
 36 interior locations, including Franks Tract, Rock Slough and Contra Costa PP #1, are predicted to
 37 increase by as much as 0.9 mg/L. Resultant substantial changes in long-term average DOC at these
 38 Delta interior locations could necessitate changes in water treatment plant operations or require
 39 treatment plant upgrades in order to maintain DBP compliance, and thus would constitute an
 40 adverse effect on water quality and MUN beneficial uses. Mitigation Measure WQ-17 is available to
 41 reduce these effects.

42 ***CEQA Conclusion:*** Key findings discussed in the effects assessment provided above are summarized
 43 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
 44 purpose of making the CEQA impact determination for this constituent. For additional details on the

1 effects assessment findings that support this CEQA impact determination, see the effects assessment
2 discussion that immediately precedes this conclusion.

3 While greater water demands under the Alternative 9 would alter the magnitude and timing of
4 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
5 on the various watershed sources of DOC. Moreover, long-term average flow and DOC at Sacramento
6 River at Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river
7 flows would not be expected to cause a substantial long-term change in DOC concentrations
8 upstream of the Delta.

9 Relative to Existing Conditions, Alternative 9 would result in substantial increases (i.e., 0.6–1.0
10 mg/L) in long-term average DOC concentrations at some Delta interior locations, and would be
11 greatest at Franks Tract, Rock Slough, and Contra Costa PP No. 1. At these locations the predicted
12 changes in DOC would substantially increase the frequency with which long-term average
13 concentrations exceeds 2, 3, or 4 mg/L. Drinking water treatment plants obtaining water from these
14 interior Delta locations would likely need to upgrade existing treatment systems in order to achieve
15 EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action thresholds. Such predicted
16 magnitude change in long-term average DOC concentrations would represent a substantially
17 increased risk for adverse effects on existing MUN beneficial.

18 The assessment of Alternative 9 effects on DOC in the SWP/CVP Export Service Areas is based on
19 assessment of changes in DOC concentrations at Banks and Jones pumping plants. Relative to
20 Existing Conditions, long-term average DOC concentrations would decrease by as much as 1.8 mg/L
21 at Banks and Jones pumping plants. The frequency with which long-term average DOC
22 concentrations would exceed 2, 3, or 4 mg/L would be substantially reduced, where predicted
23 exceedances of >4 mg/L would be nearly eliminated (i.e., ≤10% exceedance frequency). As a result,
24 substantial improvement in DOC-related water quality would be predicted in the SWP/CVP Export
25 Service Areas.

26 Based on the above, Alternative 9 operation and maintenance would not result in any substantial
27 change in long-term average DOC concentration upstream of the Delta. Furthermore, under
28 Alternative 9, water exported from the Delta to the SWP/CVP service area would be substantially
29 improved relative to DOC. DOC is not bioaccumulative, therefore change in long-term average DOC
30 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
31 Additionally, DOC is not a constituent related to any 303(d) listings. Nevertheless, new and modified
32 conveyance facilities proposed under Alternative 9 would result in a substantial increase in long-
33 term average DOC concentrations (i.e., 0.6–1.0 mg/L, equivalent to ≤28% relative increase) at
34 Franks Tract, Rock Slough, and Contra Costa PP No. 1. In particular, under Alternative 9, model
35 predicted long-term average DOC concentrations would be greater than 4 mg/L at Rock Slough and
36 Contra Costa PP No. 1 with commensurate substantial increases in the frequency with which
37 average DOC concentrations exceed 2, 3, and 4 mg/L levels. Drinking water treatment plants
38 obtaining water from these interior Delta locations would likely need to upgrade existing treatment
39 systems in order to achieve EPA Stage 1 Disinfectants and Disinfection Byproduct Rule action
40 thresholds. Therefore, such a magnitude change in long-term average DOC concentrations would
41 represent a substantially increased risk for adverse effects on existing MUN beneficial uses at Rock
42 Slough and Contra Costa PP No. 1 should such treatment upgrades not be undertaken. The impact is
43 considered significant and mitigation is required. While Mitigation Measure WQ-17 is available to
44 partially reduce this impact of DOC, the feasibility and effectiveness of this mitigation measure is

1 uncertain and implementation would not necessarily reduce the identified impact to a level that
2 would be less than significant, and therefore it is significant and unavoidable.

3 **Mitigation Measure WQ-17: Consult with Delta Water Purveyors to Identify Means to**
4 **Avoid, Minimize, or Offset Increases in Long-Term Average DOC Concentrations**

5 Please see Mitigation Measure WQ-17 under Impact WQ-17 in the Alternative 6A discussion.

6 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
7 **Implementation of CM2–CM21**

8 **NEPA Effects:** CM2–CM21 under Alternative 9 would be similar to conservation measures under
9 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors.
10 Therefore, effects on DOC resulting from the implementation of CM2–CM21 would be similar to
11 those previously discussed for Alternative 1A. In summary, CM4–CM7 and CM10 could contribute
12 substantial amounts of DOC to raw drinking water supplies, largely depending on final design and
13 operational criteria for the related wetland and riparian habitat restoration activities. Substantially
14 increased long-term average DOC in raw water supplies could lead to a need for treatment plant
15 upgrades in order to appropriately manage DBP formation in treated drinking water. This potential
16 for future DOC increases would lead to substantially greater associated risk of long-term adverse
17 effects on the MUN beneficial use.

18 In summary, the habitat restoration elements of CM4–CM7 and CM10 under Alternative 9 would
19 present new localized sources of DOC to the study area, and in some circumstances would substitute
20 for existing sources related to replaced agriculture. Depending on localized hydrodynamics and
21 proximity to municipal drinking water intakes, such restoration activities could contribute
22 substantial amounts of DOC to municipal raw water. Substantial increases in municipal raw water
23 DOC could necessitate changes in water treatment plant operations or require treatment plant
24 upgrades in order to maintain DBP compliance, and thus would constitute an adverse effect on
25 water quality. Mitigation Measure WQ-18 is available to reduce these effects.

26 **CEQA Conclusion:** Effects of CM4–CM7 and CM10 on DOC under Alternative 9 are similar to those
27 discussed for Alternative 1A. Similar to the discussion for Alternative 1A, this impact is considered
28 to be significant. Mitigation is required. It is uncertain whether implementation of Mitigation
29 Measure WQ-18 would reduce identified impacts to a less-than-significant level. Hence, this impact
30 remains significant and unavoidable.

31 In addition to and to supplement Mitigation Measure WQ-18, the BDCP proponents have
32 incorporated into the BDCP, as set forth in EIR/EIS Appendix 3B, *Environmental Commitments,*
33 *AMMs, and CMs,* a separate other commitment to address the potential increased water treatment
34 costs that could result from DOC concentration effects on municipal and industrial water purveyor
35 operations. Potential options for making use of this financial commitment include funding or
36 providing other assistance towards implementing treatment for DOC and/or DBPs or DOC source
37 control strategies. Please refer to Appendix 3B for the full list of potential actions that could be taken
38 pursuant to this commitment in order to reduce the water quality treatment costs associated with
39 water quality effects relating to DOC.

1 **Mitigation Measure WQ-18: Design Wetland and Riparian Habitat Features to Minimize**
2 **Effects on Municipal Intakes**

3 Please see Mitigation Measure WQ-18 under Impact WQ-18 in the discussion of Alternative 1A.

4 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**
5 **(CM1)**

6 **NEPA Effects:** Effects of CM1 on pathogens under Alternative 9 would be the same as those
7 discussed for Alternative 1A and are considered to not be adverse.

8 **CEQA Conclusion:** Effects of CM1 on pathogens under Alternative 9 would be the same as those
9 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
10 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
11 this constituent. For additional details on the effects assessment findings that support this CEQA
12 impact determination, see the effects assessment discussion under Alternative 1A.

13 River flow rate and reservoir storage reductions that would occur due to implementation of CM1
14 (water facilities and operations) under Alternative 9, relative to Existing Conditions, would not be
15 expected to result in a substantial adverse change in pathogen concentrations in the reservoirs and
16 rivers upstream of the Delta, given the small magnitude of urban runoff contributions relative to the
17 magnitude of river flows, that pathogen concentrations in the rivers have a minimal relationship to
18 river flow rate, and the expected reduced pollutant loadings in response to NPDES stormwater-
19 related regulations.

20 It is expected there would be no substantial change in Delta pathogen concentrations in response to
21 a shift in the Delta source water percentages under this alternative or substantial degradation of
22 these water bodies, with regard to pathogens. This conclusion is based on the Pathogens Conceptual
23 Model, which found that pathogen sources in close proximity to a Delta site appear to have the
24 greatest influence on pathogen levels at the site, rather than the primary source(s) of water to the
25 site. In-Delta potential pathogen sources, including water-based recreation, tidal habitat, wildlife,
26 and livestock-related uses, would continue under this alternative.

27 In the SWP/CVP Export Service Areas waters, relative to Existing Conditions, an increased
28 proportion of water coming from the Sacramento River would not adversely affect beneficial uses in
29 the SWP/CVP Export Service Areas. The pathogen levels in the Sacramento River are similar to or
30 lower than the water diverted at the Delta export pumps. Further, it is localized sources of
31 pathogens that appear to have the greatest influence on concentrations. Thus, an increased
32 proportion of Sacramento River water diverted to the SWP/CVP Export Service Areas would result
33 in minimal changes in pathogen levels in the SWP/CVP Export Service Areas waters.

34 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
35 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
36 beneficial uses of waters in the affected environment. Because pathogen concentrations are not
37 expected to increase substantially, no long-term water quality degradation for pathogens is
38 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
39 River in the Stockton Deep Water Ship Channel is Clean Water Act section 303(d) listed for
40 pathogens. Because no measurable increase in Deep Water Ship Channel pathogen concentrations
41 are expected to occur on a long-term basis, further degradation and impairment of this area is not

1 expected to occur. Finally, pathogens are not bioaccumulative constituents. This impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of CM2–CM21**

4 **NEPA Effects:** Effects of CM2–CM21 on pathogens under Alternative 9 would be the same as those
5 discussed for Alternative 1A and are considered to not be adverse.

6 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
7 measures proposed under Alternative 1A. As such, effects on pathogens resulting from the
8 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
9 This impact is considered to be less than significant. No mitigation is required.

10 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 11 **Maintenance (CM1)**

12 ***Upstream of the Delta***

13 For the same reasons stated for the No Action Alternative, under Alternative 9 no specific operations
14 or maintenance activity of the SWP or CVP would substantially drive a change in pesticide use, and
15 thus pesticide sources would remain unaffected upstream of the Delta. Nevertheless, changes in the
16 timing and magnitude of reservoir releases could have an effect on available dilution capacity along
17 river segments such as the Sacramento, Feather, American, and San Joaquin Rivers.

18 Under Alternative 9, winter (November–March) and summer (April–October) season average flow
19 rates on the Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito
20 and the San Joaquin River at Vernalis would change. Relative to existing condition and the No Action
21 Alternative, seasonal average flow rates on the Sacramento would decrease no more than 3% during
22 the summer and winter (Appendix 8L, *Pesticides*, Tables 1–4). On the Feather River, average flow
23 rates would increase by as much as 10% during the summer, but would decrease by as much as 5%
24 in the winter. American River average flow rates would decrease by as much as 17% in the summer
25 but would increase by as much as 7% in the winter. Seasonal average flow rates on the San Joaquin
26 River would decrease by as much as 12% in the summer, but increase by as much as 1% in the
27 winter. For the same reasons stated for the No Action Alternative, decreased seasonal average flow
28 of $\leq 17\%$ is not considered to be of sufficient magnitude to substantially increase pesticide
29 concentrations or alter the long-term risk of pesticide-related toxicity to aquatic life, nor adversely
30 affect other beneficial uses of water bodies upstream of the Delta.

31 ***Delta***

32 Sources of diuron, OP and pyrethroid insecticides to the Plan Area include direct input of surface
33 runoff from in-Delta agriculture and Delta urbanized areas as well as inputs from rivers upstream of
34 the Delta. Similar to Upstream of the Delta, CVP/SWP operations would not affect these sources.

35 Under Alternative 9, the distribution and mixing of Delta source waters would change. Percentage
36 change in monthly average source water fraction was evaluated for the modeled 16-year (1976–
37 1991) hydrologic period and a representative drought period (1987–1991), with special attention
38 given to changes in San Joaquin River, Sacramento River and Delta Agriculture sources water
39 fractions. Relative to Existing Conditions, under Alternative 9 modeled San Joaquin River fractions
40 would increase greater than 10% at Franks Tract, Rock Slough, Contra Costa PP No. 1, and the San
41 Joaquin River at Antioch (Appendix 8D, *Source Water Fingerprinting Results*). At Antioch, San

1 Joaquin River source water fractions would increase by 12–15% from October through May (11–
2 14% from November through April for the modeled drought period). While this change at Antioch is
3 not considered substantial, changes in San Joaquin River source water fraction in the Delta interior
4 would be considerable. At Franks Tract, San Joaquin River source water fractions would increase
5 between 25–57% for the entire calendar year of January through December (11–52% for October
6 through July of the modeled drought period). Changes at Rock Slough and Contra Costa PP No. 1
7 would be very similar, where modeled San Joaquin River source water fractions would increase
8 from 35–80% (25–78% for the modeled drought period) for the entire calendar year of January
9 through December. In addition, Sacramento River fractions would increase greater than 10% at
10 Staten Island and Buckley Cove (not including Banks and Jones). At Staten Island, Sacramento River
11 fractions would increase by 16% in April and 20% in May (13–15% from February through April of
12 the modeled drought period). These changes at Staten Island are not considered substantial. At
13 Buckley Cove, however, Sacramento source water fraction would increase between 36–72% (46–
14 73% for the drought period) for the entire calendar year of January through December. Although a
15 considerable change, this change in source water fraction at Buckley Cove would balance through a
16 nearly equivalent decrease in San Joaquin River water. Delta agricultural fractions would not
17 increase greater than 8% at any assessment location.

18 Relative to Existing Conditions, increases in San Joaquin River source water fraction at Franks Tract,
19 Rock Slough, and Contra Costa PP NO. 1 would primarily balance through decreases in Sacramento
20 River water, and as a result the San Joaquin River would account for greater than 50% of the total
21 source water volume at Franks Tract between October and June (>50% for November and
22 December during the modeled drought period), and would be greater than 50%, and as much as
23 86% for the entire calendar year at Rock Slough and Contra Costa PP No. 1 (greater than 50% and as
24 high as 80% for October through June of the modeled drought period). While the source water and
25 potential pesticide related toxicity co-occurrence predictions do not mean adverse effects would
26 occur, such considerable modeled increases in winter and early summer source water fraction at
27 Franks Tract and winter and summer source water fractions at Rock Slough and Contra Costa PP No.
28 1 could substantially alter the long-term risk of pesticide-related toxicity to aquatic life, given the
29 apparent greater incidence of pesticides in the San Joaquin River.

30 When compared to the No Action Alternative, changes in source water fractions would be similar in
31 season, geographic extent, and magnitude to those discussed for Existing Conditions (Appendix 8D,
32 *Source Water Fingerprinting Results*). Relative to the No Action Alternative the similar magnitude
33 increase in San Joaquin River source water fraction at Franks Tract, Rock Slough, and Contra Costa
34 PP No. 1 would be considered substantial and could substantially increase the long-term risk of
35 pesticide-related toxicity to aquatic life.

36 These predicted adverse effects on pesticides relative to Existing Conditions and the No Action
37 Alternative fundamentally assume that the present pattern of pesticide incidence in surface water
38 will occur at similar levels into the future. In reality, however, the makeup and character of the
39 pesticide use market in the late long-term (i.e., the year 2060) will not be exactly as it is today.
40 Current use of chlorpyrifos and diazinon is on the decline with their replacement by pyrethroids on
41 the rise, yet in this assessment it is the apparent greater incidence of diazinon and chlorpyrifos on
42 the San Joaquin River that serves as the basis for concluding that substantially increased San Joaquin
43 River source water fraction would correspond to an increased risk of pesticide-related toxicity to
44 aquatic life. By 2060, however, alternative pesticides, such as neonicotinoids and biologicals, will
45 likely be a more substantial contributing part of the existing mix of pesticides, and perhaps more
46 prominent. The trend in the development of future-use pesticides is towards reduced risk pesticides,

1 including more biopesticides, with greater targeted specificity, fewer residues, and lower overall
 2 non-target toxicity. By 2060 existing chlorpyrifos and diazinon TMDLs for the Sacramento and San
 3 Joaquin Rivers will have been in effect for more than 50 years. Moreover, it is reasonable to expect
 4 that CWA section 303(d) listings and future additional listings will have developed TMDLs by 2060.
 5 To the extent these existing and future TMDL's address current and future-use pesticides, a greater
 6 degree of pesticide related source control can be anticipated. Nevertheless, forecasting whether
 7 these various efforts will ultimately be successful at resolving current pesticide related impairments
 8 requires considerable speculation. While the fundamental assumptions that have guided this
 9 assessment of pesticides may be somewhat altered by 2060, these assumptions are informed by
 10 actual studies and monitoring data collected from the recent past and, therefore, judging project
 11 alternative effects in the future remain most accurate through use of these informed assumptions
 12 rather than based on assumptions founded upon future speculative conditions.

13 ***SWP/CVP Export Service Areas***

14 Assessment of effects in SWP/CVP Export Service Areas is based on effects seen in the Plan Area at
 15 the Banks and Jones pumping plants. Under Alternative 9, Sacramento River source water fractions
 16 would increase at both Banks and Jones pumping plants relative to Existing Conditions and the No
 17 Action Alternative (Appendix 8D, *Source Water Fingerprinting Results*). At Banks pumping plant,
 18 Sacramento source water fractions would generally increase from 12–38% for February through
 19 June (12–37% for February through June of the modeled drought period) and at Jones pumping
 20 plant Sacramento source water fractions would generally increase from 7–54% for the entire
 21 calendar year (14–69% for September through June of the modeled drought period). These
 22 increases in Sacramento source water fraction would primarily balance through equivalent
 23 decreases in San Joaquin River water. Based on the general observation that San Joaquin River, in
 24 comparison to the Sacramento River, is a greater contributor of OP insecticides in terms of greater
 25 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
 26 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
 27 improvement in export water quality respective to pesticides.

28 ***NEPA Effects:*** In summary, the changes in long-term average flows on the Sacramento, Feather,
 29 American, and San Joaquin Rivers, under Alternative 9 relative to the No Action Alternative, are of
 30 insufficient magnitude to substantially increase the long-term risk of pesticide-related water quality
 31 degradation and related toxicity to aquatic life in these water bodies upstream of the Delta.
 32 However, modeled increases in San Joaquin River fraction at Franks Tract, Rock Slough, and Contra
 33 Costa PP No. 1 are of sufficient magnitude to substantially alter the long-term risk of pesticide-
 34 related water quality degradation and related toxicity to aquatic life in the Delta. The effects on
 35 pesticides from operations and maintenance (CM1) are determined to be adverse and unavoidable.

36 ***CEQA Conclusion:*** Key findings discussed in the effects assessment relative to Existing Conditions is
 37 provided above are summarized here, and are then compared to the CEQA thresholds of significance
 38 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
 39 constituent. For additional details on the effects assessment findings that support this CEQA impact
 40 determination, see the effects assessment discussion that immediately precedes this conclusion.

41 Sources of pesticides upstream of the Delta include direct input of pesticide containing surface
 42 runoff from agriculture and urbanized areas. Flows in rivers receiving these discharges dilute these
 43 pesticide inputs. Relative to Existing Conditions, however, modeled changes in long-term average
 44 flows on the Sacramento, Feather, American, and San Joaquin Rivers are of insufficient magnitude to

1 substantially increase the long-term risk of pesticide-related water quality degradation and related
2 toxicity to aquatic life in these water bodies upstream of the Delta.

3 In the Delta, sources of pesticides include direct input of surface runoff from Delta agriculture and
4 Delta urbanized areas as well as inputs from rivers upstream of the Delta. While facilities operations
5 and maintenance activities would not affect these sources, changes in Delta source water fraction
6 could change the relative risk associated with pesticide related toxicity to aquatic life. Under
7 Alternative 9, modeled long-term average San Joaquin River source water fractions at Franks Tract,
8 Rock Slough and Contra Costa PP No. 1 locations would increase considerably for some months such
9 that the long-term risk of pesticide-related toxicity to aquatic life could substantially increase.

10 The assessment of Alternative 9 effects on pesticides in the SWP/CVP Export Service Areas is based
11 on assessment of changes predicted at Banks and Jones pumping plants. Sacramento River source
12 water fractions would increase substantially at both Banks and Jones pumping plants and would
13 generally represent an improvement in export water quality respective to pesticides.

14 Based on the above, Alternative 9 would not result in any substantial change in long-term average
15 pesticide concentration or result in substantial increase in the anticipated frequency with which
16 long-term average pesticide concentrations would exceed aquatic life toxicity thresholds or other
17 beneficial use effect thresholds upstream of the Delta or the SWP/CVP service area. Numerous
18 pesticides are currently used throughout the affected environment, and while some of these
19 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
20 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
21 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
22 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
23 Furthermore, while there are numerous 303(d) listings throughout the affected environment that
24 name pesticides as the cause for beneficial use impairment, the modeled changes in upstream river
25 flows and Delta source water fractions would not be expected to make any of these beneficial use
26 impairments measurably worse, with principal exception to locations in the Delta that would receive
27 a substantially greater fraction San Joaquin River water under Alternative 9. Long-term average San
28 Joaquin River source water fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1
29 locations would change considerably for the calendar year such that the long-term risk of pesticide-
30 related toxicity to aquatic life could substantially increase. Additionally, the potential for increased
31 incidence of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for
32 which existing 303(d) listings exist for the Delta, and thus existing beneficial use impairment could
33 be made discernibly worse. The impact is considered to be significant and unavoidable. There is no
34 feasible mitigation available to reduce the effect of this significant impact.

35 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of CM2–** 36 **CM21**

37 **NEPA Effects:** CM2–CM21 under Alternative 9 would be similar to conservation measures under
38 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. Effects
39 on pesticides resulting from the implementation of CM2–CM21 would be similar to those previously
40 discussed for Alternative 1A. In summary, CM13 proposes the use of herbicides to control invasive
41 aquatic vegetation around habitat restoration sites. Herbicides directly applied to water could
42 include adverse effects on non-target aquatic life, such as aquatic invertebrates and beneficial
43 aquatic plants. As such, aquatic life toxicity objectives could be exceeded with sufficient frequency

1 and magnitude such that beneficial uses would be impacted, thus constituting an adverse effect on
2 water quality.

3 In summary, based on the discussion above, the effects on pesticides from implementing CM2–CM21
4 are considered to be adverse. Mitigation Measure WQ-22 would be available to reduce this adverse
5 effect.

6 **CEQA Conclusion:** Effects of CM2–CM21 on pesticides under Alternative 9 are similar to those
7 discussed for Alternative 1A. Potential environmental effects related only to CM13 are considered to
8 be significant. Mitigation is required. While Mitigation Measure WQ-22 is available to partially
9 reduce this impact of pesticides, no feasible mitigation is available that would reduce it to a level
10 that would be less than significant.

11 **Mitigation Measure WQ-22: Implement Least Toxic Integrated Pest Management**
12 **Strategies**

13 Please see Mitigation Measure WQ-22 under Impact WQ-22 in the discussion of Alternative 1A.

14 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
15 **and Maintenance (CM1)**

16 **NEPA Effects:** Effects of water facilities and operations (CM1) on phosphorus levels in water bodies
17 of the affected environment under Alternative 9 would be very similar (i.e., nearly the same) to
18 those discussed for Alternative 1A. Consequently, the environmental consequences to phosphorus
19 levels discussed in detail for Alternative 1A also adequately represent the effects under Alternative
20 9, which are considered to be not adverse.

21 **CEQA Conclusion:** Key findings discussed in the effects assessment relative to Existing Conditions is
22 provided above are summarized here, and are then compared to the CEQA thresholds of significance
23 (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for this
24 constituent. For additional details on the effects assessment findings that support this CEQA impact
25 determination, see the effects assessment discussion that immediately precedes this conclusion.

26 Because phosphorus loading to waters upstream of the Delta is not anticipated to change, and
27 because changes in flows do not necessarily result in changes in concentrations or loading of
28 phosphorus to these water bodies, substantial changes in phosphorus concentration upstream of the
29 Delta are not anticipated for Alternative 9, relative to Existing Conditions.

30 Because phosphorus concentrations in the major source waters to the Delta are similar for much of
31 the year, phosphorus concentrations in the Delta are not anticipated to change substantially on a
32 long term-average basis under Alternative 9, relative to Existing Conditions. Algal growth rates are
33 limited by availability of light in the Delta, and therefore any minor increases in phosphorus levels
34 that may occur at some locations and times within the Delta would be expected to have little effect
35 on primary productivity in the Delta.

36 The assessment of effects of phosphorus under Alternative 9 in the SWP and CVP Export Service
37 Areas is based on effects on phosphorus at the Banks and Jones pumping plants. As noted above,
38 phosphorus concentrations in the Delta (including Banks and Jones pumping plants) are not
39 anticipated to change substantially on a long term-average basis.

1 Based on the above, there would be no substantial, long-term increase in phosphorus concentrations
 2 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 3 CVP and SWP service areas under Alternative 9 relative to Existing Conditions. As such, this
 4 alternative is not expected to cause additional exceedance of applicable water quality
 5 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 6 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
 7 are not expected to increase substantially, no long-term water quality degradation is expected to
 8 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not 303(d) listed
 9 within the affected environment and thus any minor increases that may occur in some areas would
 10 not make any existing phosphorus-related impairment measurably worse because no such
 11 impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that may
 12 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 13 turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered to be less
 14 than significant. No mitigation is required.

15 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
 16 **CM2–CM21**

17 **NEPA Effects:** Effects of CM2–CM21 on phosphorus levels in water bodies of the affected
 18 environment under Alternative 9 would be very similar (i.e., nearly the same) to those discussed for
 19 Alternative 1A. Consequently, the environmental consequences to phosphorus levels from
 20 implementing CM2–CM21 discussed in detail for Alternative 1A also adequately represent the
 21 effects of these same actions under Alternative 9, which are considered to be not adverse.

22 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 23 measures proposed under Alternative 1A. As such, effects on phosphorus resulting from the
 24 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 25 This impact is considered to be less than significant. No mitigation is required.

26 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
 27 **Maintenance (CM1)**

28 ***Upstream of the Delta***

29 For the same reasons stated for the No Action Alternative, Alternative 9 would have negligible, if
 30 any, effect on selenium concentrations in the rivers and reservoirs upstream of the Delta relative to
 31 Existing Conditions and the No Action Alternative. Any negligible increases in selenium
 32 concentrations that could occur in the water bodies of the affected environment located upstream of
 33 the Delta would not be of frequency, magnitude and geographic extent that would adversely affect
 34 any beneficial uses or substantially degrade the quality of these water bodies, with regard to
 35 selenium.

36 ***Delta***

37 Modeling scenarios included assumptions regarding how certain habitat restoration activities (CM2
 38 and CM4) would affect Delta hydrodynamics. To the extent that restoration actions alter
 39 hydrodynamics within the Delta region, which affects mixing of source waters, these effects are
 40 included in this assessment of operations-related water quality changes (i.e., CM1). Other effects of
 41 CM2–CM21 not attributable to hydrodynamics, such as additional loading of a constituent to the

1 Delta, are discussed within the impact header for CM2–CM21. See Section 8.3.1.3 for more
2 information.

3 Selenium concentrations and threshold comparisons for each of the 11 modeled Delta assessment
4 locations under Alternative 9, relative to Existing Conditions and the No Action Alternative, are
5 presented in Appendix 8M, *Selenium*, Table M-9a for water, Tables M-19 and M-29 for most biota
6 (whole-body fish [excluding sturgeon], bird eggs [invertebrate diet], bird eggs [fish diet], and fish
7 fillets) throughout the Delta, and Tables M-30 through M-32 for sturgeon at the two western Delta
8 locations. Figures 8-59a and 8-60a present graphical distributions of predicted selenium
9 concentration changes (shown as changes in available assimilative capacity based on 1.3 µg/L) in
10 water at each modeled assessment location for all years. Appendix 8M, Figure M-24, provides more
11 detail in the form of monthly patterns of selenium concentrations in water during the modeling
12 period.

13 Alternative 9 would result in small to moderate changes in average selenium concentrations in
14 water at modeled Delta assessment locations relative to Existing Conditions and the No Action
15 Alternative (Appendix 8M, *Selenium*, Table M-9a). Long-term average concentrations at some
16 interior and western Delta locations would increase by 0.01–0.21 µg/L for the entire period
17 modeled (1976–1991). These increases in selenium concentrations in water would result in
18 reductions in available assimilative capacity of 1–19%, relative to the 1.3 µg/L USEPA draft water
19 quality criterion (Figures 8-59a and 8-60a). The long-term average selenium concentrations in
20 water for Alternative 9 (range 0.09–0.37 µg/L) would be similar to Existing Conditions (range 0.09–
21 0.41 µg/L) and the No Action Alternative (range 0.09–0.38 µg/L), and all would be below the USEPA
22 draft water quality criterion of 1.3 µg/L Appendix 8M, Table M-9a).

23 Relative to Existing Conditions and the No Action Alternative, Alternative 9 would generally result in
24 small changes (less than 4%) in estimated selenium concentrations in most biota (whole-body fish
25 (excluding sturgeon), bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Figures 8-
26 61a through 8-64b; Appendix 8M, Table M-29). Despite the small changes in selenium
27 concentrations in biota, Level of Concern Exceedance Quotients (i.e., modeled tissue divided by
28 Level of Concern benchmarks) for selenium concentrations in those biota for all years and for
29 drought years are less than 1.0 (indicating low probability of adverse effects). Similarly, Advisory
30 Tissue Level Exceedance Quotients for selenium concentrations in fish fillets for all years and
31 drought years also are less than 1.0. Estimated selenium concentrations in sturgeon for the San
32 Joaquin River at Antioch are predicted to increase by about 35% relative to Existing Conditions and
33 to the No Action Alternative in all years (from about 4.7 to 6.4 mg/kg dry weight). Likewise, those
34 for sturgeon in the Sacramento River at Mallard Island are predicted to increase by about 17% in all
35 years (from about 4.4 to 5.2 mg/kg dry weight) (Appendix 8M, *Selenium*, Tables M-30 and M-31).
36 Selenium concentrations in sturgeon during drought years are expected to increase by about 35% at
37 Antioch and 17% at Mallard Island. Detection of changes in whole-body sturgeon such as those
38 estimated for the western Delta may require large sample sizes because of the inherent variability in
39 fish tissue selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium
40 concentrations in sturgeon in the western Delta would exceed 1.0 for drought years at both
41 locations (as they do for Existing Conditions and the No Action Alternative; Appendix 8M, Table M-
42 32) and for all years at Antioch, whereas Existing Conditions and the No Action Alternative do not
43 (quotient increases from 0.94 to 1.3 at Antioch) (Appendix 8M, Table M-32). High Toxicity
44 Threshold Exceedance Quotients for selenium concentrations in sturgeon in the western Delta
45 would exceed 1.0 for drought years at Antioch (where quotient increases from 0.85 to 1.2), unlike
46 Existing Conditions and the No Action Alternative (Appendix 8M, Table M-32).

1 The disparity between larger estimated changes for sturgeon and smaller changes for other biota
2 are attributable largely to differences in modeling approaches, as described in Appendix 8M,
3 *Selenium*. The model for most biota was calibrated to encompass the varying concentration-
4 dependent uptake from waterborne selenium concentrations (expressed as the K_d , which is the ratio
5 of selenium concentrations in particulates [as the lowest level of the food chain] relative to the
6 waterborne concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007
7 at various locations across the Delta. In contrast, the modeling for sturgeon could not be similarly
8 calibrated at the two western Delta locations and used literature-derived uptake factors and trophic
9 transfer factors for the estuary from Presser and Luoma (2013). As noted in the appendix, there was
10 a significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
11 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
12 concentrations. (There was no difference in bass selenium concentrations in the Sacramento River
13 at Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
14 despite a nearly 10-fold difference in waterborne selenium.) Thus, there is more confidence in the
15 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
16 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
17 waterborne selenium concentration at the two locations in different time periods.

18 Increased water residence times could increase the bioaccumulation of selenium in biota, thereby
19 potentially increasing fish tissue and bird egg concentrations of selenium (see residence time
20 discussion in Appendix 8M, *Selenium*, and Presser and Luoma [2010b]). Thus, residence time was
21 assessed for its relevance to selenium bioaccumulation. Table 8-60a shows the time for neutrally
22 buoyant particles to move through the Delta (surrogate for flow and residence time). Although an
23 increase in residence time throughout the Delta is expected under the No Action Alternative, relative
24 to Existing Conditions (because of climate change and sea level rise), the change is fairly small in
25 most areas of the Delta.

26 Relative to Existing Conditions and the No Action Alternative, increases in residence times for
27 Alternative 9 would be greater in the South Delta than in other sub-regions. Relative to Existing
28 Conditions, annual average residence times for Alternative 9 in the South Delta are expected to
29 increase by more than 18 days (Table 8-60a) and by more than 16 days relative to the No Action
30 Alternative. Increases in residence times for other sub-regions would be smaller, especially as
31 compared to Existing Conditions and the No Action Alternative. As mentioned above, these results
32 incorporate hydrodynamic effects of both CM1 and CM2 and CM4, and the effects of CM1 cannot be
33 distinguished from the effects of CM2 and CM4. However, it is expected that CM2 and CM4 are
34 substantial drivers of the increased residence time.

35 Presser and Luoma (2010b) summarized and discussed selenium uptake in the Bay-Delta (including
36 hydrologic conditions [e.g., Delta outflow and residence time for water], K_d s [the ratio of selenium
37 concentrations in particulates, as the lowest level of the food chain, relative to the water-borne
38 concentration], and associated tissue concentrations [especially in clams and their consumers, such
39 as sturgeon]). When the Delta Outflow Index (daily average flow per month) decreased by five-fold
40 (73,732 cfs in June 1998 to 12,251 cfs in October 1998), residence time doubled (from 11 to 22
41 days) and the calculated mean K_d also doubled (from 3,198 to 6,501). However, when daily average
42 Delta outflow in November 1999 was only 6,951 cfs (i.e., about one-half that in October 1998) and
43 residence time was 70 days, the calculated mean K_d (7,614) did not increase proportionally.

44 Models are not available to quantitatively estimate the level of changes in selenium bioaccumulation
45 as related to residence time, but the effects of residence time are incorporated in the

1 bioaccumulation modeling for selenium that was based on higher K_d values for drought years in
2 comparison to wet, normal, or all years (see Appendix 8M, *Selenium*). If increases in fish tissue or
3 bird egg selenium were to occur, the increases would likely be of concern only where fish tissues or
4 bird eggs are already elevated in selenium to near or above thresholds of concern. That is, where
5 biota concentrations are currently low and not approaching thresholds of concern (which, as
6 discussed above, is the case throughout the Delta, except for sturgeon in the western Delta), changes
7 in residence time alone would not be expected to cause them to then approach or exceed thresholds
8 of concern. In consideration of this factor, although the Delta as a whole is a CWA Section 303(d)-
9 listed water body for selenium, and although monitoring data of fish tissue or bird eggs in the Delta
10 are sparse, the most likely area in which biota tissues would be at levels high enough that additional
11 bioaccumulation due to increased residence time from restoration areas would be a concern is the
12 western Delta and Suisun Bay for sturgeon, as discussed above. As shown in Table 8-60a, the overall
13 increase in residence time estimated in the western Delta is 3 days relative to Existing Conditions,
14 and 1 day relative to the No Action Alternative. Given the available information, these increases are
15 small enough that they are not expected to substantially affect selenium bioaccumulation in the
16 western Delta. Because CM2 and CM4 are expected to be substantial drivers of the increased
17 residence times, further discussion is included in Impact WQ-26 below.

18 In summary, relative to Existing Conditions and the No Action Alternative, Alternative 9 would
19 result in small changes in selenium concentrations throughout the Delta for most biota (less than
20 4%), although larger increases in selenium concentrations are predicted for sturgeon in the western
21 Delta. Concentrations of selenium in sturgeon would only exceed the lower benchmark for both
22 western Delta locations for all years and drought years, indicating a low potential for effects.
23 Concentrations of selenium in sturgeon would exceed the higher benchmark for Antioch only in
24 drought years, indicating a high potential for effects. The modeling of bioaccumulation for sturgeon
25 is less calibrated to site-specific conditions than that for other biota, which was calibrated on a
26 robust dataset for modeling of bioaccumulation in largemouth bass as a representative species for
27 the Delta. Overall, the predicted increase for Alternative 9 are high enough that they may represent a
28 measureable increase in body burdens of sturgeon, which would constitute an adverse impact.

29 ***SWP/CVP Export Service Areas***

30 Alternative 9 would result in moderate decreases in average selenium concentrations in water at the
31 Banks and Jones pumping plants, relative to Existing Conditions and the No Action Alternative, for
32 the entire period modeled (Appendix 8M, *Selenium*, Table M-9a). These decreases in long-term
33 average selenium concentrations in water would result in increases in available assimilative
34 capacity for selenium at these pumping plants of 5–12%, relative to the 1.3 $\mu\text{g}/\text{L}$ USEPA draft water
35 quality criterion (Figures 8-59a and 8-60a). Furthermore, the long-term average selenium
36 concentrations in water for Alternative 9 (range 0.16–0.17 $\mu\text{g}/\text{L}$) would be well below the USEPA
37 draft water quality criterion of 1.3 $\mu\text{g}/\text{L}$ (Appendix 8M, Table M-9a).

38 Relative to Existing Conditions and the No Action Alternative, Alternative 9 would result in small
39 changes (less than 3%) in estimated selenium concentrations in biota (whole-body fish, bird eggs
40 [invertebrate diet], bird eggs [fish diet], and fish fillets) at export service areas (Figures 8-61a
41 through 8-64b; Appendix 8M, Table M-29). Concentrations in biota would not exceed any selenium
42 benchmarks for Alternative 9 (Figures 8-61a through 8-64b).

43 ***NEPA Effects:*** Based on the discussion above, the effects on selenium from Alternative 9 are
44 considered to be adverse. This determination is reached because selenium concentrations in whole-

1 body sturgeon modeled at two western Delta locations would increase by an average of 26%, which
2 may represent a measurable increase in the environment. These potentially measurable increases
3 represent an adverse impact.

4 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
5 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
6 purpose of making the CEQA impact determination for selenium. For additional details on the effects
7 assessment findings that support this CEQA impact determination, see the effects assessment
8 discussion that immediately precedes this conclusion.

9 There are no substantial point sources of selenium in watersheds upstream of the Delta, and no
10 substantial nonpoint sources of selenium in the watersheds of the Sacramento River and the eastern
11 tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to the Delta will be
12 controlled through a TMDL developed by the Central Valley Water Board (2001) for the lower San
13 Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan objectives (Central
14 Valley Water Board 2010d) and State Water Board (2010b, 2010c) that are expected to result in
15 decreasing discharges of selenium from the San Joaquin River to the Delta. Consequently, any
16 modified reservoir operations and subsequent changes in river flows under Alternative 9, relative to
17 Existing Conditions, are expected to cause negligible changes in selenium concentrations in water.
18 Any negligible changes in selenium concentrations that may occur in the water bodies of the affected
19 environment located upstream of the Delta would not be of frequency, magnitude, and geographic
20 extent that would adversely affect any beneficial uses or substantially degrade the quality of these
21 water bodies as related to selenium.

22 Relative to Existing Conditions, modeling estimates indicate that Alternative 9 would result in small
23 changes in selenium concentrations in water or most biota through the Delta, with no exceedances
24 of benchmarks for biological effects. Relative to Existing Conditions, modeling estimates indicate
25 that Alternative 9 would increase selenium concentrations in whole-body sturgeon modeled at two
26 western Delta locations by an average of 26%, which may represent a measurable increase in the
27 environment. Because both low and high toxicity benchmarks are exceeded, these potentially
28 measurable increases represent a potential impact to fish and wildlife beneficial uses.

29 The assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
30 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
31 Alternative 9 would cause no increase in the frequency with which applicable benchmarks would be
32 exceeded, and would slightly improve the quality of water in selenium concentrations at the Banks
33 and Jones pumping plants.

34 Based on the above, although waterborne selenium concentrations would not exceed applicable
35 water quality objectives/criteria; however, significant impacts on some beneficial uses of waters in
36 the Delta could occur because uptake of selenium from water to biota would be expected to increase
37 above potential effects levels at some locations, and in the western Delta where concentrations in
38 sturgeon exceed both low and high toxicity benchmarks under Existing Conditions, uptake of
39 selenium from water to sturgeon may measurably increase. In comparison to Existing Conditions,
40 water quality conditions under this alternative would increase levels of selenium (a bioaccumulative
41 pollutant) by frequency, magnitude, and geographic extent such that the affected environment
42 would be expected to have measurably higher body burdens of selenium in aquatic organisms,
43 thereby substantially increasing the health risks to wildlife (including fish); however, impacts to
44 humans consuming those organisms are not expected to occur. Water quality conditions under this

1 alternative with respect to selenium would cause long-term degradation of water quality in the
 2 western Delta. Except in the vicinity of the western Delta, water quality conditions under this
 3 alternative would not increase levels of selenium by frequency, magnitude, and geographic extent
 4 such that the affected environment would be expected to have measurably higher body burdens of
 5 selenium in aquatic organisms. The greater level of selenium bioaccumulation in the western Delta
 6 would further degrade water quality by measurable levels, on a long-term basis, for selenium and,
 7 thus, cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly
 8 worse. This impact is considered significant. *AMM27 Selenium Management*, which affords for site-
 9 specific measures to reduce effects, would be available to reduce BDCP-related effects associated
 10 with selenium. The effectiveness of AMM27 is uncertain and, therefore implementation may not
 11 reduce the identified impact to a level that would be less than significant, and therefore it is
 12 significant and unavoidable.

13 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of CM2- 14 CM21**

15 **NEPA Effects:** Effects of CM2–CM21 on selenium under Alternative 9 would be the same as those
 16 discussed for Alternative 1A and are considered not to be adverse.

17 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 18 measures proposed under Alternative 1A. As such, effects on selenium resulting from the
 19 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 20 This impact is considered to be less than significant. No mitigation is required.

21 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations 22 and Maintenance (CM1)**

23 ***Upstream of the Delta***

24 For the same reasons stated for the No Action Alternative, Alternative 9 would result in negligible,
 25 and likely immeasurable, increases in trace metal concentrations in the rivers and reservoirs
 26 upstream of the Delta, relative to Existing Conditions and the No Action Alternative. Effects due to
 27 the operation and maintenance of the conveyance facilities are expected to be immeasurable, on an
 28 annual and long-term average basis. As such, Alternative 9 would not be expected to substantially
 29 increase the frequency with which applicable Basin Plan objectives or CTR criteria would be
 30 exceeded in water bodies of the affected environment located upstream of the Delta or substantially
 31 degrade the quality of these water bodies, with regard to trace metals.

32 ***Delta***

33 For the same reasons stated for the No Action Alternative, Alternative 9 would not result in
 34 substantial increases in trace metal concentrations in the Delta relative to Existing Conditions and
 35 the No Action Alternative. However, substantial changes in source water fraction would occur in the
 36 south Delta (Appendix 8D, *Source Water Fingerprinting Results*). Throughout much of the south
 37 Delta, San Joaquin River water would replace Sacramento River water, with the future trace metals
 38 profile largely reflecting that of the San Joaquin River. As discussed for the No Action Alternative,
 39 trace metal concentration profiles between the San Joaquin and Sacramento Rivers are very similar
 40 and currently meet Basin Plan objectives and CTR criteria. While the change in trace metal
 41 concentrations in the south Delta would likely be measurable, Alternative 9 would not be expected
 42 to substantially increase the frequency with which applicable Basin Plan objectives or CTR criteria

1 would be exceeded in the Delta or substantially degrade the quality of Delta waters with regard to
2 trace metals.

3 ***SWP/CVP Export Service Areas***

4 For the same reasons stated for the No Action Alternative, Alternative 9 would not result in
5 substantial increases in trace metal concentrations in the water exported from the Delta or diverted
6 from the Sacramento River through the proposed conveyance facilities. As such, there is not
7 expected to be substantial changes in trace metal concentrations in the SWP/CVP export service
8 area waters under Alternative 9, relative to Existing Conditions and the No Action Alternative. As
9 such, Alternative 9 would not be expected to substantially increase the frequency with which
10 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
11 affected environment in the SWP and CVP Service Area or substantially degrade the quality of these
12 water bodies, with regard to trace metals.

13 ***NEPA Effects:*** In summary, Alternative 9, relative to the No Action Alternative, would not cause a
14 substantial increase in long-term average trace metals concentrations within the affected
15 environment, nor would it cause an increased frequency of water quality objective/criteria
16 exceedances within the affected environment. The effect on trace metals is determined not to be
17 adverse.

18 ***CEQA Conclusion:*** Effects of CM1 on trace metals under Alternative 9 would be similar to those
19 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
20 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
21 this constituent. For additional details on the effects assessment findings that support this CEQA
22 impact determination, see the effects assessment discussion under Alternative 1A.

23 While greater water demands under the Alternative 9 would alter the magnitude and timing of
24 reservoir releases north, south and east of the Delta, these activities would have no substantial effect
25 on the various watershed sources of trace metals. Moreover, long-term average flow and trace
26 metals at Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated;
27 therefore, changes in river flows would not be expected to cause a substantial long-term change in
28 trace metal concentrations upstream of the Delta.

29 Average and 95th percentile trace metal concentrations are very similar across the primary source
30 waters to the Delta. Given this similarity, very large changes in source water fraction would be
31 necessary to effect a relatively small change in trace metal concentration at a particular Delta
32 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
33 waters are all below their respective water quality criteria, including those that are hardness-based
34 without a WER adjustment. No mixing of these three source waters could result in a metal
35 concentration greater than the highest source water concentration, and given that trace metals do
36 not already exceed water quality criteria, more frequent exceedances of criteria in the Delta would
37 not be expected to occur under the Alternative 9.

38 The assessment of the Alternative 9 effects on trace metals in the SWP/CVP Export Service Areas is
39 based on assessment of changes in trace metal concentrations at Banks and Jones pumping plants.
40 As just discussed regarding similarities in Delta source water trace metal concentrations, the
41 Alternative 9 is not expected to result in substantial changes in trace metal concentrations in Delta
42 waters, including Banks and Jones pumping plants, therefore effects on trace metal concentrations
43 in the SWP/CVP Export Service Area are expected to be negligible.

1 Based on the above, there would be no substantial long-term increase in trace metal concentrations
2 in the rivers and reservoirs upstream of the Delta, in the Delta Region, or the SWP/CVP export
3 service area waters under Alternative 9 relative to Existing Conditions. As such, this alternative is
4 not expected to cause additional exceedance of applicable water quality objectives by frequency,
5 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
6 in the affected environment. Because trace metal concentrations are not expected to increase
7 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
8 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
9 trace metal concentrations that may occur in water bodies of the affected environment would not be
10 expected to make any existing beneficial use impairments measurably worse. The trace metals
11 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
12 bioaccumulative problems in aquatic life or humans. This impact is considered to be less than
13 significant. No mitigation is required.

14 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 15 **CM2–CM21**

16 *NEPA Effects:* CM2–CM21 under Alternative 9 would be similar to conservation measures under
17 Alternative 1A, but with changes in the south Delta to accommodate the modified corridors. Effects
18 on trace metals resulting from the implementation of CM2–CM21 would be similar to those
19 previously discussed for Alternative 1A. Implementation of CM2–CM21 would not be expected to
20 adversely affect beneficial uses of the affected environment or substantially degrade water quality
21 with respect to trace metals.

22 In summary, implementation of CM2–CM21 under Alternative 9, relative to the No Action
23 Alternative, would have negligible, if any, effect on trace metals concentrations. The effect on trace
24 metals from implementing CM2–CM21 is determined not to be adverse.

25 *CEQA Conclusion:* Implementation of CM2–CM21 under Alternative 9 would not cause substantial
26 long-term increase in trace metal concentrations in the rivers and reservoirs upstream of the Delta,
27 in the Delta Region, or the SWP/CVP export service area. As such, this alternative is not expected to
28 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
29 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
30 environment. Because trace metal concentrations are not expected to increase substantially, no
31 long-term water quality degradation for trace metals is expected to occur and, thus, no adverse
32 effects to beneficial uses would occur. Furthermore, any negligible changes in long-term trace metal
33 concentrations that may occur throughout the affected environment would not be expected to make
34 any existing beneficial use impairments measurably worse. The trace metals discussed in this
35 assessment are not considered bioaccumulative, and thus would not directly cause bioaccumulative
36 problems in aquatic life or humans. This impact is considered to be less than significant. No
37 mitigation is required.

38 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 39 **Maintenance (CM1)**

40 *NEPA Effects:* Effects of CM1 on TSS and turbidity under Alternative 9 would be the same as those
41 discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM1 is determined
42 to not be adverse.

1 **CEQA Conclusion:** Effects of CM1 on TSS and turbidity under Alternative 9 would be similar to those
 2 discussed for Alternative 1A, and are summarized here, then compared to the CEQA thresholds of
 3 significance (defined in Section 8.3.2) for the purpose of making the CEQA impact determination for
 4 this constituent. For additional details on the effects assessment findings that support this CEQA
 5 impact determination, see the effects assessment discussion under Alternative 1A.

6 Changes river flow rate and reservoir storage that would occur under Alternative 9, relative to
 7 Existing Conditions, would not be expected to result in a substantial adverse change in TSS
 8 concentrations and turbidity levels in the reservoirs and rivers upstream of the Delta, given that
 9 suspended sediment concentrations are more affected by season than flow. Site-specific and
 10 temporal exceptions may occur due to localized temporary construction activities, dredging
 11 activities, development, or other land use changes would be site-specific and temporal, which would
 12 be regulated to limit both their short-term and long-term effects on TSS and turbidity levels to less
 13 than substantial levels.

14 Within the Delta, geomorphic changes associated with sediment transport and deposition are
 15 usually gradual, occurring over years, and high storm event inflows would not be substantially
 16 affected. Thus, it is expected that the TSS concentrations and turbidity levels in the affected channels
 17 would not be substantially different from the levels under Existing Conditions. Consequently, this
 18 alternative is expected to have minimal effect on TSS concentrations and turbidity levels in the Delta
 19 region, relative to Existing Conditions.

20 There is not expected to be substantial, if even measurable, changes in TSS concentrations and
 21 turbidity levels in the SWP/CVP Export Service Areas waters under Alternative 9, relative to Existing
 22 Conditions, because as stated above, this alternative is not expected to result in substantial changes
 23 in TSS concentrations and turbidity levels at the south Delta export pumps, relative to Existing
 24 Conditions.

25 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 26 objectives where such objectives are not exceeded under Existing Conditions. Because TSS
 27 concentrations and turbidity levels are not expected to be substantially different, long-term water
 28 quality degradation is not expected, and, thus, beneficial uses are not expected to be adversely
 29 affected. Finally, TSS and turbidity are neither bioaccumulative nor Clean Water Act section 303(d)
 30 listed constituents. This impact is considered to be less than significant. No mitigation is required.

31 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of CM2–CM21**

32 **NEPA Effects:** Effects of CM2–CM21 on TSS and turbidity under Alternative 9 would be the same as
 33 those discussed for Alternative 1A. The effects on TSS and turbidity from implementing CM2–CM21
 34 is determined to not be adverse.

35 **CEQA Conclusion:** CM2–CM21 proposed under Alternative 9 would be similar to conservation
 36 measures proposed under Alternative 1A. As such, effects on TSS and turbidity resulting from the
 37 implementation of CM2–CM21 would be similar to those previously discussed for Alternative 1A.
 38 This impact is considered to be less than significant. No mitigation is required.

39 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities** 40 **(CM1–CM21)**

41 The construction activities necessary to implement new conveyance features for CM1 under
 42 Alternative 9 would involve substantially different locations and types of construction activity to

1 those discussed for Alternative 1A. In particular, the construction of permanent operable gates,
2 locks, new levees, channel improvements and enlargement within Delta channels would involve
3 considerable in-channel dredging and in-water facility construction activity. However, construction
4 techniques for many features of the conveyance system within the Delta would be similar. Landside
5 construction of water conveyance facilities under Alternative 9 would involve an array of intakes,
6 pumping plants, pipelines, culvert siphons, canals, borrow areas, and other facilities. The remainder
7 of the facilities constructed under Alternative 9, including CM2–CM21, would be very similar to, or
8 the same as, those to be constructed for Alternative 1A.

9 **NEPA Effects:** he types of potential construction-related materials used, constituent discharges, and
10 related water quality effects associated with implementation of CM1 under Alternative 9 would be
11 similar to the effects discussed for Alternative 1A, and the effects anticipated with implementation
12 of CM2–CM21 would be essentially identical. However, given the substantial differences in the
13 conveyance features under CM1, there could be differences in the location, magnitude, duration, and
14 frequency of construction activities and related water quality effects. In particular, relative to the
15 Existing Conditions and No Action Alternative conditions, the extensive in-water dredging, and
16 construction of channel enlargements, operable barriers, culvert siphons, and canal segments under
17 Alternative 9 would result in potential direct turbidity discharges and sediment resuspension.
18 Nevertheless, the construction of CM1, and any individual components necessitated by CM2, and
19 CM4–CM10, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
20 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements would result
21 in the potential water quality effects being largely avoided and minimized. The specific
22 environmental commitments that would be implemented under Alternative 9 would be similar to
23 those described for Alternative 1A with the exception that Category “B” BMPs for RTM dewatering
24 basin construction and operations, if necessary at all, would be much reduced. Consequently,
25 relative to Existing Conditions, Alternative 9 would not be expected to cause exceedance of
26 applicable water quality objectives/criteria or substantial degradation with respect to constituents
27 of concern, and thus would not adversely affect any beneficial uses upstream of the Delta, in the
28 Delta, or in the SWP and CVP service area.

29 In summary, with implementation of environmental commitments in Appendix 3B, the potential
30 construction-related water quality effects are considered to be not adverse.

31 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative 9
32 for construction-related activities along with agency-issued permits that also contain construction
33 requirements to protect water quality, the construction-related effects, relative to Existing
34 Conditions, would not be expected to cause or contribute to substantial alteration of existing
35 drainage patterns which would result in substantial erosion or siltation on- or off-site, substantial
36 increased frequency of exceedances of water quality objectives/criteria, or substantially degrade
37 water quality with respect to the constituents of concern on a long-term average basis, and thus
38 would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
39 Delta, or in the SWP and CVP service area. Moreover, because the construction-related activities
40 would be temporary and intermittent in nature, the construction would involve negligible
41 discharges, if any, of bioaccumulative or 303(d) listed constituents to water bodies of the affected
42 environment. As such, construction activities would not contribute measurably to bioaccumulation
43 of contaminants in organisms or humans or cause 303(d) impairments to be discernibly worse.
44 Based on these findings, this impact is determined to be less than significant. No mitigation is
45 required.

1 **Impact WQ-32. Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations**
2 **and Maintenance (CM1)**

3 Effects of facilities and operations (CM1) on *Microcystis* abundance, and thus microcystins
4 concentrations, in water bodies of the affected environment under Alternative 9 would be very
5 similar (i.e., nearly the same) to those discussed for Alternative 1A. This is because factors that affect
6 *Microcystis* abundance in waters upstream of the Delta, in the Delta, and in the SWP/CVP Export
7 Services Areas under Alternative 1A would similarly change under Alternative 9, relative to Existing
8 Conditions and the No Action Alternative. For the Delta in particular, there are differences in the
9 direction and magnitude of water residence time changes during the *Microcystis* bloom period
10 among the six Delta sub-regions under Alternative 9 compared to Alternative 1A, relative to Existing
11 Conditions and No Action Alternative. However, under Alternative 9, relative to Existing Conditions
12 and No Action Alternative, water residence times during the *Microcystis* bloom period in various
13 Delta sub-regions are expected to increase to a degree that could, similar to Alternative 1A, lead to
14 an increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout
15 the Delta.

16 Similar to Alternative 1A, water exported from the Delta to the SWP/CVP Export Service Areas will
17 consist of a mixture of water from the south Delta that is affected by *Microcystis* and Sacramento
18 River water diverted from the north Delta that is unaffected by *Microcystis*. Sacramento River water
19 will be conveyed through existing Delta channels under Alternative 9, in contrast to pipelines or
20 tunnels which will be constructed to convey this water under Alternative 1A. Under Alternative 9,
21 Delta channels, gates and barriers will be operated and maintained to convey Sacramento River
22 water to the south Delta pump intakes in manner to maintain the water quality of this source water.
23 Thus, it is expected that diverted Sacramento River water will remain relatively unaffected by
24 *Microcystis* until it mixes with *Microcystis*-affected water from the south Delta at Banks and Jones
25 pumping plants. For the same reasons described for Alternative 1A, it cannot be determined
26 whether operations and maintenance under Alternative 9, relative to existing conditions, will result
27 in increased or decreased levels of *Microcystis* and microcystins in the mixture of source waters
28 exported from Banks and Jones pumping plants.

29 Similar to Alternative 1A, elevated ambient water temperatures relative to Existing Conditions
30 would occur in the Delta under Alternative 9, which could lead to earlier occurrences of *Microcystis*
31 blooms in the Delta, and increase the overall duration and magnitude of blooms. However, the
32 degradation of water quality from *Microcystis* blooms due to the expected increases in Delta water
33 temperatures is driven entirely by climate change, not effects of CM1. While *Microcystis* blooms have
34 not occurred in the Export Service Areas, conditions in the Export Service Areas under Alternative 9
35 may become more conducive to *Microcystis* bloom formation, relative to Existing Conditions,
36 because water temperatures will increase in the Export Service Areas due to the expected increase
37 in ambient air temperatures resulting from climate change.

38 **NEPA Effects:** Effects of water facilities and operations (CM1) on *Microcystis* in water bodies of the
39 affected environment under Alternative 9 would be very similar to (i.e., nearly the same) to those
40 discussed for Alternative 1A. In summary, Alternative 9 operations and maintenance, relative to the
41 No Action Alternative, would result in long-term increases in hydraulic residence time of various
42 Delta sub-regions during the summer and fall *Microcystis* bloom period. During this period, the
43 increased residence time could result in a concurrent increase in the frequency, magnitude, and
44 geographic extent of *Microcystis* blooms, and thus microcystin levels, in affected areas of the Delta.
45 As a result, Alternative 9 operation and maintenance activities would cause further degradation to

1 water quality with respect to *Microcystis* in the Delta. Under Alternative 9, relative to No Action
2 Alternative, water exported to the SWP/CVP Export Service Area will be a mixture of *Microcystis*-
3 affected source water from the south Delta intakes and unaffected source water from the
4 Sacramento River, diverted at the north Delta intakes. It cannot be determined whether operations
5 and maintenance under Alternative 9 will result in increased or decreased levels of *Microcystis* and
6 microcystins in the mixture of source waters exported from Banks and Jones pumping plants.
7 Mitigation Measure WQ-32a and WQ-32b are available to reduce the effects of degraded water
8 quality in the Delta. Although there is considerable uncertainty regarding this impact, the effects on
9 *Microcystis* from implementing CM1 is determined to be adverse.

10 **CEQA Conclusion:** Key findings discussed in the effects assessment provided above are summarized
11 here, and are then compared to the CEQA thresholds of significance (defined in Section 8.3.2) for the
12 purpose of making the CEQA impact determination for this constituent. For additional details on the
13 effects assessment findings that support this CEQA impact determination, see the effects assessment
14 discussion that immediately precedes this conclusion.

15 Under Alternative 9, additional impacts from *Microcystis* in the reservoirs and watersheds upstream
16 of the Delta are not expected, relative to Existing Conditions. Operations and maintenance occurring
17 under Alternative 9 is not expected to change nutrient levels in upstream reservoirs or
18 hydrodynamic conditions in upstream rivers and streams such that conditions would be more
19 conducive to *Microcystis* production.

20 Relative to Existing Conditions, water temperatures and hydraulic residence times in the Delta are
21 expected to increase under Alternative 9, resulting in an increase in the frequency, magnitude and
22 geographic extent of *Microcystis* blooms in the Delta. However, the degradation of water quality
23 from *Microcystis* blooms due to the expected increases in Delta water temperatures is driven
24 entirely by climate change, not effects of CM1. Increases in Delta residence times are expected
25 throughout the Delta during the summer and fall bloom period, due in small part to climate change
26 and sea level rise, but due more proportionately to CM1 and the hydrodynamic impacts of
27 restoration included in CM2 and CM4. The precise change in local residence times and *Microcystis*
28 production expected within any Delta sub-region is unknown because conditions will vary across
29 the complex networks of intertwining channels, shallow back water areas, and submerged islands
30 that compose the Delta. Nonetheless, Delta residence times are, in general, expected to increase due
31 to Alternative 9. Consequently, it is possible that increases in the frequency, magnitude, and
32 geographic extent of *Microcystis* blooms in the Delta will occur due to the operations and
33 maintenance of Alternative 9 and the hydrodynamic impacts of restoration (CM2 and CM4).

34 The assessment of effects of *Microcystis* on SWP/CVP Export Service Areas is based on the
35 assessment of changes in *Microcystis* levels in export source waters, as well as the effects of
36 temperature and residence time changes within the Export Service Areas on *Microcystis* production.
37 Under Alternative 9, relative to Existing Conditions, the potential for *Microcystis* to occur in the
38 Export Service Area is expected to increase due to increasing water temperature, but this impact is
39 driven entirely by climate change and not Alternative 9. Water exported from the Delta to the Export
40 Service Area is expected to be a mixture of *Microcystis*-affected source water from the south Delta
41 intakes and unaffected source water from the Sacramento River. Because of this, it cannot be
42 determined whether operations and maintenance under Alternative 9, relative to existing
43 conditions, will result in increased or decreased levels of *Microcystis* and microcystins in the mixture
44 of source waters exported from Banks and Jones pumping plants.

1 Based on the above, this alternative would not be expected to cause additional exceedance of
 2 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 3 would cause significant impacts on any beneficial uses of waters in the affected environment.
 4 *Microcystis* and microcystins are not 303(d) listed within the affected environment and thus any
 5 increases that could occur in some areas would not make any existing *Microcystis* impairment
 6 measurably worse because no such impairments currently exist. However, because it is possible that
 7 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta will
 8 occur due to the operations and maintenance of Alternative 9 and the hydrodynamic impacts of
 9 restoration (CM2 and CM4), long-term water quality degradation may occur and, thus, significant
 10 impacts on beneficial uses could occur. Further, microcystin is bioaccumulative in the Delta foodweb
 11 (Lehman 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased
 12 microcystin presence in the Delta relative to Existing Conditions. This has potential to cause
 13 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 14 risks to fish, wildlife or humans. Although there is considerable uncertainty regarding this impact,
 15 the effects on *Microcystis* from implementing CM1 is determined to be significant.

16 Implementation of Mitigation Measure WQ-32a and WQ-32b may reduce degradation of Delta water
 17 quality due to *Microcystis*. However, because the effectiveness of these mitigation measures to result
 18 in feasible measures for reducing water quality effects is uncertain, this impact is considered to
 19 remain significant and unavoidable.

20 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 21 ***Microcystis* Blooms**

22 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

23 **Mitigation Measure WQ-32b: Investigate and Implement Operational Measures to Manage**
 24 **Water Residence Time**

25 Please see Mitigation Measure WQ-32b under Impact WQ-32 in the discussion of Alternative 1A.

26 **Impact WQ-33. Effects on *Microcystis* Bloom Formation Resulting from Other Conservation**
 27 **Measures (CM2–CM21)**

28 The effects of CM2–CM21 on *Microcystis* under Alternative 9 would be the same as those discussed
 29 for Alternative 1A. In summary, implementation of CM2 and CM4 could result in an increase in the
 30 frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta, relative to Existing
 31 Conditions and the No Action Alternative, as a result of increased residence times for Delta waters.
 32 Because the hydrodynamic effects associated with implementing CM2 and CM4 were incorporated
 33 into the modeling used to assess CM1, a detailed assessment of the effects of implementing CM2 and
 34 CM4 on *Microcystis* blooms in the Delta via their effects on Delta water residence time is provided
 35 under CM1 (above). The effects of CM2 and CM4 on *Microcystis* may be reduced by implementation
 36 of Mitigation Measures WQ-32a. The effectiveness of the mitigation measure to result in feasible
 37 measures for reducing water quality effects is uncertain. CM3 and CM5–CM21 would not result in an
 38 increase in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta.

39 **NEPA Effects:** Effects of CM2–CM21 on *Microcystis* under Alternative 9 would be the same as those
 40 discussed for Alternative 1A and are considered to be adverse.

1 **CEQA Conclusion:** Based on the above, this alternative would not be expected to cause additional
 2 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
 3 extent that would cause significant impacts on any beneficial uses of waters in the affected
 4 environment. *Microcystis* and microcystins are not 303(d) listed within the affected environment
 5 and thus any increases that could occur in some areas would not make any existing *Microcystis*
 6 impairment measurably worse because no such impairments currently exist. Because restoration
 7 actions implemented under CM2 and CM4 will increase residence time throughout the Delta and
 8 create local areas of warmer water during the bloom season, it is possible that increases in the
 9 frequency, magnitude, and geographic extent of *Microcystis* blooms, and thus long-term water
 10 quality degradation and significant impacts on beneficial uses, could occur. Further, microcystin is
 11 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 12 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 13 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 14 would, in turn, pose health risks to fish, wildlife or humans. Although there is considerable
 15 uncertainty regarding this impact, the effects on *Microcystis* from implementing CM2–CM21 are
 16 determined to be significant.

17 Implementation of Mitigation Measure WQ-32a may reduce degradation of Delta water quality due
 18 to *Microcystis*. However, because the effectiveness of this mitigation measure to result in feasible
 19 measures for reducing water quality effects is uncertain, this impact is considered to remain
 20 significant and unavoidable.

21 **Mitigation Measure WQ-32a: Design Restoration Sites to Reduce Potential for Increased**
 22 ***Microcystis* Blooms**

23 Please see Mitigation Measure WQ-32a under Impact WQ-32 in the discussion of Alternative 1A.

24 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 25 **Operations and Maintenance (CM1) and Implementation of CM2–CM21**

26 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 27 that Alternative 9 would have a less than significant impact/no adverse effect on the following
 28 constituents in the Delta:

- 29 ● Boron
- 30 ● DO
- 31 ● Pathogens
- 32 ● Pesticides
- 33 ● Trace Metals
- 34 ● Turbidity and TSS

35 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 36 However, waters in the San Francisco Bay are not designated to support MUN and AGR beneficial
 37 uses. Changes in Delta DO, pathogens, pesticides, and turbidity and TSS are not anticipated to be of a
 38 frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 39 substantially degrade the quality of the Delta. Thus, changes in boron, DO, pathogens, pesticides, and
 40 turbidity and TSS in Delta outflow are not anticipated to be of a frequency, magnitude and

1 geographic extent that would adversely affect any beneficial uses or substantially degrade the
2 quality of the of San Francisco Bay.

3 The effects of Alternative 9 on bromide, chloride, and DOC, in the Delta were determined to be
4 significant/adverse. Increases in bromide, chloride, and DOC concentrations are of concern in
5 drinking water supplies; however, as described previously, the San Francisco Bay does not have a
6 designated MUN use. Thus, changes in bromide, chloride, and DOC in Delta outflow would not
7 adversely effect any beneficial uses of San Francisco Bay.

8 Elevated EC, as assessed for this alternative, is of concern for its effects on the AGR AGR and fish and
9 wildlife beneficial uses. As discussed above, San Francisco Bay does not have an AGR beneficial use
10 designation. Further, as discussed for the No Action Alternative, changes in Delta salinity would not
11 contribute to measurable changes in Bay salinity, as the change in Delta outflow, which would be the
12 primary driver of salinity changes, would be two to three orders of magnitude lower than (and thus
13 minimal compared to) the Bay's tidal flow.

14 Also, as discussed for the No Action Alternative, adverse changes in *Microcystis* levels that could
15 occur in the Delta would not cause adverse *Microcystis* blooms in San Francisco Bay, because
16 *Microcystis* are intolerant of the Bay's high salinity and, thus have not been detected downstream of
17 Suisun Bay.

18 While effects of Alternative 9 on the nutrients ammonia, nitrate, and phosphorus were determined
19 to be less than significant/not adverse, these constituents are addressed further below because the
20 response of the seaward bays to changed nutrient concentrations/loading may differ from the
21 response of the Delta. Selenium and mercury are discussed further, because they are
22 bioaccumulative constituents where changes in load due to both changes in Delta concentrations
23 and exports are of concern.

24 **Nutrients: Ammonia, Nitrate, and Phosphorus**

25 Total nitrogen loads in Delta outflow to Suisun and San Pablo Bays under Alternative 9 would be
26 dominated almost entirely by nitrate, because planned upgrades to the SRWTP will result in >95%
27 removal of ammonia in its effluent. Total nitrogen loads to Suisun and San Pablo Bays would
28 decrease by 17%, relative to Existing Conditions, and increase by 21%, relative to the No Action
29 Alternative (Appendix 80, *San Francisco Bay Analysis*, Table O-1). The change in nitrogen loading to
30 Suisun and San Pablo Bays under Alternative 9 would not adversely impact primary productivity in
31 these embayments because light limitation and grazing currently limit algal production in these
32 embayments. To the extent that algal growth increases in relation to a change in ammonia
33 concentration, this would have net positive benefits, because current algal levels in these
34 embayments are low. Nutrient levels and ratios are not considered a direct driver of *Microcystis* and
35 cyanobacteria levels in the North Bay.

36 The phosphorus load exported from the Delta to Suisun and San Pablo Bays for Alternative 9 is
37 estimated to increase by 5%, relative to Existing Conditions, and there would be no change relative
38 to the No Action Alternative (Appendix 80, Table O-1). The only postulated effect of changes in
39 phosphorus loads to Suisun and San Pablo Bays is related to the influence of nutrient stoichiometry
40 on primary productivity. However, there is uncertainty regarding the impact of nutrient ratios on
41 phytoplankton community composition and abundance. Any effect on phytoplankton community
42 composition would likely be small compared to the effects of grazing from introduced clams and
43 zooplankton in the estuary (Senn and Novick 2014; Kimmerer and Thompson 2014). Therefore, the

1 projected change in total nitrogen and phosphorus loading that would occur in Delta outflow to San
2 Francisco Bay is not expected to result in degradation of water quality with regard to nutrients that
3 would result in adverse effects to beneficial uses.

4 **Mercury**

5 The estimated long-term average mercury and methylmercury loads in Delta exports are shown in
6 Appendix 80, *San Francisco Bay Analysis*, Table O-2. Loads of mercury and methylmercury from the
7 Delta to San Francisco Bay are estimated to change relatively little due to changes in source water
8 fractions and net Delta outflow that would occur under Alternative 9. Mercury load to the Bay is
9 estimated to increase by 8 kg/year (3%), relative to Existing Conditions, and 5 kg/year (2%),
10 relative to the No Action Alternative. Methylmercury load is estimated to increase by 0.14 kg/year
11 (4%), relative to Existing Conditions, and increase by 0.05 kg/year (1%) relative to the No Action
12 Alternative. The estimated total mercury load to the Bay is 268 kg/year, which would be less than
13 the San Francisco Bay mercury TMDL WLA for the Delta of 330 kg/year. The estimated changes in
14 mercury and methylmercury loads would be within the overall uncertainty associated with the
15 estimates of long-term average net Delta outflow and the long-term average mercury and
16 methylmercury concentrations in Delta source waters. The estimated changes in mercury load
17 under the alternative would also be substantially less than the considerable differences among
18 estimates in the current mercury load to San Francisco Bay (San Francisco Bay Regional Water
19 Quality Control Board 2006; David et al. 2009).

20 Given that the estimated incremental increases of mercury and methylmercury loading to San
21 Francisco Bay would fall within the uncertainty of current mercury and methylmercury load
22 estimates, the estimated changes in mercury and methylmercury loads in Delta exports to San
23 Francisco Bay due to Alternative 9 are not expected to result in adverse effects to beneficial uses or
24 substantially degrade the water quality with regard to mercury, or make the existing CWA Section
25 303(d) impairment measurably worse.

26 **Selenium**

27 Changes in source water fraction and net Delta outflow under Alternative 9, relative to Existing
28 Conditions, are projected to cause the total selenium load to the North Bay to increase by 16%,
29 relative to Existing Conditions, and increase by 13%, relative to the No Action Alternative (Appendix
30 80, *San Francisco Bay Analysis*, Table O-3). Changes in long-term average selenium concentrations of
31 the North Bay are assumed to be proportional to changes in North Bay selenium loads. Under
32 Alternative 9, the long-term average total selenium concentration of the North Bay is estimated to be
33 0.15 µg/L and the dissolved selenium concentration is estimated to be 0.13 µg/L, which would be a
34 0.02 µg/L increase relative to Existing Conditions and the No Action Alternative (Appendix 80, Table
35 O-3). The dissolved selenium concentration would be below the target of 0.202 µg/L developed by
36 Presser and Luoma (2013) to coincide with a white sturgeon whole-body fish tissue selenium
37 concentration not greater than 8 mg/kg in the North Bay.

38 The incremental increase in dissolved selenium concentrations projected to occur under Alternative
39 9, relative to Existing Conditions and the No Action Alternative, would be higher than under
40 Alternatives 1A–5, but still low (0.02 µg/L). The increased dissolved selenium concentration would
41 be within the overall uncertainty of the analytical methods used to measure selenium in water
42 column samples; however, it also would be within the uncertainty associated with estimating
43 numeric water column selenium thresholds (Presser and Luoma 2013). As described in Section
44 8.3.1.8, there have been improvements in selenium concentrations in the tissue of diving ducks and

1 muscle of white sturgeon since the initial CWA Section 303(d) listing of the North Bay for selenium
2 impairments, and selenium concentrations in white sturgeon muscle have also generally been below
3 the USEPA's draft recommended fish muscle tissue concentration of 11.8 mg/kg dry weight (San
4 Francisco Estuary Institute 2014). However, as described under Impact WQ-25, though there is
5 some uncertainty in the estimate of sturgeon concentrations at western Delta locations, the
6 predicted increases for Alternative 9 are high enough that they may represent measurably higher
7 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
8 wildlife (including fish). Because the projected incremental increases in dissolved selenium could
9 cause measurable changes in water column concentrations, and these incremental increases would
10 be within the uncertainty in the target water column threshold for dissolved selenium for protection
11 against adverse bioaccumulative effects in the North Bay ecosystem, and modeling predicts
12 concentrations in the western Delta may represent a measurable increase in body burdens of
13 sturgeon, there is potential that the incremental increase in dissolved selenium concentration
14 projected to occur in the North Bay under Alternative 9 could result in adverse effects beneficial
15 uses.

16 **NEPA Effects:** Based on the discussion above, Alternative 9, relative to the No Action Alternative,
17 would not cause further degradation to water quality with respect to boron, bromide, chloride, DO,
18 DOC, EC, mercury, pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or
19 turbidity and TSS in the San Francisco Bay. Further, changes in these constituent concentrations in
20 Delta outflow would not be expected to cause changes in Bay concentrations of frequency,
21 magnitude, and geographic extent that would adversely affect any beneficial uses. In summary,
22 based on the discussion above, effects on the San Francisco Bay from implementation of CM1–CM21
23 are considered to be not adverse with respect to boron, bromide, chloride, DO, DOC, EC, mercury,
24 pathogens, pesticides, nutrients (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS.
25 However, Alternative 9 could result in increases in selenium concentrations in the North San
26 Francisco Bay that could result in adverse effects to fish and wildlife beneficial uses. This effect is
27 considered to be adverse.

28 **CEQA Conclusion:** Based on the above, Alternative 9 would not be expected to cause long-term
29 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
30 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
31 would result in substantially increased risk for adverse effects to one or more beneficial uses with
32 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
33 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Further, based on the above, this
34 alternative would not be expected to cause additional exceedance of applicable water quality
35 objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent that
36 would cause significant impacts on any beneficial uses of waters in the affected environment with
37 respect to boron, bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, nutrients
38 (ammonia, nitrate, phosphorus), trace metals, or turbidity and TSS. Any changes in boron, bromide,
39 chloride, and DOC in the San Francisco Bay would not adversely affect beneficial uses, because the
40 uses most affected by changes in these parameters, MUN and AGR, are not beneficial uses of the Bay.
41 Further, no substantial changes in DO, pathogens, pesticides, trace metals or turbidity or TSS are
42 anticipated in the Delta, relative to Existing Conditions, therefore, no substantial changes these
43 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
44 measurable changes in Bay salinity, as the change in Delta outflow would two to three orders of
45 magnitude lower than (and thus minimal compared to) the Bay's tidal flow. Adverse changes in
46 *Microcystis* levels that could occur in the Delta would not cause adverse *Microcystis* blooms in the

1 Bay, because *Microcystis* are intolerant of the Bay's high salinity and, thus not have not been
 2 detected downstream of Suisun Bay. The 17% decrease in total nitrogen load and 5% increase in
 3 phosphorus load, relative to Existing Conditions, are expected to have minimal effect on water
 4 quality degradation, primary productivity, or phytoplankton community composition. The estimated
 5 increase in mercury load (8 kg/year; 3%) and methylmercury load (0.14 kg/year; 4%), relative to
 6 Existing Conditions, is within the level of uncertainty in the mass load estimate and not expected to
 7 contribute to water quality degradation, make the CWA section 303(d) mercury impairment
 8 measurably worse or cause mercury/methylmercury to bioaccumulate to greater levels in aquatic
 9 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans.

10 In regard to selenium, the estimated increase in selenium load would be 16% and the estimated
 11 increase in dissolved selenium concentrations would be 0.02 µg/L. Though there is some
 12 uncertainty in the estimate of sturgeon concentrations at western Delta locations, the predicted
 13 increases are high enough that they may represent measurably higher body burdens of selenium in
 14 aquatic organisms, thereby substantially increasing the health risks to wildlife (including fish). Thus,
 15 the increase in selenium load may make the CWA section 303(d) selenium impairment measurably
 16 worse and cause selenium to bioaccumulate to greater levels in aquatic organisms that would, in
 17 turn, pose substantial health risks to fish and wildlife. This impact is considered to be
 18 significant. *AMM27 Selenium Management*, which affords for site-specific measures to reduce effects,
 19 would be available to reduce BDCP-related effects associated with selenium. The effectiveness of
 20 AMM27 is uncertain and, therefore implementation may not reduce the identified impact to a level
 21 that would be less than significant, and therefore it is significant and unavoidable.

22 **8.3.4 Effects and Mitigation Approaches—Alternatives 4A,** 23 **2D, and 5A**

24 **8.3.4.1 No Action Alternative Early Long-Term**

25 Discussion of water quality impacts of the No Action Alternative (ELT) was first provided in the
 26 Partially Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental
 27 Impact Statement (RDEIR/SDEIS). The water quality assessments in the RDEIR/SDEIS for boron,
 28 bromide, chloride, DOC, EC, mercury, nitrate, and selenium in the Delta and SWP/CVP Export
 29 Services Areas utilized results from water quality modeling that assumed no implementation of Yolo
 30 Bypass improvements or tidal habitat restoration. The analysis of effects of the No Action
 31 Alternative (ELT) presented herein on boron, bromide, chloride, DOC, EC, mercury, nitrate, and
 32 selenium in the Delta and SWP/CVP Export Service Areas is based on revised modeling, which
 33 assumed implementation of Yolo Bypass improvements, but no tidal habitat restoration. The water
 34 quality impact conclusions for the No Action Alternative (ELT) in this Final EIR/EIS remain the same
 35 as those presented in the RDEIR/SDEIS. The revisions to the assessment are in the presentation of
 36 modeled changes in concentrations, water quality criteria/objective exceedances, and use of
 37 assimilative capacity.

38 As described in Section Chapter 3, Section 3.5.17, *No Action Alternative ELT*, 8,000 acres of tidal
 39 habitat restoration areas would be developed under the No Action Alternative (ELT). In general, the
 40 significance of this relative to the modeling results that do not reflect this restoration area is the
 41 assessment of bromide, chloride and EC for the No Action Alternative (ELT), relative to Existing
 42 Conditions, may underestimate increases in bromide, EC, and chloride that could occur, particularly
 43 in the west Delta. Nevertheless, there is some uncertainty in the results of all quantitative

1 assessments that refer to modeling results, due to the differing assumptions used in the modeling
2 and the description of the No Action Alternative (ELT).

3 Note that the numbering of water quality impacts for the No Action Alternative (ELT), presented
4 below, is consistent with the numbering of impacts for Alternatives 4A, 2D, and 5A. For the project
5 alternatives, two numbered impacts are provided for each constituent or constituent class, one for
6 impacts due to water conveyance facilities operations and maintenance and the other for impacts
7 due to Environmental Commitments. For the No Action Alternative (ELT), only discussion of impacts
8 due to water conveyance facilities operations and maintenance is applicable. Therefore, only one
9 numbered impact for each constituent or constituent-class is provided for the No Action Alternative
10 (ELT), consistent with the numbering for Alternatives 4A, 2D, and 5A water conveyance facilities
11 operations and maintenance impacts.

12 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 13 **Maintenance**

14 The effects of the No Action Alternative (ELT) on ammonia levels in surface waters upstream of the
15 Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would
16 be similar to those described for the No Action Alternative (LLT) discussed in Section 8.3.3.1. This is
17 because factors which affect ammonia levels in these areas would be similar at the ELT and LLT
18 timeframes. The Sacramento Regional County Sanitation District will have completed modifications
19 to the Sacramento Regional Wastewater Treatment Plant (SRWTP) in the ELT that will substantially
20 reduce ammonia in the treated wastewater discharge and thus substantially lower concentrations of
21 ammonia in the Sacramento River downstream of the SRWTP relative to Existing Conditions. A
22 substantial decrease in Sacramento River ammonia concentrations is expected to decrease ammonia
23 concentrations for all areas that are influenced by Sacramento River water, which includes various
24 locations in the Delta and at Jones and Banks Pumping Plants where Delta water is exported to the
25 SWP/CVP Export Service Areas. At locations which are not influenced notably by Sacramento River
26 water, concentrations are expected to remain relatively unchanged relative to Existing Conditions.
27 Based on these factors and for the reasons described for the No Action Alternative (LLT) in Section
28 8.3.3.1, the effects on ammonia from implementing the No Action Alternative (ELT) would not be
29 adverse.

30 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on ammonia levels in surface
31 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
32 Existing Conditions would be similar to those described for the No Action Alternative (LLT). This is
33 because factors that would directly affect ammonia levels in the surface waters of these areas are
34 expected to be similar in the ELT and LLT. As such, this alternative is not expected to cause
35 additional exceedance of applicable water quality objectives/criteria by frequency, magnitude, and
36 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
37 environment. Because ammonia concentrations are not expected to increase substantially, no long-
38 term water quality degradation is expected to occur and, thus, no adverse effects to beneficial uses
39 would occur. Ammonia is not CWA Section 303(d) listed within the affected environment and thus
40 any minor increases that may occur in some areas would not make any existing ammonia-related
41 impairment measurably worse because no such impairments currently exist. Because ammonia is
42 not bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to
43 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
44 or humans. Based on these findings, this impact is considered less than significant.

1 **Impact WQ-3: Effects on Boron Concentrations Resulting from Existing Facilities Operations** 2 **and Maintenance**

3 ***Upstream of the Delta***

4 The effects of the No Action Alternative (ELT) on boron concentrations in reservoirs and rivers
5 upstream of the Delta would be similar to those effects described for the No Action Alternative (LLT)
6 in Section 8.3.3.1. There would be no expected change to the sources of boron in the Sacramento
7 River and eastside tributary watersheds, and changes in the magnitude and timing of reservoir
8 releases and river flows upstream of the Delta would have negligible, if any, effect on the
9 concentration of boron in the rivers and reservoirs of these watersheds. The modeled annual
10 average lower San Joaquin River flow at Vernalis would decrease slightly compared to Existing
11 Conditions in association with climate change and increased water demands. The reduced flow
12 would result in possible increases in long-term average boron concentrations of up to about 0.5%
13 relative to the Existing Conditions (Appendix 8F, *Boron*, Table Bo-32). Consequently, the increases in
14 lower San Joaquin River boron levels under the No Action Alternative (ELT), relative to Existing
15 Conditions, would be small and not adversely affect any beneficial uses of the lower San Joaquin
16 River.

17 ***Delta***

18 Relative to Existing Conditions, the No Action Alternative (ELT) would result in similar or decreased
19 long-term annual average boron concentrations at all of the Delta assessment locations for the 16-
20 year period modeled (i.e., 1976–1991) (Appendix 8F, *Boron*, Table Bo-24). For the drought year
21 period modeled (i.e., 1987–1991), the No Action Alternative (ELT) would result in increased annual
22 average concentrations at Franks Tract (1% increase), Old River at Rock Slough (1% increase), and
23 the Sacramento River at Emmaton (3% increase) relative to Existing Conditions.

24 With respect to the 2,000 µg/L EPA drinking water human health advisory objective (i.e., for
25 children) and agricultural objective of 500 µg/L contained in the San Francisco Bay Water Board
26 (Region 2) Basin Plan, the long-term annual average boron concentrations, for either the 16-year
27 period or drought period modeled, are low and would not exceed these objectives at any of the
28 eleven Delta assessment locations (Appendix 8F, *Boron*, Table Bo-3C). The maximum long-term
29 average concentration of about 423 µg/L in the Sacramento River at Mallard Island under the No
30 Action Alternative (ELT) represents a slight decrease from the Existing Conditions. Accordingly, the
31 long-term assimilative capacity with respect to both objectives would not change substantially, thus
32 boron levels that may occur under the No Action Alternative (ELT), relative to Existing Conditions,
33 would not be expected to adversely affect municipal water supply beneficial uses of the Delta.

34 ***SWP/CVP Export Service Areas***

35 Under the No Action Alternative (ELT), a relatively small increase would occur in the long-term
36 average boron concentration at the Jones Pumping Plant, relative to the Existing Conditions (i.e., up
37 to 1% for both the 16-year and drought period modeled) and a small decrease would occur at the
38 Banks Pumping Plant (i.e., reduced 1%) (Appendix 8F, *Boron*, Table Bo-24). The small change in
39 boron concentrations exported from the Delta would not be expected to measurably affect boron
40 levels in the lower San Joaquin River at Vernalis or the existing CWA Section 303(d) impairment in
41 the lower San Joaquin River and associated TMDL actions for reducing boron loading.

1 In summary, the effects of additional future climate change/sea level rise under the No Action
2 Alternative (ELT) condition would result in relatively small changes in long-term average boron
3 concentrations in the lower San Joaquin River and several Delta locations. However, the predicted
4 changes would not be expected to cause exceedances of applicable objectives or further measurable
5 water quality degradation, and thus would not constitute an adverse effect on water quality. The
6 changes to long-term and monthly average boron concentrations at locations upstream of the Delta,
7 in the Delta, and the SWP/CVP Export Service areas under the No Action Alternative (ELT) would be
8 similar or lower in magnitude relative to effects described for the No Action Alternative (LLT) in
9 Section 8.3.3.1.

10 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on boron levels in surface waters
11 upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing
12 Conditions would be similar to those described for the No Action Alternative (LLT). This is because
13 factors that would directly affect boron levels in the surface waters of these areas are expected to be
14 similar at the ELT and LLT timeframes. As such, the No Action Alternative (ELT) is not expected to
15 cause additional exceedance of applicable water quality objectives/criteria by frequency, magnitude,
16 and geographic extent that would cause adverse effects on any beneficial uses of waters in the
17 affected environment. Because boron concentrations are not expected to increase substantially, no
18 long-term water quality degradation is expected to occur and, thus, no adverse effects to beneficial
19 uses would occur. Additionally, the changes in long-term average boron concentrations in exported
20 water would not result in further degradation or the existing impairment and CWA Section 303(d)
21 listing of boron in the lower San Joaquin River for the agricultural water supply beneficial use to be
22 discernibly worse. Boron is not a bioaccumulative constituent, thus any increased concentrations
23 under the No Action Alternative (ELT) would not result in adverse boron bioaccumulation effects to
24 aquatic life or humans. Based on these findings, this impact is determined to be less than significant.

25 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 26 **Maintenance**

27 ***Upstream of the Delta***

28 The effects of the No Action Alternative (ELT) on bromide concentrations in reservoirs and rivers
29 upstream of the Delta would be similar to those effects described for the No Action Alternative (LLT)
30 in Section 8.3.3.1, because factors affecting bromide concentrations in these water bodies would be
31 the same in the ELT. There would be no expected change to the sources of bromide in the
32 Sacramento River and eastside tributary watersheds, and changes in the magnitude and timing of
33 reservoir releases north and east of the Delta would have negligible, if any, effect on the sources, and
34 ultimately the concentration of bromide in the Sacramento River, the eastside tributaries, and the
35 various reservoirs of the related watersheds. The modeled annual average lower San Joaquin River
36 flow at Vernalis would decrease slightly (1%) compared to Existing Conditions in association with
37 climate change and increased water demands, but the associated change would less than in the LLT,
38 and any associated bromide increase would not be substantial, as described for the LLT (Appendix
39 8E, *Bromide*, Table 24). Moreover, there are no existing municipal intakes on the lower San Joaquin
40 River. Consequently, the No Action Alternative (ELT) would not be expected to adversely affect the
41 MUN beneficial use, or any other beneficial uses, of the Sacramento River, the San Joaquin River, the
42 eastside tributaries, or their associated reservoirs upstream of the Delta due to changes in bromide
43 concentrations.

1 Delta

2 Estimates of bromide concentrations at Delta assessment locations were generated using a mass
3 balance approach, and using relationships between EC and chloride and between chloride and
4 bromide and DSM2 EC output. See Section 8.3.1.3 for more information regarding these modeling
5 approaches. The assessment below identifies changes in bromide at Delta assessment locations
6 based on both approaches.

7 Relative to Existing Conditions, the No Action Alternative (ELT) would result in small decreases or
8 essentially no change in long-term average bromide concentrations at all modeled Delta assessment
9 locations (Appendix 8E, *Bromide*, Tables 22 and 23). Long-term average concentrations of seawater-
10 derived constituents generally decrease under the No Action Alternative (ELT) relative to Existing
11 Conditions because the No Action Alternative (ELT) includes Fall X2 operations, while Existing
12 Conditions does not (Appendices 3D, *Defining Existing Conditions, No Action Alternative, No Project*
13 *Alternative, and Cumulative Impact Condition*, and 5A, *BDCP/California WaterFix FEIR/FEIS Modeling*
14 *Technical Appendix*). Therefore, even though sea level rise is included in the No Action Alternative
15 (ELT), and not in Existing Conditions, the effect of Fall X2 on bromide is generally greater than sea
16 level rise.

17 The modeled frequency with which bromide concentrations would exceed bromide thresholds
18 would change only slightly at Delta assessment locations (Appendix 8E, *Bromide*, Table 22). Small
19 increases in exceedance of the CALFED Drinking Water Program long-term goal of 50 µg/L would
20 occur at the Mokelumne River at Staten Island (4% increase), in the Sacramento River at Emmaton
21 (2% increase) and in Old River at Rock Slough (1% increase). Small increases in exceedance of 100
22 µg/L, which is the concentration believed to be sufficient to meet currently established drinking
23 water criteria for disinfection byproducts, would occur at some Delta interior and western Delta
24 assessment locations. In the Delta interior at Rock Slough and Franks Tract, the frequency of
25 exceeding 100 µg/L would increase by up to 2%. In the western Delta, the frequency of exceeding
26 100 µg/L would increase by up to 5% at Emmaton, by up to 2% at Antioch and up to 1% at Mallard
27 Island. As described for the No Action Alternative (LLT) in Section 8.3.3.1, the resulting bromide
28 concentrations would not be expected to adversely affect MUN beneficial uses, or any other
29 beneficial use, particularly when considering the relatively small change in long-term annual
30 average concentration.

31 Results of the modeling approach which used relationships between EC and chloride and between
32 chloride and bromide were consistent with the discussion above, and assessment of bromide using
33 these data results in the same conclusions as are presented above for the mass-balance approach
34 (Appendix 8E, *Bromide*, Table 23).

35 SWP/CVP Export Service Areas

36 Under the No Action Alternative (ELT), long-term average bromide concentrations at the Banks and
37 Jones Pumping Plants would decrease by as much as 6% relative to Existing Conditions (Appendix
38 8E, *Bromide*, Table 22), based on the mass balance modeling results. The frequency with which
39 bromide would exceed bromide concentration thresholds at the Banks and Jones Pumping Plants,
40 relative to Existing Conditions, would remain unchanged (Appendix 8E, *Bromide*, Table 22).
41 Consequently water exported into the SWP/CVP Export Service Areas through these south Delta
42 pumps would be of similar or slightly better quality with regard to bromide under the No Action
43 Alternative (ELT), relative to Existing Conditions. Results of the modeling approach which used
44 relationships between EC and chloride and between chloride and bromide were consistent these

1 results, and assessment of bromide using these modeling results leads to the same conclusions as
2 presented for the mass balance approach (Appendix 8E, *Bromide*, Table 23).

3 In summary, the effects of additional future climate change/sea level rise under the No Action
4 Alternative (ELT) condition would result in relatively small changes in long-term average bromide
5 concentrations in the lower San Joaquin River and several Delta locations. However, the predicted
6 changes would not be expected to cause exceedances of applicable objectives or further measurable
7 water quality degradation, and thus would not constitute an adverse effect on water quality. The
8 changes to long-term and monthly average boron concentrations at locations upstream of the Delta,
9 in the Delta, and the SWP/CVP Export Service areas under the No Action Alternative (ELT) would be
10 similar or lower in magnitude relative to effects described for the No Action Alternative (LLT) in
11 Section 8.3.3.1.

12 Maintenance of SWP and CVP facilities under the No Action Alternative (ELT) would not be expected
13 to create new sources of bromide or contribute towards a substantial change in existing sources of
14 bromide in the affected environment. Maintenance activities would not be expected to cause any
15 substantial change in bromide such that MUN beneficial uses, or any other beneficial use, would be
16 adversely affected anywhere in the affected environment.

17 **CEQA Conclusion:** While greater water demands under the No Action Alternative (ELT) would alter
18 the magnitude and timing of reservoir releases north and east of the Delta, these activities would
19 have negligible, if any, effect on the sources of bromide, and ultimately the concentration of bromide
20 in the Sacramento River, the San Joaquin River, the eastside tributaries, and the various reservoirs of
21 the related watersheds, as described for the No Action Alternative (LLT).

22 Relative to Existing Conditions, the No Action Alternative (ELT) would result in small decreases or
23 essentially no change in average bromide concentrations at all modeled Delta assessment locations.
24 Small increases in bromide threshold exceedances would occur at some Delta interior and western
25 Delta assessment locations, including the Mokelumne River at Staten Island, Rock Slough, Franks
26 Tract, Emmaton, Antioch and Mallard Island, but the resulting conditions would not be expected to
27 adversely affect MUN beneficial uses, or any other beneficial use.

28 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
29 of changes in bromide concentrations at Banks and Jones Pumping Plants. Average bromide
30 concentrations at the Banks and Jones Pumping Plants are predicted to decrease by as much as 6%
31 relative to Existing Conditions while exceedance of bromide concentration thresholds at the Banks
32 and Jones Pumping Plants would remain unchanged.

33 Based on the above, the No Action Alternative (ELT) would not cause exceedance of applicable state
34 or federal numeric or narrative water quality objectives/criteria because none exist for bromide.
35 The No Action Alternative (ELT) would not result in any substantial change in long-term average
36 bromide concentration or exceed 50 and 100 µg/L assessment threshold concentrations by
37 frequency, magnitude, and geographic extent that would result in adverse effects on any beneficial
38 uses within affected water bodies. Bromide is not a bioaccumulative constituent and thus
39 concentrations under this alternative would not result in bromide bioaccumulating in aquatic
40 organisms. Increases in exceedances of the 100 µg/L assessment threshold concentration would be
41 5% or less at all locations assessed, which is considered to be less-than substantial long-term
42 degradation of water quality. The levels of bromide degradation that may occur under the No Action
43 Alternative (ELT) would not be of sufficient magnitude to cause substantially increased risk for
44 adverse effects on any beneficial uses of water bodies within the affected environment. Bromide is

1 not CWA Section 303(d) listed and thus the minor increases in long-term average bromide
 2 concentrations would not affect existing beneficial use impairment because no such use impairment
 3 currently exists for bromide. Based on these findings, this impact is less than significant.

4 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 5 **Maintenance**

6 ***Upstream of the Delta***

7 The effects of the No Action Alternative (ELT) on chloride concentrations in reservoirs and rivers
 8 upstream of the Delta would be similar to those effects described for the No Action Alternative in
 9 Section 8.3.3.1, because factors affecting chloride concentrations in these water bodies would be the
 10 same in the early long-term timeframe. There would be no expected change to the sources of
 11 chloride in the Sacramento River and eastside tributary watersheds, and changes in the magnitude
 12 and timing of reservoir releases north and east of the Delta would have negligible, if any, effect on
 13 the sources, and ultimately the concentration of chloride in the Sacramento River, the eastside
 14 tributaries, and the various reservoirs of the related watersheds. The modeled annual average lower
 15 San Joaquin River flow at Vernalis would decrease slightly (1%) compared to Existing Conditions in
 16 association with climate change and increased water demands, but the associated change would less
 17 than under the LLT, and any associated chloride increase would be less than substantial, as
 18 described for the LLT. Moreover, there are no existing municipal intakes on the lower San Joaquin
 19 River. Consequently, the No Action Alternative (ELT) would not be expected to cause exceedance of
 20 chloride objectives or substantially degrade water quality with respect to chloride and thus would
 21 not adversely affect any beneficial uses of the Sacramento River, the San Joaquin River, the eastside
 22 tributaries, or their associated reservoirs upstream of the Delta.

23 ***Delta***

24 Estimates of chloride concentrations at Delta assessment locations were generated using a mass
 25 balance approach and EC chloride relationships and DSM2 EC output. See Section 8.3.1.3 for more
 26 information regarding these modeling approaches. The assessment below identifies changes in
 27 chloride at Delta assessment locations based on both approaches.

28 Relative to Existing Conditions, the mass balance modeling predicts that the No Action Alternative
 29 (ELT) would result in similar, or in small decreases in, long-term average chloride concentrations
 30 for the 16-year period modeled (i.e., 1976–1991) at all Delta assessment locations except the
 31 Sacramento River at Emmaton (Appendix 8G, *Chloride*, Table CI-65). In the Sacramento River at
 32 Emmaton, there would be a 2 mg/L (<1%) decrease in the long-term average chloride
 33 concentration, but a 45 mg/L (9%) increase in the drought period modeled (i.e., 1987–1991)
 34 chloride concentration. Long-term average concentrations of seawater-derived constituents would
 35 generally decrease under the No Action Alternative (ELT) relative to Existing Conditions because the
 36 No Action Alternative (ELT) includes Fall X2, while Existing Conditions does not (Appendices 3D,
 37 *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact*
 38 *Condition*, and 5A, *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). Therefore,
 39 even though sea level rise is included in the No Action Alternative (ELT), and not in Existing
 40 Conditions, the effect of Fall X2 on chloride is generally greater than sea level rise.

41 The comparison to Existing Conditions reflects changes in chloride due to both increased demands
 42 and changed hydrology and Delta hydrodynamic conditions associated with climate change and sea

1 level rise. The following outlines the modeled chloride changes relative to the applicable objectives
2 and effects on beneficial uses in Delta waters.

3 **Municipal and Industrial Beneficial Uses Relative to Existing Conditions**

4 Estimates of chloride concentrations generated using EC chloride relationships were used to
5 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses on a
6 basis of the percentage of years the chloride objective would be exceeded for the 16-year period
7 modeled. The objective is exceeded if chloride concentrations exceed 150 mg/L for a specified
8 number of days in a given water year at Antioch or Contra Costa Pumping Plant #1. For the No
9 Action Alternative (ELT), the frequency of objective exceedance would decrease relative to Existing
10 Conditions. The frequency of exceedance of the 150 mg/L objective is predicted to be 7% of years
11 under Existing Conditions and 0% under the No Action Alternative (Appendix 8G, *Chloride*, Table Cl-
12 64).

13 Evaluation of the 250 mg/L Bay-Delta WQCP objective for chloride utilized results from both the
14 mass balance approach and EC chloride relationships. The basis for the evaluation was the predicted
15 number of days the objective would be exceeded for the modeled 16-year period.

16 Based on the mass-balance approach, there would be an increased frequency of exceedance of the
17 250 mg/L objective under the No Action Alternative (ELT), relative to Existing Conditions, in the
18 Sacramento River at Emmaton, the San Joaquin River at Antioch, and the Sacramento River at
19 Mallard Island. At Emmaton, the frequency of objective exceedance would increase from 55% under
20 Existing Conditions to 60% under the alternative during the drought period; when the entire
21 modeled period is considered, there would be a decrease in the frequency of objective exceedance.
22 At Antioch, the frequency of objective exceedance would increase from 66% to 70% for the entire
23 period modeled, and from 82% to 85% during the drought period modeled. In the Sacramento River
24 at Mallard Island, the frequency of objective exceedance would increase from 85% to 86% for the
25 entire period modeled (Appendix 8G, *Chloride*, Table Cl-81). These changes are small enough that
26 they may be within the uncertainty of the modeling approach.

27 Estimates of chloride concentrations generated using EC-chloride relationships and DSM2 EC output
28 (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective for chloride
29 at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for the evaluation
30 was the predicted number of days the objective was exceeded for the modeled 16-year period. For
31 the No Action Alternative (ELT), the modeled frequency of objective exceedance would increase,
32 from 6% of modeled days under Existing Conditions, to 8% of modeled days under the No Action
33 Alternative (ELT) (Appendix 8G, *Chloride*, Table Cl-63).

34 The mass balance results also indicate reduced assimilative capacity with respect to the 250 mg/L
35 objective during certain months and locations. At Franks Tract, Old River at Rock Slough, and
36 Sacramento River at Emmaton, there would be a reduction in assimilative capacity in January of 48-
37 100% during the drought period modeled. Use of assimilative capacity would be 67% over the 16
38 year period modeled in June in the Sacramento River at Emmaton. In the San Joaquin River at
39 Antioch, there would be a reduction in assimilative capacity in March and April of up to 19% for the
40 16-year period modeled, and a 49% reduction during the drought period modeled (Appendix 8G,
41 *Chloride*, Table Cl-67). Assimilative capacity at the Contra Costa Pumping Plant #1 also would be
42 reduced, in February and March, by up to 13%, and by 75% during January of the drought period
43 modeled.

1 When utilizing the EC-chloride relationship to model chloride concentrations for the 16-year period,
 2 trends in frequency of exceedance of the 250 mg/L objective and use of assimilative capacity are
 3 similar to those discussed above for the mass balance modeling approach (Appendix 8G, *Chloride*,
 4 Tables Cl-68 and Cl-82).

5 Based on the additional predicted seasonal and annual exceedances of Bay Delta WQCP objectives
 6 for chloride, and the associated long-term water quality degradation and use of assimilative
 7 capacity, the potential exists for adverse effects on the municipal and industrial beneficial uses in the
 8 western Delta, particularly at Antioch, through reduced opportunity for diversion of water with
 9 acceptable chloride levels.

10 *CWA Section 303(d) Listed Water Bodies—Relative to Existing Conditions*

11 Tom Paine Slough in the southern Delta is on the state’s CWA Section 303(d) list for chloride with
 12 respect to the secondary MCL of 250 mg/L. Monthly average chloride concentrations at the Old
 13 River at Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled
 14 location to Tom Paine Slough, would be well below the MCL and generally would be similar to
 15 Existing Conditions (Appendix 8G, *Chloride*, Figure Cl-17).

16 Suisun Marsh also is on the state’s CWA Section 303(d) list for chloride in association with the Bay-
 17 Delta WQCP objectives for maximum allowable salinity during the months of October through May,
 18 which establish appropriate seasonal salinity conditions for fish and wildlife beneficial uses. The
 19 Sacramento River at Mallard Island, Sacramento River at Collinsville, and Montezuma Slough at
 20 Beldon’s Landing within the marsh are DSM2-modeled locations representative of source water
 21 quality conditions for the marsh that is supported by inflowing flood tide waters from the west, and
 22 ebb tide flows of Sacramento River water into Montezuma Slough through the Suisun Marsh Salinity
 23 Control Gates located near Collinsville. Long-term average chloride concentrations at the
 24 Sacramento River at the Mallard Island for the 16-year period modeled would decrease by 100 mg/L
 25 (4%) relative to Existing Conditions (Appendix 8G, *Chloride*, Table Cl-65). The plots of monthly
 26 average chloride concentrations for the Sacramento River at Collinsville (Appendix 8G, *Chloride*,
 27 Figure Cl-19) and Montezuma Slough at Beldon’s Landing (Appendix 8G, *Chloride*, Figure Cl-20) for
 28 the 16-year period modeled indicate that, relative to Existing Conditions, chloride concentrations
 29 would be similar or lower during the months of October through May. Consequently, chloride
 30 concentrations at Tom Paine Slough and Suisun Marsh would not be further degraded on a long-
 31 term basis or adversely affect necessary actions to reduce chloride loading for any TMDLs
 32 developed.

33 ***SWP/CVP Export Service Areas***

34 Under the No Action Alternative (ELT), long-term average chloride concentrations at the Banks and
 35 Jones Pumping Plants would decrease by 6% and 5%, respectively, relative to Existing Conditions
 36 for the 16-year period modeled, based on mass-balance modeling results (Appendix 8G, *Chloride*,
 37 Table Cl-65). However, the frequency of objective exceedance would increase at both pumping
 38 plants, relative to Existing Conditions, for both the 16-year period and the drought period modeled
 39 (Appendix 8G, *Chloride*, Table Cl-81). Results of the modeling approach which utilized a EC chloride
 40 relationship are consistent these results, and assessment of chloride using these modeling output
 41 results in the same conclusions as for the mass-balance approach (Appendix 8G, *Chloride*, Tables Cl-
 42 66 and Cl-82).

1 Maintenance of SWP and CVP facilities under the No Action Alternative (ELT) would not be expected
2 to create new sources of chloride or contribute towards a substantial change in existing sources of
3 chloride in the affected environment. Maintenance activities would not be expected to cause any
4 substantial change in chloride such that any beneficial uses would be adversely affected anywhere in
5 the affected environment.

6 **CEQA Conclusion:** Chloride is not a constituent of concern in the Sacramento River watershed
7 upstream of the Delta, thus river flow rate and reservoir storage reductions that would occur under
8 the No Action Alternative (ELT), relative to Existing Conditions, would not be expected to result in a
9 substantial adverse change in chloride levels. Additionally, relative to Existing Conditions, the No
10 Action Alternative (ELT) would not result in reductions in river flow rates (i.e., less dilution) or
11 increased chloride loading such that there would be any substantial increase in chloride
12 concentrations upstream of the Delta in the San Joaquin River watershed.

13 It is expected there would be changes in Delta chloride levels in response to a shift in the Delta
14 source water percentages under the No Action Alternative (ELT) or some degradation of these water
15 bodies. There would be an increase in the frequency of exceedance of the daily average 250 mg/L
16 chloride objective applicable at Contra Costa Pumping Plant #1 from 6% of modeled days to under
17 Existing Conditions to 8% of modeled days under the No Action Alternative (ELT). Relative to
18 Existing Conditions, the No Action Alternative (ELT) also would result in increased chloride
19 concentrations such that frequency of exceedance of the 250 mg/L Bay-Delta WQCP objective would
20 increase in the San Joaquin River at Antioch (by 4%) and in the Sacramento River at Mallard Island
21 (by 1%), and long-term degradation may occur, that may result in adverse effects on the municipal
22 and industrial water supply beneficial use. With respect to CWA Section 303(d) listings, the similar
23 average chloride concentrations would not cause further degradation on a long-term basis that
24 would adversely affect necessary actions to reduce chloride loading for any TMDLs developed for
25 Tom Paine Slough and Suisun Marsh.

26 Long-term average chloride concentrations would be reduced in water exported from the Delta to
27 the CVP/SWP Export Service Areas thus reflecting a potential improvement to chloride loading in
28 the lower San Joaquin River.

29 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the No
30 Action Alternative (ELT) would not result in adverse chloride bioaccumulation effects to aquatic life
31 or humans.

32 Based on these findings, this impact is determined to be significant due to increased chloride
33 concentrations and objective exceedances, and additional long-term degradation, in the western
34 Delta and associated effects on the municipal and industrial water supply beneficial uses.

35 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and** 36 **Maintenance**

37 The effects of the No Action Alternative (ELT) on DO levels in surface waters upstream of the Delta,
38 in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would be
39 similar to those described for the No Action Alternative (LLT) in Section 8.3.3.1. This is because the
40 factors that would affect DO levels in the surface waters of these areas would be the same in the ELT
41 as in the LLT. For the reasons described for the No Action Alternative (LLT) in Section 8.3.3.1, the
42 effects on DO from implementing the No Action Alternative (ELT) is determined to not be adverse.

1 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on DO levels in surface waters
 2 upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing
 3 Conditions would be similar to those described for the No Action Alternative (LLT). This is because
 4 the factors that would affect DO levels in the surface waters of these areas would be similar in the
 5 ELT and LLT. There would be no substantial, and likely no measurable, long-term change in DO
 6 levels Upstream of the Delta, in the Plan Area, or the SWP/CVP Export Service Areas under the No
 7 Action Alternative relative to Existing Conditions. As such, this alternative is not expected to cause
 8 additional exceedance of applicable water quality objectives by frequency, magnitude, and
 9 geographic extent that would adversely affect beneficial uses. Because no substantial changes in DO
 10 levels are expected, long-term water quality degradation would not be expected, and, thus,
 11 beneficial uses would not be expected to be adversely affected. Various Delta waterways are CWA
 12 Section 303(d)-listed for low DO, but because no substantial decreases in DO levels are expected,
 13 greater degradation and impairment of these areas is not expected to occur. Based on these findings,
 14 this impact is considered less than significant.

15 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 16 **Operations and Maintenance**

17 ***Upstream of the Delta***

18 The effects of the No Action Alternative (ELT) on EC levels in reservoirs and rivers upstream of the
 19 Delta would be similar to those effects described for the No Action Alternative in Section 8.3.3.1. The
 20 extent of new urban growth would be less in the early long-term, thus discharges of EC-elevating
 21 parameters in runoff and wastewater discharges to water bodies upstream of the Delta would be
 22 expected to be less than in the LLT. However, the state is regulating point source discharges of EC-
 23 related parameters and implementing a program to further loading of EC-related parameters to
 24 tributaries. Based on these considerations, and those described in Section 8.3.3.1, EC levels (highs,
 25 lows, typical conditions) in the Sacramento River and its tributaries, the eastside tributaries, or their
 26 associated reservoirs upstream of the Delta would not be expected to be outside the ranges
 27 occurring under Existing Conditions.

28 For the San Joaquin River, increases in EC levels under the No Action Alternative (ELT) could occur,
 29 but would be slightly less than those described for No Action Alternative (LLT) in Section 8.3.3.1.
 30 This is because the effects of climate change on flows, which could affect dilution of high EC
 31 discharges, would be less in the early long-term. The implementation of the adopted TMDL for the
 32 San Joaquin River at Vernalis and the ongoing development of the TMDL for the San Joaquin River
 33 upstream of Vernalis are expected to contribute to improved EC levels. Based on these
 34 considerations, substantial changes in EC levels in the San Joaquin River relative to Existing
 35 Conditions would not be expected of sufficient magnitude and geographic extent that would result in
 36 adverse effects on any beneficial uses, or substantially degrade the quality of these water bodies,
 37 with regard to EC.

38 ***Delta***

39 Similar to the No Action Alternative (LLT), the No Action Alternative (ELT) would result in a fewer
 40 number of days when interior and southern Bay-Delta WQCP compliance locations would exceed EC
 41 objectives or be out of compliance with the EC objectives (Appendix 8H, *Electrical Conductivity*,
 42 Table EC-26). However, western Delta locations—Sacramento River at Emmaton (agricultural
 43 objective) and San Joaquin River at Jersey Point (fish and wildlife objective)—would experience an

1 increased frequency of exceedance of EC objectives, where sea level rise and increased water
2 demands would combine to cause increases in EC, relative to Existing Conditions (Appendix 8H,
3 *Electrical Conductivity*, Table EC-26). The number of days the EC levels would exceed objectives and
4 be out of compliance at these locations would be less at the ELT than the LLT. Further, average EC
5 levels at western, interior, and southern Delta compliance locations, other than the Sacramento
6 River at Emmaton, would decrease relative to Existing Conditions. The increase in exceedances at
7 Jersey Point would be from 0% under Existing Conditions to 3% under No Action Alternative (ELT),
8 which represents a very small increase for this objective. Further discussion of EC increases relative
9 to this objective can be found in Appendix 8H, *Electrical Conductivity*, Attachment 2. Average EC at
10 Emmaton would increase by 1% for the entire modeled period (1976–1991) and 10% for the
11 drought period modeled (1987–1991), relative to Existing Conditions (Appendix 8H, *Electrical*
12 *Conductivity*, Table EC-28), similar to increases that would occur in the LLT. Given that the western
13 Delta is CWA Section 303(d) listed as impaired due to elevated EC, the increase in the incidence of
14 exceedance of EC objectives and average EC levels at Emmaton during the drought period has the
15 potential to contribute to additional impairment and adversely affect beneficial uses.

16 Also similar to the No Action Alternative (LLT), relative to Existing Conditions, the No Action
17 Alternative (ELT) would result in increased average EC in Suisun Marsh during the months of
18 February through May. The average EC increases would be lower in magnitude than in the LLT,
19 ranging from 0.1–0.4 mS/cm, depending on the location and month (Appendix 8H, *Electrical*
20 *Conductivity*, Tables EC-32 through EC-36). For the reasons described for the No Action Alternative
21 in Section 8.3.3.1, the small increase in EC relative to Existing Conditions would not be expected to
22 adversely affect beneficial uses of Suisun Marsh under the No Action Alternative (ELT). While Suisun
23 Marsh is CWA Section 303(d) listed as impaired because of elevated EC, the potential increases in
24 long-term average EC concentrations, relative to Existing Conditions, would not be expected to
25 contribute to additional impairment, because the increase would be so small (<1 mS/cm) relative to
26 the substantial fluctuations in daily EC in the marsh channels as to not be measurable, and beneficial
27 uses would not be adversely affected.

28 ***SWP/CVP Export Service Areas***

29 The frequency of exceedance of EC objectives at the Banks and Jones Pumping Plants under the No
30 Action Alternative (ELT) would be slightly higher than that described for the No Action Alternative
31 (LLT) in Section 8.3.3.1 (Appendix 8H, *Electrical Conductivity*, Table EC-27). The frequency of
32 exceedance of the Bay-Delta WQCP 1,000 μ mhos/cm objective would increase from 1% to 3% at
33 Banks Pumping Plant and from 0% to 1% at Jones Pumping Plant. However, similar to the No Action
34 Alternative (LLT), average EC levels for the entire period modeled would decrease slightly at the
35 Banks and Jones Pumping Plants relative to Existing Conditions in the ELT time period (Appendix
36 8H, *Electrical Conductivity*, Table EC-28). For the reasons described for the No Action Alternative in
37 Chapter 8, *Water Quality*, Section 8.3.3.1, the slight increase in frequency of exceedance of the EC
38 objective under the No Action Alternative (ELT) would not be expected to adversely affect
39 agricultural beneficial uses of this water. Further, the No Action Alternative (ELT) would not cause
40 long-term degradation of EC levels in the SWP/CVP Export Service Areas, relative to Existing
41 Conditions or contribute to additional CWA Section 303(d) impairment related to elevated EC in the
42 SWP CVP Export Service Areas waters, because long-term average EC levels would be lower in the
43 exported water. The lower average EC in the exported water would be expected to result in an
44 improvement in lower San Joaquin River EC levels, as these levels are related, in part, by the
45 irrigation deliveries from the Delta.

1 In summary, the increased frequency of exceedance of EC objectives and increased drought period
 2 average EC levels that would occur in the western Delta under the No Action Alternative (ELT)
 3 would contribute to adverse effects on the agricultural beneficial uses. Given that the western Delta
 4 is Clean Water Act Section 303(d) listed as impaired due to elevated EC, the increase in the incidence
 5 of exceedance of EC objectives and increases in drought period average EC in the western Delta
 6 under the No Action Alternative has the potential to contribute to additional beneficial use
 7 impairment. These increases in EC constitute an adverse effect on water quality.

8 **CEQA Conclusion:** River flow rate and reservoir storage reductions that would occur under the No
 9 Action Alternative (ELT), relative to Existing Conditions, would not be expected to result in a
 10 substantial adverse change in EC levels in the reservoirs and rivers upstream of the Delta, given that:
 11 changes in the quality of watershed runoff and reservoir inflows would not be expected to occur in
 12 the future; the state's current regulation of point-source discharge effects on Delta salinity-elevating
 13 parameters and the expected further regulation as salt management plans are developed; the salt-
 14 related TMDLs adopted and being developed for the San Joaquin River; and the expected
 15 improvement in lower San Joaquin River average EC levels commensurate with the lower EC of the
 16 irrigation water deliveries from the Delta.

17 Relative to Existing Conditions, the No Action Alternative (ELT) would not result in any substantial
 18 increases in long-term average EC levels in the SWP CVP Export Service Areas. At the Jones and
 19 Banks Pumping Plants there would be only a, respective, 1–2% increase in exceedance of the EC
 20 objective when the entire period modeled is considered. Average EC levels for the entire period
 21 modeled would decrease at both plants. Because the EC objective is for agricultural beneficial use
 22 protection, for which longer-term crop exposure to elevated EC waters is a concern, the minimal
 23 increase in the frequency of exceedance of the EC objective at the pumping plants for the entire
 24 period modeled coupled with the long-term average decrease in EC levels at the pumping plants
 25 would not adversely affect this beneficial use.

26 In the Plan Area, the No Action Alternative (ELT) would result in an increase in the frequency with
 27 which Bay-Delta WQCP EC objectives are exceeded in the Sacramento River at Emmaton. Further,
 28 long-term average EC levels would increase by 1% for the entire period modeled and 10% during
 29 the drought period modeled at Emmaton. The increases in drought period average EC levels that
 30 would occur in the Sacramento River at Emmaton would further degrade existing EC levels and thus
 31 contribute additionally to adverse effects on the agricultural beneficial use. Because EC is not
 32 bioaccumulative, the increases in long-term average EC levels would not directly cause
 33 bioaccumulative problems in aquatic life or humans. The western Delta is CWA Section 303(d) listed
 34 for elevated EC and the increases in long-term average EC and increased frequency of exceedance of
 35 EC objectives that would occur in the Sacramento River at Emmaton could make beneficial use
 36 impairment measurably worse. This impact is considered significant.

37 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 38 **Maintenance**

39 ***Upstream of the Delta***

40 The effects of the No Action Alternative (ELT) on mercury levels in surface waters upstream of the
 41 Delta relative to Existing Conditions would be similar to those described for the No Action
 42 Alternative (LLT) in Section 8.3.3.1. This is because factors that affect mercury concentrations in
 43 surface waters upstream of the Delta are similar in the ELT and LLT under the No Action Alternative.

1 For the reasons stated for the No Action Alternative (LLT) in Section 8.3.3.1, any modified reservoir
2 operations and subsequent changes in river flows at the ELT, relative to Existing Conditions, are
3 expected to have negligible, if any, effects on average reservoir and river mercury concentrations in
4 the Sacramento River watershed upstream of the Delta. Any negligible changes in mercury
5 concentrations that may occur in the water bodies of the affected environment located upstream of
6 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
7 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
8 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
9 are expected to remain above guidance levels at upstream of Delta locations, but will not change
10 substantially relative to Existing Conditions due to changes in flows under the No Action Alternative
11 (ELT).

12 ***Delta***

13 Similar to the No Action Alternative (LLT), the No Action Alternative (ELT) would have very little
14 effect on mercury or methylmercury concentrations in the Delta (Appendix 8I, *Mercury*, Tables I-17
15 and I-18), to the extent that these changes would likely not be measurable. Because of this, use of
16 assimilative capacity for mercury would be negligible. Any small changes would not be expected to
17 result in adverse effects to beneficial uses.

18 Similarly, estimates of fish tissue mercury concentrations and exceedance quotients show almost no
19 differences would occur among sites for the No Action Alternative (ELT) as compared to Existing
20 Conditions for the Delta sites (Appendix 8I, *Mercury*, Tables I-19a and I-19b). Peak exceedance
21 quotients for drought conditions are all at the San Joaquin River at Buckley Cove (4.3 for Existing
22 Conditions; 4.6 for the No Action Alternative (ELT); Eq2 model, Appendix 8I, *Mercury*, Table I-19b).
23 These small differences of less than 7% are not expected to further degrade water quality, with
24 regards to mercury, by measurable levels, and thus beneficial use impairment would not be made
25 discernibly worse. Similar to waterborne concentrations of methylmercury (Appendix 8I, *Mercury*,
26 Table I-18), the fish tissue concentrations and exceedance quotients would be highest at the San
27 Joaquin River, Buckley Cove site during drought years. All modeled fish tissue mercury
28 concentrations exceed tissue guidelines, with exceedance quotients greater than 1 (Appendix 8I,
29 *Mercury*, Tables I-19a and I-19b).

30 Because the increases are relatively small, and it is not evident that substantive increases are
31 expected at numerous locations throughout the Delta, these changes are expected to be within the
32 uncertainty inherent in the modeling approach, and would likely not be measurable in the
33 environment. See Appendix 8I, *Mercury*, for a complete discussion of the uncertainty associated with
34 the fish tissue estimates. Briefly, the bioaccumulation models contain multiple sources of
35 uncertainty associated with their development. These are related to: analytical variability; temporal
36 and/or seasonal variability in Delta source water concentrations of methylmercury; interconversion
37 of mercury species (i.e., the non-conservative nature of methylmercury as a modeled constituent);
38 and limited sample size (both in number of fish and time span over which the measurements were
39 made), among others. Although there is considerable uncertainty in the models used, the results
40 serve as a reasonable approximations of a very complex process. Considering the uncertainty, small
41 (i.e., <20–25%) increases or decreases in modeled fish tissue mercury concentrations at a low
42 number of Delta locations (i.e., 2–3) should be interpreted to be within the uncertainty of the overall
43 approach, and not predictive of actual adverse effects. Larger increases, or increases evident
44 throughout the Delta, can be interpreted as more reliable indicators of potential adverse effects.

1 **SWP/CVP Export Service Areas**

2 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
3 concentrations estimated at the Banks and Jones Pumping Plants. Concentrations changes at these
4 locations are expected to be very small, and likely not measurable. Thus, any change in use of
5 assimilative capacity is also expected to be small and not measurable. Any increases in mercury
6 concentrations that may occur in water exported via Banks and Jones Pumping Plants are not
7 expected to result in adverse effects to beneficial uses or substantially degrade the quality of
8 exported water, with regards to mercury.

9 Relative to Existing Conditions, the No Action Alternative (ELT) would result in small changes (less
10 than 3%) in estimated methylmercury concentrations in largemouth bass. All modeled
11 methylmercury concentrations in largemouth bass exceed fish tissue guidelines (Appendix 8I,
12 *Mercury*, Tables I-19a and I-19b).

13 **CEQA Conclusion:** Under the No Action Alternative (ELT), greater water demands and climate
14 change would alter the magnitude and timing of reservoir releases and river flows upstream of the
15 Delta in the Sacramento River watershed and eastside tributaries, relative to Existing Conditions.
16 Concentrations of mercury and methylmercury upstream of the Delta will not be substantially
17 different relative to Existing Conditions due to the lack of important relationships between
18 mercury/methylmercury concentrations and flow for the major rivers.

19 Methylmercury concentrations exceed criteria at all locations in the Delta for Existing Conditions
20 and no assimilative capacity exists. However, monthly average waterborne concentrations of total
21 and methylmercury, over the period of record under the No Action Alternative (ELT) would be very
22 similar to Existing Conditions. Similarly, estimates of fish tissue mercury concentrations show
23 almost no differences would occur among sites for the No Action Alternative (ELT) as compared to
24 Existing Conditions for Delta sites.

25 Assessment of effects of mercury in the SWP and CVP Export Service Areas were based on effects on
26 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones Pumping
27 Plants. The Banks and Jones Pumping Plants are expected to show very small water concentration
28 changes and very small changes in fish tissue concentration of mercury for the No Action Alternative
29 (ELT) as compared to Existing Conditions.

30 As such, this alternative is not expected to cause additional exceedance of applicable water quality
31 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
32 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
33 not expected to increase substantially, no long-term water quality degradation is expected to occur
34 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
35 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
36 or fish tissue mercury concentrations would not make any existing mercury-related impairment
37 measurably worse. In comparison to Existing Conditions, the No Action Alternative (ELT) would not
38 increase levels of mercury by frequency, magnitude, and geographic extent such that the affected
39 environment would be expected to have measurably higher body burdens of mercury in aquatic
40 organisms, thereby substantially increasing the health risks to wildlife (including fish) or humans
41 consuming those organisms. Based on these findings, this impact is considered less than significant.

1 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 2 **Maintenance**

3 ***Upstream of the Delta***

4 The effects of the No Action Alternative (ELT) on nitrate levels in surface waters upstream of the
5 Delta relative to Existing Conditions would be similar to those described for the No Action
6 Alternative (LLT) in Section 8.3.3.1. This is because factors which affect nitrate concentrations in
7 surface waters upstream of the Delta are similar in the ELT and LLT under the No Action Alternative.
8 For the reasons stated for the No Action Alternative (LLT) in Section 8.3.3.1, any modified reservoir
9 operations and subsequent changes in river flows at the ELT, relative to Existing Conditions, are
10 expected to have negligible, if any, effects on average reservoir and river nitrate concentrations in
11 the Sacramento River watershed upstream of the Delta. In the San Joaquin River watershed, nitrate
12 concentrations are higher than in the Sacramento watershed, owing to use of nitrate-based
13 fertilizers throughout the lower watershed. The correlation between historical water year average
14 nitrate concentrations and water year average flow in the San Joaquin River at Vernalis is a weak
15 inverse relationship—that is, generally higher flows result in lower nitrate concentrations, while
16 low flows result in higher nitrate concentrations (linear regression $r^2=0.49$; Figure 2 in Appendix 8J,
17 *Nitrate*). Under the No Action Alternative (ELT), average flows at Vernalis would decrease an
18 estimated 1% relative to Existing Conditions, which is less than the 6% decrease in average flows
19 estimated to occur at the LLT. Given these relatively small decreases in flows and the weak
20 correlation between nitrate and flows in the San Joaquin River, it is expected that nitrate
21 concentrations in the San Joaquin River would be minimally affected, if at all, by anticipated changes
22 in flow rates under the No Action Alternative (ELT).

23 ***Delta***

24 Results of the mass balance calculations indicate that under the No Action Alternative (ELT), relative
25 to Existing Conditions, nitrate concentrations throughout the Delta would remain low (<1.4 mg/L-N)
26 relative to adopted objectives (Appendix 8J, *Nitrate*, Table 34). Although changes at specific Delta
27 locations and for specific months may be substantial on a relative basis (Appendix 8J, *Nitrate*, Table
28 35), the absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N) in
29 relation to the drinking water MCL of 10 mg/L-N, as well as all other relevant nitrate thresholds.
30 Long-term average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 Delta
31 assessment locations except the San Joaquin River at Buckley Cove, where early long-term average
32 concentrations would be somewhat above 1 mg/L-N. Nevertheless, at this location, early long-term
33 average nitrate concentration would be somewhat reduced under the No Action Alternative (ELT),
34 relative to Existing Conditions. No additional exceedances of the MCL are anticipated at any location
35 (Appendix 8J, *Nitrate*, Table 34). On a monthly average basis and a long-term annual average basis,
36 for all modeled years (1976–1991) and for the drought period (1987–1991) only, use of assimilative
37 capacity available under Existing Conditions, relative to the drinking water MCL of 10 mg/L-N,
38 would be low or negligible (i.e., <1%) for all locations and months (Appendix 8J, *Nitrate*, Table 36).
39 Nitrate concentrations, change in nitrate concentrations relative to existing conditions, and use of
40 assimilative capacity with regard to nitrate at various locations throughout the Delta under the No
41 Action Alternative (ELT) would be approximately the same as would occur in the LLT.

42 As described in for the No Action Alternative for the LLT in Section 8.3.3.1, actual nitrate on
43 concentrations would likely be higher than the modeling results indicate at certain locations under
44 the No Action Alternative (ELT). This is because the mass balance modeling does not account for

1 contributions from the SRWTP, which would be implementing nitrification/partial denitrification, or
2 Delta wastewater treatment plant dischargers that practice nitrification, but not denitrification.
3 However, for the reasons described for the No Action Alternative (LLT), additional nitrate
4 contributions and resulting concentrations that may occur at certain locations within the Delta at
5 the ELT would not be of frequency, magnitude and geographic extent that would adversely affect
6 any beneficial uses or substantially degrade the water quality at these locations, with regard to
7 nitrate.

8 ***SWP/CVP Export Service Areas***

9 Assessment of effects of the No Action Alternative (ELT) on nitrate in the SWP/CVP Export Service
10 Areas is based on effects on nitrate at the Banks and Jones Pumping Plants.

11 Results of the mass balance calculations indicate that under the No Action Alternative (ELT), relative
12 to Existing Conditions, early long-term average nitrate concentrations at Banks and Jones pumping
13 plants are anticipated to change negligibly (Appendix 8J, *Nitrate*, Table 35), as is also expected for
14 the LLT (see Section 8.3.3.1). No exceedances of the 10 mg/L MCL would occur (Appendix 8J,
15 *Nitrate*, Table 34). On a monthly average basis and on a long-term annual average basis, for all
16 modeled years and for the drought period only, use of assimilative capacity available under Existing
17 Conditions relative to the MCL would be negligible (i.e., <1%) for both Banks and Jones Pumping
18 Plants (Appendix 8J, *Nitrate*, Table 36). As discussed above, in the Delta region, nitrate
19 concentrations would be higher than indicated in the modeling results for areas receiving
20 Sacramento River water, including Banks and Jones pumping plants. However, long-term average
21 nitrate concentrations would be expected to decrease under the No Action Alternative (ELT),
22 relative to Existing Conditions. Resultant nitrate concentrations in water exported via Banks and
23 Jones pumping plants under the No Action Alternative (ELT) are not expected to result in adverse
24 effects to beneficial uses of exported water or substantially degrade the quality of exported water,
25 with regard to nitrate.

26 In summary, based on the discussion above, effects on nitrate of facilities operation and
27 maintenance are considered not adverse.

28 ***CEQA Conclusion:*** For the same reasons described for the LLT in Section 8.3.3.1, any modified
29 reservoir operations and subsequent changes in river flows under the No Action Alternative (ELT),
30 relative to Existing Conditions, are expected to have negligible, if any, effects on reservoir and river
31 nitrate concentrations upstream of Freeport in the Sacramento River watershed and upstream of
32 the Delta in the San Joaquin River watershed.

33 In the Delta, results of the mass balance calculations indicate that under the No Action Alternative
34 (ELT), relative to Existing Conditions, nitrate concentrations throughout the Delta are anticipated to
35 remain low (<1.4 mg/L-N) relative to adopted objectives. No additional exceedances of the 10 mg/L
36 MCL are anticipated at any location, and use of assimilative capacity available under Existing
37 Conditions, relative to the drinking water MCL of 10 mg/L-N, would be low or negligible (i.e., <1%)
38 for all locations and months.

39 Results of the mass balance calculations indicate that under the No Action Alternative (ELT), relative
40 to Existing Conditions, average nitrate concentrations at Banks and Jones pumping plants are
41 anticipated to change negligibly. No additional exceedances of the MCL are anticipated, and use of
42 assimilative capacity available under Existing Conditions, relative to the MCL would be negligible
43 (i.e., <1%) for both Banks and Jones pumping plants for all months.

1 Based on the above, there would be no substantial, long-term increase in nitrate concentrations in
 2 the rivers and reservoirs upstream of the Delta, in the Delta Region, or the waters exported to the
 3 SWP/CVP Export Service Areas under the No Action Alternative (ELT), relative to Existing
 4 Conditions. As such, this alternative is not expected to cause additional exceedance of applicable
 5 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 6 adverse effects on any beneficial uses of waters in the affected environment from nitrate. Because
 7 nitrate concentrations are not expected to increase substantially, no long-term water quality
 8 degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur. Nitrate
 9 is not CWA Section 303(d) listed within the affected environment and thus any minor increases that
 10 may occur in some areas would not make any existing nitrate-related impairment measurably worse
 11 because no such impairments currently exist. Because nitrate is not bioaccumulative, minor
 12 increases that may occur in some areas would not bioaccumulate to greater levels in aquatic
 13 organisms that would, in turn, pose substantial health risks to fish, wildlife, or humans. Based on
 14 these findings, this impact is considered less than significant.

15 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities**
 16 **Operations and Maintenance**

17 ***Upstream of the Delta***

18 While increased water demands and climate change under the No Action Alternative (ELT) would
 19 alter the magnitude and timing of reservoir releases north, south and east of the Delta, these
 20 activities would have no substantial effect on the various watershed sources of DOC. Moreover, long-
 21 term average flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are
 22 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
 23 long-term change in DOC concentrations upstream of the Delta. Consequently, long-term average
 24 DOC concentrations under the No Action Alternative (ELT) would not be expected to change by
 25 frequency, magnitude and geographic extent, relative to Existing Conditions and, and thus, would
 26 not adversely affect the MUN beneficial use, or any other beneficial uses, in water bodies of the
 27 affected environment located upstream of the Delta.

28 ***Delta***

29 Relative to the Existing Conditions, the No Action Alternative (ELT) would result in no changes, or a
 30 0.1 mg/L decrease, in the long-term average DOC concentrations at the 11 assessment locations for
 31 the modeled 16-year period. However, the average DOC concentrations would increase slightly (i.e.,
 32 up to 0.1 mg/L) in the modeled drought period (1987–1991) only at the Jones pumping plant
 33 location (Appendix 8K, *Organic Carbon*, Table DOC-11). At all 11 assessment locations, the range of
 34 frequency with which average DOC concentrations would exceed the 2 mg/L threshold
 35 concentration under the No Action Alternative (ELT) would be similar to Existing Conditions (i.e.,
 36 93–100%) for the modeled 16-year period and the drought period. The frequency with which DOC
 37 concentration would exceed the 3 mg/L and 4 mg/L thresholds also would be similar at most of the
 38 assessment locations, with exception of predicted changes at both the Banks and Jones pumping
 39 plants (discussed further below). While the No Action Alternative (ELT) would generally lead to
 40 similar or slightly higher long-term average DOC concentration in the western and interior Delta
 41 locations, the predicted changes would not be expected to be of magnitude that would adversely
 42 affect MUN beneficial uses, or any other beneficial use, particularly when considering the relatively
 43 small change in long-term annual average concentration (i.e., ≤ 0.1 mg/L).

1 **SWP/CVP Export Service Areas**

2 With respect to the potential for effects of the No Action Alternative (ELT), the long-term average
3 DOC concentrations in water exported at the Banks and Jones pumping plants would not change
4 measurably relative to Existing Conditions (i.e., up to 0.1 mg/L at Jones pumping plant for the
5 modeled drought period) (Appendix 8K, *Organic Carbon*, Table DOC-11). At the Banks pumping
6 plant, the frequency with which DOC concentrations would exceed 3 mg/L would increase from 64%
7 under Existing Conditions to 69% under the No Action Alternative (ELT) for the 16-year period, and
8 from 57% to 70% during the drought year period (Appendix 8K, *Organic Carbon*, Table DOC-11).
9 The frequencies of exceedance of 3 mg/L at the Jones pumping plant would increase from 71% to
10 79% for the modeled 16-year and from 72% to 88% for the modeled drought period. The relative
11 increase in the frequency with which DOC concentrations would exceed 4 mg/L at both the Banks
12 and Jones pumping plants would be minimal (i.e., up to a 3% increased frequency at the Jones
13 pumping plant). However, the predicted changes in long-term average DOC concentrations would
14 not be expected to be of sufficient magnitude to adversely affect the MUN beneficial use, or any
15 other beneficial use, within the SWP/CVP Export Service Areas. Long-term average DOC
16 concentrations, and frequency of exceedance of threshold concentrations, would decrease slightly at
17 Barker Slough under the No Action Alternative (ELT) relative to Existing Conditions.

18 In summary, the potential operations- and maintenance-related changes to DOC concentrations
19 under the No Action Alternative (ELT) at locations upstream of the Delta, in the Delta, and the
20 SWP/CVP Export Service Areas would generally be similar to, or of lower magnitude, than the
21 effects described for the No Action Alternative (LLT) in Section 8.3.3.1. This is because the effects of
22 climate change on hydrology and sea level rise would be less in the ELT compared to the LLT, and
23 thus factors affecting DOC concentrations, would be lower in these water bodies in the ELT.

24 Maintenance of SWP and CVP facilities under the No Action Alternative (ELT) would not be expected
25 to create new sources of DOC or contribute towards a substantial change in existing sources of DOC
26 in the affected environment.

27 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on DOC concentrations in surface
28 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
29 Existing Conditions would be similar, or of lower magnitude, than the effects described for the No
30 Action Alternative (LLT). While greater water demands and climate change under the No Action
31 Alternative (ELT) would alter the magnitude and timing of reservoir releases north, south and east
32 of the Delta, these activities would have no substantial effect on the various watershed sources of
33 DOC. Based on the above, the No Action Alternative (ELT) would not result in any substantial
34 increase in the frequency with which long-term average DOC concentrations exceed the 2, 3, or
35 4 mg/L levels at any of the 11 assessment locations relative to Existing Conditions. The predicted
36 change in long-term average DOC concentrations, relative to Existing Conditions, would not be
37 expected to be of sufficient magnitude to adversely affect MUN beneficial uses, nor would there be
38 any long-term water quality degradation with respect to DOC. DOC is not bioaccumulative and thus
39 would not directly cause bioaccumulative problems in aquatic life or humans. Finally, DOC is not
40 causing beneficial use impairments and thus is not CWA Section 303(d) listed for any water body
41 within the affected environment. Because long-term average DOC concentrations would not be
42 expected to increase substantially, no significant impacts on beneficial uses would occur. Based on
43 these findings, this impact would be less than significant.

1 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

2 The effects of the No Action Alternative (ELT) on pathogen levels in surface waters upstream of the
 3 Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would
 4 be similar to those described for the No Action Alternative (LLT) in Section 8.3.3.1. This is because
 5 the factors that would affect pathogen levels in the surface waters of these areas would be similar in
 6 the ELT and LLT. The difference in reservoir storage, river flows, and associated changes in Delta
 7 source water fractions due to climate change and sea level rise would not alter the pathogen sources
 8 in these waters. Thus, for the reasons described for the No Action Alternative in Section 8.3.3.1, the
 9 effects on pathogens from implementing the No Action Alternative (ELT) is determined to not be
 10 adverse.

11 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on pathogen levels in surface
 12 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
 13 Existing Conditions would be similar to those described for the No Action Alternative. This is
 14 because the factors that would affect pathogen levels in the surface waters of these areas would be
 15 similar in the ELT and LLT. Therefore, this alternative is not expected to cause additional
 16 exceedance of applicable water quality objectives by frequency, magnitude, and geographic extent
 17 that would cause adverse effects on any beneficial uses of waters in the affected environment.
 18 Because pathogen concentrations are not expected to increase substantially, no long-term water
 19 quality degradation for pathogens is expected to occur and, thus, no adverse effects on beneficial
 20 uses would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is Clean Water
 21 Act Section 303(d) listed for pathogens. Because no measurable increase in Deep Water Ship
 22 Channel pathogen concentrations are expected to occur on a long-term basis, further degradation
 23 and impairment of this area is not expected to occur. Finally, pathogens are not bioaccumulative
 24 constituents. This impact is considered less than significant.

25 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 26 **Maintenance**

27 The effects of the No Action Alternative (ELT) on pesticide levels in surface waters upstream of the
 28 Delta, within the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions
 29 would be similar to or less than those expected to occur at the LLT, described in Section 8.3.3.1. This
 30 is because at the ELT, the primary factor that will influence pesticide concentrations in surface
 31 waters upstream of the Delta, the effect of timing and magnitude of reservoir releases on dilution
 32 capacity, is expected to change to a similar or less degree than under the No Action Alternative
 33 (LLT). Changes in average winter and summer flow rates at the ELT relative to Existing Conditions
 34 are expected to be similar to or less than changes in flow rates expected at the LLT in the
 35 Sacramento River at Freeport, American River at Nimbus, Feather River at Thermalito and the San
 36 Joaquin River at Vernalis (Appendix 8L, *Pesticides*, Tables 1 through 4). Similarly, at the ELT, the
 37 primary factor that will influence pesticide concentrations in surface waters of the Delta and in the
 38 SWP/CVP Export Service areas (i.e., changes in San Joaquin River, Sacramento River and Delta
 39 agriculture source water fractions at various Delta locations, including Banks and Jones pumping
 40 plants) is expected to change by a similar or less degree than at the LLT. The percentage change in
 41 monthly average source water fractions at the ELT are similar to or less than changes expected at
 42 the LLT (Appendix 8D, *Source Water Fingerprinting Results*).

43 Development of 8,000 acres of tidal habitat under the No Action Alternative (ELT) could result in a
 44 limited reduction in pesticide use throughout the Delta through the potential repurposing of active

1 or fallow agricultural land for natural habitat purposes. In the short-term, the repurposing of
2 agricultural land associated with these measures may expose water used for habitat restoration to
3 pesticide residues. Moreover, the fisheries enhancements to the Yolo Bypass that would occur under
4 the No Action Alternative (ELT) could be managed alongside continuing agriculture, where
5 pesticides may be used on a seasonal basis and where water during flood events may come in
6 contact with residues of these pesticides. However, rapid dissipation would be expected, particularly
7 in the large volumes of water involved in flooding, such that aquatic life toxicity objectives would
8 not be exceeded by frequency, magnitude, and geographic extent whereby adverse effects on
9 beneficial uses would be expected.

10 **CEQA Conclusion:** As discussed above, the effects of the No Action Alternative (ELT) on pesticide
11 levels in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service
12 Areas relative to Existing Conditions would be similar to those described for the No Action
13 Alternative in Section 8.3.3.1. As such, the No Action Alternative (ELT) would not result in any
14 substantial change in long-term average pesticide concentration or result in substantial increase in
15 the anticipated frequency with which long-term average pesticide concentrations would exceed
16 aquatic life toxicity thresholds or other beneficial use effect thresholds upstream of the Delta, at the
17 11 assessment locations analyzed for the Delta, or the SWP CVP Export Service Areas. Numerous
18 pesticides are currently used throughout the affected environment, and while some of these
19 pesticides may be bioaccumulative, those present-use pesticides for which there is sufficient
20 evidence for their presence in waters affected by SWP and CVP operations (i.e., diazinon,
21 chlorpyrifos, diuron, and pyrethroids) are not considered bioaccumulative, and thus changes in their
22 concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
23 Furthermore, while there are numerous CWA Section 303(d) listings throughout the affected
24 environment that name pesticides as the cause for beneficial use impairment, the modeled changes
25 in upstream river flows and Delta source water fractions would not be expected to make any of
26 these beneficial use impairments measurably worse. Because long-term average pesticide
27 concentrations are not expected to increase substantially, no long-term water quality degradation
28 with respect to pesticides is expected to occur and, thus, no adverse effects on beneficial uses would
29 occur. This impact is considered less than significant.

30 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 31 **and Maintenance**

32 The effects of the No Action Alternative (ELT) on phosphorus levels in surface waters upstream of
33 the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions
34 would be similar to or less than those described for the No Action Alternative (LLT) in Section
35 8.3.3.1. This is because factors which affect phosphorus levels in surface waters of these areas would
36 be similar at the ELT and LLT under the No Action Alternative. Phosphorus concentrations may
37 increase during January through March at locations in the Delta where the source fraction of San
38 Joaquin River water increases, due to the higher concentration of phosphorus in the San Joaquin
39 River during these months compared to Sacramento River water or San Francisco Bay water.
40 However, based on the DSM2 fingerprinting results (see Figures 288–308 in Appendix 8D, *Source*
41 *Water Fingerprinting Results*), together with source water concentrations (presented in Figure 8-
42 56), the magnitude of increases during these months is expected to be negligible (i.e., <0.01 mg/L) at
43 all Delta locations. Thus, phosphorus levels in the Delta and waters exported from Banks and Jones
44 pumping plants to the SWP/CVP Export Service Areas are expected to change less at the ELT
45 compared to the LLT. For the reasons described for the No Action Alternative in Section 8.3.3.1 and

1 those described above, the effects on phosphorus from implementing the No Action Alternative
2 (ELT) is determined to not be adverse.

3 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on phosphorus levels in surface
4 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
5 Existing Conditions would be similar to those described for the No Action Alternative in Section
6 8.3.3.1. This is because factors that would directly affect phosphorus levels in the surface waters of
7 these areas are expected to be the same or change to a lesser degree than at the LLT. As such, this
8 alternative is not expected to cause additional exceedance of applicable water quality
9 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
10 on any beneficial uses of waters in the affected environment. Because phosphorus concentrations
11 are not expected to increase substantially, no long-term water quality degradation is expected to
12 occur and, thus, no adverse effects to beneficial uses would occur. Phosphorus is not CWA Section
13 303(d) listed within the affected environment and thus any minor increases that may occur in some
14 areas would not make any existing phosphorus-related impairment measurably worse because no
15 such impairments currently exist. Because phosphorus is not bioaccumulative, minor increases that
16 may occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would,
17 in turn, pose substantial health risks to fish, wildlife, or humans. This impact is considered less than
18 significant.

19 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 20 **Maintenance**

21 ***Upstream of the Delta***

22 The effects of the No Action Alternative (ELT) on selenium concentrations in reservoirs and rivers
23 upstream of the Delta would be similar to those effects described for the No Action Alternative (LLT)
24 in Section 8.3.3.1. There would be no expected change to the sources of selenium in the Sacramento
25 River and eastside tributary watersheds, and changes in the magnitude and timing of reservoir
26 releases and river flows upstream of the Delta would have negligible, if any, effect on the
27 concentration of selenium in the rivers and reservoirs of these watersheds.

28 Selenium concentrations in the San Joaquin River upstream of the Delta comply with NTR criteria
29 and Basin Plan objectives at Vernalis under Existing Conditions, and they are expected to do so
30 under the No Action Alternative (ELT). This is because a TMDL has been developed by the Central
31 Valley Water Board (2001), the Grassland Bypass Project has established limits that will result in
32 reduced inputs of selenium to the Delta, and the Central Valley Water Board (2010a) and State
33 Water Board (2010d, 2010e) have established Basin Plan objectives that are expected to result in
34 decreasing discharges of selenium from the San Joaquin River to the Delta. Further, modeling of
35 flows for the San Joaquin River at Vernalis indicates that average annual flows under the No Action
36 Alternative (ELT) will vary by less than 10% from Existing Conditions (Appendix 5A,
37 *BDCP/California WaterFix FEIR/FEIS Modeling Technical Appendix*). Given these relatively small
38 decreases in flows and the considerable variability in the relationship between selenium
39 concentrations and flows in the San Joaquin River, it is expected that selenium concentrations in the
40 San Joaquin River would be minimally affected, if at all, by anticipated changes in flow rates under
41 the No Action Alternative (ELT).

42 In summary, any negligible changes in selenium concentrations that may occur in the water bodies
43 of the affected environment located upstream of the Delta would not be of frequency, magnitude,

1 and geographic extent that would adversely affect any beneficial uses or substantially degrade the
2 quality of these water bodies as related to selenium.

3 **Delta**

4 Relative to Existing Conditions, the No Action Alternative (ELT) would result in little to no change in
5 average selenium concentrations in water at all modeled Delta assessment locations. Long-term
6 average concentrations would be the same or lower, with the exception of Old River at Rock Slough
7 during the drought (1987–1991) period modeled, the Sacramento River at Emmaton and North Bay
8 Aqueduct Pumping Plant for the entire and drought periods modeled, and Contra Costa Pumping
9 Plant No. 1 for the entire (1976–1991) period modeled (Appendix 8M, *Selenium*, Table M-33). Long-
10 term average concentrations at these locations would increase negligibly (by 0.01 µg/L). The long-
11 term average selenium concentrations in water under the No Action Alternative (ELT) would range
12 from 0.09–0.39 µg/L (Appendix 8M, *Selenium*, Table M-33), which would be well below the EPA
13 draft water quality criterion of 1.3 µg/L. Thus, the No Action Alternative (ELT) would not result in
14 selenium concentration increases in water that would substantially degrade water quality.

15 Relative to Existing Conditions, the No Action Alternative (ELT) would result in little to no change in
16 estimated selenium concentrations in most biota (whole-body fish, bird eggs [invertebrate diet],
17 bird eggs [fish diet], and fish fillets), with the largest increase being 0.01 mg/kg dry weight
18 (Appendix 8M, *Selenium*, Table M-34). During the drought period, concentrations of selenium in
19 sturgeon in the western Delta would increase slightly, with about a 0.19 mg/kg dry weight (<3%)
20 increase for the San Joaquin River at Antioch (Appendix 8M, *Selenium*, Tables M-41 and M-42).

21 All Toxicity Threshold Exceedance Quotients for whole fish, bird eggs, and fish fillets are less than
22 1.0, indicating low probability of adverse effects (Appendix 8M, *Selenium*, Table M-37). Low Toxicity
23 Threshold Exceedance Quotients for selenium concentrations in sturgeon from the western Delta
24 exceed 1.0 for the drought period, indicating a higher probability for adverse effects for drought
25 years (Appendix 8M, *Selenium*, Table M-43). Relative to Existing Conditions, Exceedance Quotients
26 would increase by 0.00–0.02, indicating that there would be essentially no increased risk of toxicity
27 associated with selenium concentrations under the No Action Alternative (ELT).

28 In summary, relative to Existing Conditions, the No Action Alternative (ELT) would result in
29 essentially no change in selenium concentrations throughout the Delta. The No Action Alternative
30 (ELT) would not be expected to substantially increase the frequency with which the applicable
31 water quality criterion or toxicity or level of concern thresholds would be exceeded in the Delta or
32 to substantially degrade the quality of water in the Delta, with regard to selenium.

33 **SWP/CVP Export Service Areas**

34 Relative to Existing Conditions, the No Action Alternative (ELT) would result in little to no change in
35 average selenium concentrations in water at the south Delta pumping plants. At the Banks pumping
36 plant, there would be no change in long-term average concentrations for the entire period modeled
37 or the drought period modeled (Appendix 8M, *Selenium*, Table M-33). At the Jones pumping plant,
38 selenium concentrations would increase by 0.01 µg/L for the entire period modeled (Appendix 8M,
39 *Selenium*, Table M-33). Furthermore, the modeled selenium concentrations in water for the No
40 Action Alternative (ELT) would range from 0.21–0.29 µg/L, well below the USEPA water quality
41 criterion of 1.3 µg/L (Appendix 8M, *Selenium*, Table M-33).

1 Similarly, the No Action Alternative (ELT) would result in little to no change in estimated selenium
2 concentrations in biota (whole-body fish, bird eggs [invertebrate diet], bird eggs [fish diet], and fish
3 fillets), and concentrations of selenium in biota would not be expected to exceed any toxicity or level
4 of concern benchmarks for biota (Appendix 8M, *Selenium*, Tables M-34 and Se-37).

5 Residence time of water in the Delta is not expected to change substantially under the No Action
6 Alternative (ELT) relative to Existing Conditions. Thus, any minor residence time changes would not
7 be expected to affect selenium bioaccumulation or fish tissue and bird egg concentrations of
8 selenium.

9 In summary, relative to Existing Conditions, the No Action Alternative (ELT) would result in
10 essentially no change in selenium concentrations in the SWP/CVP Export Service Areas, because
11 there would essentially be no change in selenium concentrations at the Bank and Jones pumping
12 plants. Thus, the No Action Alternative (ELT) would not be expected to substantially increase the
13 frequency with which applicable water quality criteria, or toxicity and level of concern benchmarks
14 would be exceeded in the Export Service Areas or substantially degrade the quality of water in the
15 Export Service Areas, with regard to selenium.

16 **CEQA Conclusion:** There are no substantial point sources of selenium in watersheds upstream of the
17 Delta, and no substantial nonpoint sources of selenium in the watersheds of the Sacramento River
18 and the eastern tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to
19 the Delta will be controlled through a TMDL developed by the Central Valley Water Board (2001) for
20 the lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
21 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources
22 Control Board 2010d, 2010e) that are expected to result in decreasing discharges of selenium from
23 the San Joaquin River to the Delta. Consequently, any modified reservoir operations and subsequent
24 changes in river flows under the No Action Alternative (ELT), relative to Existing Conditions, are
25 expected to cause negligible changes in selenium concentrations in water. Any negligible changes in
26 selenium concentrations that may occur in the water bodies of the affected environment located
27 upstream of the Delta would not be of frequency, magnitude, and geographic extent that would
28 adversely affect any beneficial uses or substantially degrade the quality of these water bodies as
29 related to selenium.

30 Relative to Existing Conditions, modeling estimates indicate that the No Action Alternative (ELT)
31 would result in essentially no change in selenium concentrations throughout the Delta, with all
32 changes on the order of 0.01 µg/L or less. Furthermore, there would not be an increased risk of
33 exceeding toxicity and level of concern benchmarks for biota.

34 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
35 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions, the
36 No Action Alternative (ELT) would result in no change in long-term average selenium
37 concentrations at the Bank pumping plant, and very little increase (0.01 µg/L) at the Jones pumping
38 plant.

39 Based on the above, selenium concentrations that would occur in water under this alternative would
40 not cause additional exceedances of applicable state or federal numeric or narrative water quality
41 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment
42 by frequency, magnitude, and geographic extent that would result in adverse effects to one or more
43 beneficial uses within affected water bodies. In comparison to Existing Conditions, water quality
44 conditions under this alternative would not increase levels of selenium by frequency, magnitude,

1 and geographic extent such that the affected environment would be expected to have measurably
2 higher body burdens of selenium in aquatic organisms, thereby substantially increasing the health
3 risks to wildlife (including fish) or humans consuming those organisms. Water quality conditions
4 under this alternative with respect to selenium would not cause long-term degradation of water
5 quality in the affected environment, and therefore would not result in use of available assimilative
6 capacity such that exceedances of water quality objectives/criteria would be likely and would result
7 in substantially increased risk for adverse effects to one or more beneficial uses. This alternative
8 would not further degrade water quality by measurable levels, on a long-term basis, for selenium
9 and, thus, cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly
10 worse. This impact is considered less than significant.

11 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 12 **and Maintenance**

13 The effects of the No Action Alternative (ELT) on trace metal concentrations in surface waters
14 upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing
15 Conditions would be similar to those described for the No Action Alternative in Section 8.3.3.1. This
16 is because the factors that would affect trace metal concentrations in the surface waters of these
17 areas would be the same in the ELT as in the LLT. For the reasons described for the No Action
18 Alternative in Section 8.3.3.1, the effects on trace metal concentrations from implementing the No
19 Action Alternative (ELT) is determined to not be adverse.

20 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on trace metal concentrations in
21 surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative
22 to Existing Conditions would be similar to those described for the No Action Alternative. This is
23 because the factors that would affect trace metal concentrations in the surface waters of these areas
24 would be similar in the ELT and LLT. As such, this alternative is not expected to cause additional
25 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
26 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
27 Because trace metal concentrations are not expected to increase substantially, no long-term water
28 quality degradation for trace metals is expected to occur and, thus, no adverse effects to beneficial
29 uses would occur. Furthermore, negligible change in long-term trace metal concentrations
30 throughout the affected environment would not be expected to make any existing beneficial use
31 impairments measurably worse. The trace metals discussed in this assessment are not considered
32 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
33 humans. This impact is considered less than significant.

34 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 35 **Maintenance**

36 The effects of the No Action Alternative (ELT) on TSS and turbidity levels in surface waters
37 upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing
38 Conditions would be similar to those described for the No Action Alternative in Section 8.3.3.1. This
39 is because the factors that would affect TSS and turbidity levels in the surface waters of these areas
40 would be the same in the ELT as in the LLT. For the reasons described for the No Action Alternative
41 (LLT) in Section 8.3.3.1, the effects on TSS and turbidity from implementing the No Action
42 Alternative (ELT) is determined to not be adverse.

1 **CEQA Conclusion:** The effects of the No Action Alternative (ELT) on TSS and turbidity levels in
2 surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative
3 to Existing Conditions would be similar to those described for the No Action Alternative. This is
4 because the factors that would affect TSS and turbidity levels in the surface waters of these areas
5 would be similar in the ELT and LLT. Therefore, this alternative is not expected to cause additional
6 exceedance of applicable water quality objectives where such objectives are not exceeded under
7 Existing Conditions. Because TSS concentrations and turbidity levels are not expected to be
8 substantially different from Existing Conditions, long-term water quality degradation is not
9 expected, and, thus, beneficial uses are not expected to be adversely affected. Finally, TSS and
10 turbidity are neither bioaccumulative nor Clean Water Act section 303(d) listed constituents. This
11 impact is considered less than significant.

12 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities**

13 The effects of construction-related activities and potential water quality effects that would occur
14 under the No Action Alternative (ELT) in association with projects other than Alternative 4A would
15 be similar to those described for the No Action Alternative in Section 8.3.3.1. This is because many
16 construction-related activities that could affect the surface waters in the project area are ongoing
17 (e.g., urban development), or recurring (e.g., maintenance activities for channels and levees,
18 sediment dredging), and thus are expected to result in generally similar effects in the ELT and LLT.
19 While the timing of construction of planned projects, described under the No Action Alternative
20 (ELT) (e.g., restoration projects), is uncertain relative to the Existing Conditions, the potential
21 construction-related contaminant discharges that may occur under the No Action Alternative (ELT)
22 would be avoided and minimized upon implementation of BMPs and adherence to permit terms and
23 conditions. Consequently, construction-related activities would not be expected to cause constituent
24 discharges of sufficient magnitude to result in a substantial increased frequency of exceedances of
25 water quality objectives/criteria, or substantially degrade water quality with respect to the
26 constituents of concern, and thus would not adversely affect any beneficial uses in water bodies
27 upstream of the Delta, within the Delta, or in the SWP/CVP Export Service Areas.

28 **CEQA Conclusion:** Alternative 4A construction-related contaminant discharges under the No Action
29 Alternative (ELT) would not occur. Other reasonably foreseeable projects that are independent from
30 Alternative 4A would result in construction-related impacts that are temporary and intermittent in
31 nature and would involve negligible, if any, discharges of bioaccumulative or CWA Section 303(d)
32 listed constituents to water bodies of the affected environment. As such, construction activities
33 would therefore not contribute to bioaccumulation of contaminants in organisms or humans or
34 cause Section 303(d) impairments to be discernibly worse. Relative to Existing Conditions, the
35 construction-related effects of other projects in the Delta would not be expected to cause or
36 contribute to a substantial increased frequency of exceedances of water quality objectives/criteria,
37 or substantially degrade water quality on a long-term average basis with respect to the constituents
38 of concern, and thus would not adversely affect any beneficial uses in water bodies upstream of the
39 Delta, within the Delta, or in the SWP/CVP Export Service Areas. Based on these findings, this impact
40 is determined to be less than significant.

1 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations**
2 **and Maintenance**

3 ***Upstream of the Delta***

4 The effects of the No Action Alternative (ELT) on *Microcystis* levels, and thus microcystin
5 concentrations, in surface waters upstream of the Delta relative to Existing Conditions would be
6 similar to those described for the No Action Alternative in Section 8.3.3.1. This is because factors
7 that would affect *Microcystis* levels in these areas would be the same in the ELT and the LLT. In the
8 rivers and streams of the Sacramento River watershed, watersheds of the eastern tributaries
9 (Cosumnes, Mokelumne, and Calaveras Rivers), and the San Joaquin River upstream of the Delta,
10 under Existing Conditions, bloom development is limited by high water velocity and low residence
11 times. These conditions are not expected to change under the No Action Alternative (ELT).

12 ***Delta***

13 In the Delta, enhancements to the Yolo Bypass and 8,000 acres of tidal habitat would be developed
14 under the No Action Alternative (ELT). The hydrodynamic effects of these actions could lead to
15 increased residence times in the affected Delta sub-regions relative to Existing Conditions. As
16 described in Section 8.3.3.1, climate change and sea level rise are also expected to cause slight
17 increases in water residence times throughout the Delta at the LLT. At the ELT the incremental
18 contribution of climate change and sea level rise to increased water residence times would be less
19 than that at the LLT.

20 Due to the assumed effects of climate change, Delta water temperatures are expected to increase
21 relative to Existing Conditions under the No Action Alternative (ELT), although the magnitude of
22 increase would be less at the ELT (1.3–2.5°F) compared to the LLT (2.9–4.9°F). Increasing water
23 temperatures could lead to earlier attainment of the water temperature threshold of 19°C required
24 to initiate *Microcystis* bloom formation, and thus earlier occurrences of *Microcystis* blooms in the
25 Delta, relative to Existing Conditions. Elevated ambient water temperatures in the Delta, and thus an
26 increase in *Microcystis* bloom duration and magnitude, are expected under the No Action Alternative
27 (ELT), relative to Existing Conditions. However, the effects of elevated ambient water temperatures
28 on *Microcystis* at the ELT are expected to be less than would occur at the LLT.

29 The combination of increased water residence times in the Delta, due to assumed restoration
30 activities, and increased water temperatures, due to climate change, could lead to measurable
31 increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms throughout the
32 Delta at the ELT, relative to Existing Conditions. It is not expected that the effects on *Microcystis* in
33 the Delta that could occur at the ELT would be significantly different than those that could occur at
34 LLT.

35 ***SWP/CVP Export Service Area***

36 The effects of the No Action Alternative (ELT) on *Microcystis* levels, and thus microcystin
37 concentrations, in SWP/CVP Export Service Areas, relative to Existing Conditions, would be similar
38 to or slightly less than those described for the No Action Alternative (LLT) in Section 8.3.3.1. This is
39 for two reasons. First, the assessment of effects on *Microcystis* in the SWP/CVP Export Service Areas
40 is based on the assessment of *Microcystis* production in source waters to Banks and Jones pumping
41 plants, and the effects on *Microcystis* at Banks and Jones pumping plants is not expected to be
42 different at the ELT and LLT for the reason discussed for the “Delta” above. Second, changes in

1 ambient air temperatures due to climate change are expected to be less at the ELT compared to the
 2 LLT, as described for the “Delta” above. Thus, effects of climate change on the potential for
 3 environmental conditions in the SWP/CVP Export Service Areas to become more conducive for
 4 *Microcystis* growth, relative to Existing Conditions, are expected to be less at the ELT than at the LLT.

5 **CEQA Conclusion:** For the reasons described above, the effects of the No Action Alternative (ELT) on
 6 *Microcystis* levels, and thus microcystin concentrations, in surface waters upstream of the Delta,
 7 within the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would be
 8 similar to or less than those described for the No Action Alternative (LLT) in Section 8.3.3.1. As such,
 9 the No Action Alternative (ELT) would not be expected to cause additional exceedance of applicable
 10 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 11 significant impacts on any beneficial uses of waters in the affected environment. *Microcystis* and
 12 microcystins are not CWA Section 303(d) listed within the affected environment and thus any
 13 increases that could occur in some areas would not make any existing *Microcystis* impairment
 14 measurably worse because no such impairments currently exist. Because *Microcystis* and
 15 microcystins are not bioaccumulative, increases that could occur in some areas would not
 16 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
 17 risks to fish, wildlife, or humans. However, because it is possible that under the No Action
 18 Alternative (ELT) increases in the frequency, magnitude, and geographic extent of *Microcystis*
 19 blooms in the Delta would occur due to both increased water temperatures from climate change, as
 20 well as increased water residence times related to restoration activities, long-term water quality
 21 degradation may occur in the Delta and water exported from the Delta to the SWP/CVP Export
 22 Service Areas. Thus, impacts on beneficial uses could occur. This impact is considered significant.

23 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities** 24 **Operations and Maintenance**

25 The effects of the No Action Alternative (ELT) on San Francisco Bay water quality would be similar
 26 to those described for the No Action Alternative (LLT) (see Section 8.3.3.1 and Appendix 80, *San*
 27 *Francisco Bay Analysis*). The primary difference in the ELT is that the effects of climate change on
 28 upstream hydrology and sea level rise in the Delta and Bay would be less. However, for the same
 29 reasons described for the LLT, upstream constituent concentrations and Delta outflow would not be
 30 altered sufficiently by these differences to cause substantial water degradation or contribute to
 31 adverse effects to beneficial uses in San Francisco Bay.

32 **CEQA Conclusion:** The No Action Alternative (ELT) would not be expected to cause long-term
 33 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
 34 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
 35 would result in substantially increased risk for adverse effects to one or more beneficial uses.
 36 Further, this alternative would not be expected to cause additional exceedance of applicable water
 37 quality objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent
 38 that would cause significant impacts on any beneficial uses of waters in the affected environment.
 39 Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay would not adversely
 40 affect beneficial uses, because the uses most affected by changes in these parameters, MUN and AGR,
 41 are not beneficial uses of the Bay. Further, no substantial changes in DO, pathogens, pesticides, trace
 42 metals or turbidity or TSS are anticipated in the Delta, relative to Existing Conditions, therefore, no
 43 substantial changes in these constituents levels in the Bay are anticipated. Changes in Delta salinity
 44 would not contribute to measurable changes in Bay salinity, as the change in Delta outflow would be
 45 two to three orders of magnitude lower than (and thus minimal compared to) the Bay’s tidal flow

1 and thus, have minimal influence on salinity changes. Adverse changes in *Microcystis* levels that
 2 could occur in the Delta would not cause adverse *Microcystis* blooms in the Bay, because *Microcystis*
 3 are intolerant of the Bay's high salinity and, thus have not been detected downstream of Suisun Bay.
 4 The reduction in total nitrogen load (associated with the SRWTP improvements) and changes in
 5 phosphorus load, relative to Existing Conditions, are expected to have minimal effect on water
 6 quality degradation, primary productivity, or phytoplankton community composition. As with the
 7 LLT, the change in mercury and methylmercury load (which is based on source water and Delta
 8 outflow), relative to Existing Conditions, would be within the level of uncertainty in the mass load
 9 estimate and not expected to contribute to water quality degradation, make the CWA section 303(d)
 10 mercury impairment measurably worse or cause mercury/methylmercury to bioaccumulate to
 11 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
 12 or humans. Similarly, based on LLT estimates, the increase in selenium load would be minimal, and
 13 total and dissolved selenium concentrations would be expected to be the same as Existing
 14 Conditions, and less than the target associated with white sturgeon whole-body fish tissue levels for
 15 the North Bay. Thus, the change in selenium load is not expected to contribute to water quality
 16 degradation, or make the CWA section 303(d) selenium impairment measurably worse or cause
 17 selenium to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
 18 substantial health risks to fish, wildlife, or humans. This impact is considered less than significant.

19 **8.3.4.2 Alternative 4A—Dual Conveyance with Modified** 20 **Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational** 21 **Scenario H)**

22 Discussion of water quality impacts of Alternative 4A was first provided in the Bay Delta
 23 Conservation Plan/California WaterFix RDEIR/SDEIS. The water quality assessments in the
 24 RDEIR/SDEIS for boron, bromide, chloride, DOC, EC, mercury, nitrate, and selenium in the Delta and
 25 SWP/CVP Export Services Areas utilized results from water quality modeling performed for
 26 Alternative 4 in the ELT, which included Yolo Bypass improvements, 25,000 acres of tidal habitat
 27 restoration, and the EC compliance location at Emmaton relocated to Threemile Slough. The analysis
 28 of effects of Alternative 4A, presented herein, on boron, bromide, chloride, DOC, EC, mercury, nitrate,
 29 and selenium in the Delta and SWP/CVP Export Service Areas is based on revised modeling, which
 30 assumed implementation of Yolo Bypass improvements, the EC compliance location remaining at
 31 Emmaton, and no tidal habitat restoration. Also, whereas the RDEIR/SDEIS Alternative 4A included
 32 two operational scenarios (H3 and H4), modeling for Alternative 4A was conducted at Operational
 33 Scenario H3+, a point that generally falls between Scenario H3 and H4 operations, as the initial
 34 conveyance facilities operational scenario. As specified in Chapter 3, *Description of Alternatives*,
 35 Section 3.6.4, the Delta outflow criteria under Scenario H for Alternative 4A would be determined by
 36 the Endangered Species Act and California Endangered Species Act Section 2081 permits, and
 37 operations to obtain such outflow would likely occur between Scenarios H3 and H4. Modeling
 38 results for Scenarios H3 and H4 using the 2015 CALSIM II model are shown in Appendix 5E,
 39 *Supplemental Modeling Requested by the State Water Resources Control Board Related to Increased*
 40 *Delta Outflows*, Attachment 1. In addition, following the initial operations, the adaptive management
 41 and monitoring program could be used to make long-term changes in initial operations criteria to
 42 address uncertainties about spring outflow for longfin smelt and fall outflow for delta smelt, among
 43 other species.

1 Future conveyance facilities operational changes may also be made as a result of adaptive
 2 management to respond to advances in science and understanding of how operations affect species.
 3 Conveyance facilities would be operated under an adaptive management range represented by
 4 Boundary 1 and Boundary 2 (See Section 5E.2 of Appendix 5E for additional information on
 5 Boundary 1 and Boundary 2). Impacts as a result of operations within this range would be
 6 consistent with the impacts discussed for the range of alternatives considered in this EIR/EIS. As
 7 shown in Appendix 5F, water supply modeling results for H3+ are within the range of results for
 8 Scenarios H3 and H4, and are consistent with the impacts discussed in the RDEIR/SDEIS. The
 9 following analysis of Alternative 4A impacts reflects modeling results of Operational Scenario H3+.

10 Because the modeling of Alternative 4A and the No Action Alternative (ELT) included Yolo Bypass
 11 Improvements, but no tidal habitat restoration, comparison of modeling results for Alternative 4A to
 12 No Action Alternative (ELT) results in the impact discussions below allows for isolating and
 13 identifying effects solely due to implementation of Alternative 4A in the ELT.

14 As described in Chapter 3, *Description of Alternatives*, actions associated with Alternative 4 that are
 15 not proposed to be implemented under Alternative 4A would continue to be pursued as part of
 16 existing, but separate, projects and programs associated with the 2008 USFWS and 2009 NMFS
 17 BiOps, California EcoRestore, and the 2014 California Water Action Plan. Due to the reduced suite of
 18 Environmental Commitments in Alternative 4A compared to Alternative 4 (in particular,
 19 significantly less tidal habitat restoration), the impacts to water quality due to Alternative 4A are
 20 substantially less compared to Alternative 4, particularly in the Delta.

21 The water quality impact conclusions for Alternative 4A remain the same as those presented in the
 22 RDEIR/SDEIS. The revisions to the assessment are in the presentation of modeled changes in
 23 concentrations, water quality criteria/objective exceedances, and use of assimilative capacity, and
 24 refinements to mitigation measures for EC.

25 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 26 **Maintenance**

27 ***Upstream of the Delta***

28 As described for Alternative 4 (see Section 8.3.3.9), substantial point and non-point sources of
 29 ammonia-N do not exist upstream of the SRWTP at Freeport in the Sacramento River watershed, in
 30 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
 31 upstream of the Delta in the San Joaquin River watershed. Thus, like Alternative 4, operation of the
 32 water conveyance facilities under Alternative 4A would have negligible, if any, effect on ammonia
 33 concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and
 34 the No Action Alternative (ELT and LLT). Any negligible increases in ammonia-N concentrations that
 35 could occur in the water bodies of the affected environment located upstream of the Delta would not
 36 be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 37 substantially degrade the quality of these water bodies, with regard to ammonia.

38 ***Delta***

39 As described for Alternative 4 (Section 8.3.3.9), a substantial decrease in Sacramento River ammonia
 40 concentrations is expected under Alternative 4A relative to Existing Conditions, due to planned
 41 lowering of ammonia in the SRWTP effluent discharge, and this is expected to decrease ammonia
 42 concentrations for all areas of the Delta that are influenced by Sacramento River water.

1 Concentrations of ammonia at locations not influenced notably by Sacramento River water would
2 change little relative to Existing Conditions, due to the similarity in San Joaquin River and San
3 Francisco Bay concentrations and the lack of expected changes in either of these concentrations.
4 Thus, Alternative 4A would not result in substantial increases in ammonia concentrations in the
5 Plan Area, relative to Existing Conditions.

6 Relative to the No Action Alternative (ELT and LLT), the primary mechanism that could potentially
7 alter ammonia concentrations under Alternative 4A is decreased flows in the Sacramento River,
8 which would lower dilution available to the SRWTP discharge. This flow change would be
9 attributable only to operations of the water conveyance facilities, since the same assumptions
10 regarding SRWTP discharge ammonia concentrations, water demands, climate change, and sea level
11 rise apply to both Alternative 4A and the No Action Alternative (ELT and LLT). A simple mass
12 balance calculation was performed to calculate ammonia concentrations downstream of the SRWTP
13 discharge (i.e., downstream of Freeport) under Alternative 4A and the No Action Alternative (ELT)
14 to assess the effects of the flow changes. Monthly average CALSIM II flows at Freeport and the
15 upstream ammonia concentration (0.04 mg/L-N; Central Valley Water Board 2010a:5) were used,
16 together with the SRWTP permitted average dry weather flow (181 mgd) and seasonal ammonia
17 limitations (1.5 mg/L-N in Apr–Oct, 2.4 mg/L-N in Nov–Mar), to estimate the average change in
18 ammonia concentrations downstream of the SRWTP. Table 8-73 shows monthly average and long-
19 term annual average predicted concentrations under the alternative. As Table 8-73 shows, average
20 monthly ammonia concentrations in the Sacramento River downstream of Freeport (upon full
21 mixing of the SRWTP discharge with river water) under Alternative 4A and the No Action
22 Alternative (ELT) are expected to be similar. In comparison to the No Action Alternative (ELT),
23 minor increases in monthly average ammonia concentrations would occur during July through
24 September, and during November. Minor decreases in ammonia concentrations are expected for
25 January through April, June, and October. The annual average concentration under Alternative 4A
26 would be the same as that under the No Action Alternative (ELT). Relative to the No Action
27 Alternative (LLT), Alternative 4A (LLT) is expected to result in similar minor increases in
28 Sacramento River ammonia concentration, because the increased water demands, climate change,
29 and sea level rise in the LLT would occur under both alternatives, and neither would affect ammonia
30 sources or loading. The estimated ammonia concentrations in the Sacramento River downstream of
31 Freeport under Alternative 4A would be similar to existing source water concentrations for the San
32 Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated
33 under Alternative 4A, relative to the No Action Alternative (ELT and LLT), are not expected to
34 substantially increase ammonia concentrations at any Delta locations.

35 Ammonia concentrations downstream of Freeport in the Sacramento River under Alternative 4A
36 would be similar to those under Alternative 4 (see Table 8-67 in Section 8.3.3.9). As stated for
37 Alternative 4, any negligible increases in ammonia concentrations that could occur at certain
38 locations in the Delta under Alternative 4A would not be of frequency, magnitude and geographic
39 extent that would adversely affect any beneficial uses or substantially degrade the water quality at
40 these locations, with regard to ammonia.

Table 8-73. Estimated Ammonia (mg/L as N) Concentrations in the Sacramento River Downstream of the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative Early Long-Term (ELT) and Alternative 4A

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative (ELT)	0.076	0.082	0.069	0.062	0.059	0.062	0.059	0.062	0.067	0.060	0.067	0.064	0.066
Alternative 4A ELT	0.075	0.086	0.069	0.061	0.058	0.061	0.058	0.062	0.063	0.061	0.069	0.066	0.066

SWP/CVP Export Service Areas

As discussed above, for areas of the Delta that are influenced by Sacramento River water, including Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease under Alternative 4A, relative to Existing Conditions (in association with less diversion of water influenced by the SRWTP). Like Alternative 4, this decrease in ammonia-N concentrations for water exported via the south Delta pumps is not expected to result in an adverse effect on beneficial uses or substantially degrade water quality of exported water, with regard to ammonia. Furthermore, as discussed above, for all areas of the Delta, including Banks and Jones pumping plants, ammonia concentrations are not expected to be substantially different under Alternative 4A (ELT) relative to the No Action Alternative (ELT), and Alternative 4A (LLT) relative to the No Action Alternative (LLT). Thus, any negligible increases in ammonia concentrations that could occur at Banks and Jones pumping plants would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade water quality at these locations, with regard to ammonia.

NEPA Effects: In summary, ammonia concentrations in water bodies upstream of the Delta, in the Plan Area, and the waters exported to the SWP/CVP Export Service Areas are not expected to be substantially different under Alternative 4A relative to the No Action Alternative (ELT and LLT). Thus, effects of the water conveyance facilities on ammonia are considered to be not adverse.

CEQA Conclusion: The magnitude and direction of changes in ammonia concentrations in water bodies upstream of the Delta, in the Plan Area, or the waters exported to the SWP/CVP Export Service Areas would be approximately the same as expected under Alternative 4, relative to Existing Conditions. There would be no substantial, long-term increase in ammonia concentrations in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the CVP and SWP service areas under Alternative 4A relative to Existing Conditions. As such, Alternative 4A is not expected to cause additional exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters in the affected environment. Because ammonia concentrations are not expected to increase substantially, no long-term water quality degradation is expected to occur and, thus, no adverse effects on beneficial uses would occur. Ammonia is not CWA Section 303(d) listed within the affected environment and thus any minor increases that could occur in some areas would not make any existing ammonia-related impairment measurably worse because no such impairments currently exist. Because ammonia is not bioaccumulative, minor increases that could occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose

1 substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of** 4 **Environmental Commitments 3, 4, 6–12, 15, and 16**

5 **NEPA Effects:** Some habitat restoration activities included in Environmental Commitments 3, 4, and
6 6–11 would occur on lands in the Delta formerly used for irrigated agriculture. Although this may
7 decrease ammonia loading to the Delta from agriculture, increased biota in those areas as a result of
8 restored habitat may increase ammonia loading originating from flora and fauna. Ammonia loaded
9 from organisms is expected to be converted rapidly to nitrate by established microbial communities.
10 Thus, these land use changes would not be expected to substantially increase ammonia
11 concentrations in the Delta. Implementation of Environmental Commitments 12, 15, and 16 do not
12 include actions that would affect ammonia sources or loading. Based on these findings, the effects on
13 ammonia from the implementation Environmental Commitments 3, 4, 6–12, 15, and 16 under
14 Alternative 4A are determined to not be adverse.

15 **CEQA Conclusion:** Land use changes that would result from the Environmental Commitments are
16 not expected to substantially increase ammonia concentrations, because the amount of area to be
17 converted would be small relative to existing habitat, and any resulting ammonia would likely be
18 rapidly converted to nitrate. Thus, it is expected there would be no substantial, long-term increase in
19 ammonia concentrations in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the
20 waters exported to the SWP/CVP Export Service Areas due to implementation of Environmental
21 Commitments 3, 4, 6–12, 15, and 16 relative to Existing Conditions. As such, implementation of these
22 Environmental Commitments would not be expected to cause additional exceedance of applicable
23 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
24 significant impacts on any beneficial uses of waters in the affected environment. Because ammonia
25 concentrations would not be expected to increase substantially from implementation of these
26 Environmental Commitments, no long-term water quality degradation would be expected to occur
27 and, thus, no significant impact on beneficial uses would occur. Ammonia is not CWA Section 303(d)
28 listed within the affected environment and thus any minor increases that could occur in some areas
29 would not make any existing ammonia-related impairment measurably worse because no such
30 impairments currently exist. Because ammonia is not bioaccumulative, minor increases that could
31 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
32 turn, pose substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
33 considered less than significant. No mitigation is required.

34 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 35 **Maintenance**

36 ***Upstream of the Delta***

37 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 4A there would be no
38 expected change to the sources of boron in the Sacramento River and eastside tributary watersheds
39 and, thus, resultant changes in flows from altered system-wide operations would have negligible, if
40 any, effects on the concentration of boron in the rivers and reservoirs of these watersheds. The
41 modeled annual average lower San Joaquin River flow at Vernalis would decrease by 1%, relative to
42 Existing Conditions (in association with the different operational components of Alternative 4A in
43 the ELT, climate change, and increased water demands) (Appendix 8F, *Boron*, Table Bo-32). The

1 reduced flow relative to Existing Conditions would result in possible increases in long-term average
2 boron concentrations of up to about 0.5% relative to the Existing Conditions. Flows would remain
3 virtually the same as the No Action Alternative (ELT), and thus flow changes would not result in
4 substantial boron increases relative to the No Action Alternative (ELT). The increased boron
5 concentrations, relative to Existing Conditions, under Alternative 4A in the ELT would not increase
6 the frequency of exceedances of any applicable objectives or criteria and would not be expected to
7 cause further degradation at measurable levels in the lower San Joaquin River, and thus would not
8 cause the existing impairment there to be discernibly worse. Consequently, Alternative 4A in the
9 ELT would not be expected to cause exceedance of boron objectives/criteria or substantially
10 degrade water quality with respect to boron, and thus would not adversely affect any beneficial uses
11 of the Sacramento River, the eastside tributaries, associated reservoirs upstream of the Delta, or the
12 San Joaquin River.

13 Effects of Alternative 4A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
14 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
15 change and sea level rise that would occur in the LLT would not affect boron sources in these areas.

16 **Delta**

17 Effects of water conveyance facilities on boron under Alternative 4A in the Delta would be similar to
18 the effects discussed for Alternative 4.

19 The effects of Alternative 4A relative to Existing Conditions and the No Action Alternative (ELT) are
20 discussed together because the direction and magnitude of predicted change are similar. Relative to
21 the Existing Conditions and No Action Alternative (ELT), Alternative 4A would result in increased
22 long-term average boron concentrations for the 16-year period modeled at most of the interior
23 Delta locations (increases up to 2% at the S. Fork Mokelumne River at Staten Island, 8% at Franks
24 Tract, and 10% at Old River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-26). The long-term
25 average boron concentrations at most of the western Delta assessment locations would not change
26 measurably. The long-term annual average and monthly average boron concentrations, for either
27 the 16-year period or drought period modeled, would never exceed the 2,000 µg/L human health
28 advisory objective (i.e., for children) or the 500 µg/L agricultural objective at the majority of
29 assessment locations, which represents no change from the Existing Conditions and No Action
30 Alternative (ELT) (Appendix 8F, *Boron*, Table Bo-3C). A small increase in the frequency of
31 exceedances 500 µg/L agricultural objective at the Sacramento River at Mallard Island (i.e., as much
32 as 3% in the drought period relative to the No Action Alternative [ELT]) would not be anticipated to
33 substantially affect agricultural diversions which occur primarily at interior Delta locations. Minor
34 reductions in long-term average assimilative capacity of up to 6% at interior Delta locations (i.e., Old
35 River at Rock Slough) would occur with respect to the 500 µg/L agricultural objective (Appendix 8F,
36 *Boron*, Table Bo-27). However, because the absolute boron concentrations would still be well below
37 the lowest 500 µg/L objective for the protection of the agricultural beneficial use under Alternative
38 4A, the levels of boron degradation would not be of sufficient magnitude to substantially increase
39 the risk of exceeding objectives or cause adverse effects to municipal and agricultural water supply
40 beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, *Boron*, Figure Bo-6).

41 Effects of Alternative 4A in the Delta in the LLT, relative to Existing Conditions and the No Action
42 Alternative (LLT), would be expected to be similar to those described above for the ELT. Boron
43 concentrations may be higher at western Delta locations due to greater effects of climate change on
44 sea level rise that would occur in the LLT; however, these effects are independent of the alternative.

1 Further, boron is of concern in waters diverted for agricultural use, which primarily occurs in the
 2 interior Delta, and based on Delta source water characteristics (see Table 8-42 in Section 8.3.1.7,
 3 *Construction-Specific Considerations Used in the Assessment*), boron concentrations in the interior
 4 Delta would be expected to remain suitable for agricultural use.

5 **SWP/CVP Export Service Areas**

6 Under Alternative 4A, long-term average boron concentrations would decrease at the Banks
 7 pumping plant (20%) and at Jones pumping plant (23%) relative to Existing Conditions, and the
 8 reductions would be similar compared to No Action Alternative (ELT) (Appendix 8F, *Boron*, Table
 9 Bo-26) as a result of export of a greater proportion of low-boron Sacramento River water.
 10 Commensurate with the decrease in exported boron concentrations, boron concentrations in the
 11 lower San Joaquin River may be reduced and would likely alleviate or lessen any expected increase
 12 in boron concentrations at Vernalis associated with flow reductions (see discussion of Upstream of
 13 the Delta), as well as locations in the Delta receiving a large fraction of San Joaquin River water.
 14 Reduced export boron concentrations also may contribute to reducing the existing CWA Section
 15 303(d) impairment in the lower San Joaquin River and associated TMDL actions for reducing boron
 16 loading. These same effects on boron at the Banks and Jones pumping plants would be expected in
 17 the LLT, because the primary effect of climate change on sea level rise and boron concentrations is
 18 expected in the western Delta.

19 Maintenance of SWP and CVP facilities under Alternative 4A would not be expected to create new
 20 sources of boron or contribute towards a substantial change in existing sources of boron in the
 21 affected environment.

22 **NEPA Effects:** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 4A
 23 would result in relatively small increases in long-term average boron concentrations in the Delta,
 24 not measurably increase boron levels in the lower San Joaquin River, and reduce boron levels in
 25 water exported to the SWP/CVP export service areas. However, the predicted changes would not be
 26 expected to cause exceedances of applicable objectives or further measurable water quality
 27 degradation, and thus would not constitute an adverse effect on water quality.

28 **CEQA Conclusion:** Based on the above assessment, any modified reservoir operations and
 29 subsequent changes in river flows under Alternative 4A, relative to Existing Conditions, would not
 30 be expected to result in a substantial adverse change in boron levels upstream of the Delta. Small
 31 increases in boron levels predicted for interior Delta locations in response to a shift in the Delta
 32 source water percentages would not be expected to cause exceedances of objectives, or substantial
 33 degradation of these water bodies. Alternative 4A maintenance also would not result in any
 34 substantial increases in boron concentrations in the affected environment. Boron concentrations
 35 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
 36 reflecting a potential improvement to boron loading in the lower San Joaquin River.

37 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 4A
 38 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 39 Existing Conditions, Alternative 4A would not result in substantially increased boron concentrations
 40 such that frequency of exceedances of municipal and agricultural water supply objectives would
 41 increase. The levels of boron degradation that may occur under Alternative 4A would not be of
 42 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
 43 agricultural beneficial uses within the affected environment. Long-term average boron
 44 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may

1 contribute to reducing the existing CWA Section 303(d) impairment of agricultural beneficial uses in
 2 the lower San Joaquin River. Based on these findings, this impact is determined to be less than
 3 significant. No mitigation is required.

4 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of**
 5 **Environmental Commitments 3, 4, 6–12, 15, and 16**

6 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
 7 Alternative 4A would present no new direct sources of boron to the affected environment, including
 8 areas upstream of the Delta, within the Delta region, and in the SWP/CVP Export Service Areas.
 9 Habitat restoration activities in the Delta, while involving increased land and water interaction
 10 within these habitats, would not be anticipated to contribute boron which is primarily associated
 11 with source water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and Bay source
 12 water). Moreover, some habitat restoration would occur on lands within the Delta currently used for
 13 irrigated agriculture, thus replacing agricultural land uses with restored habitats. The potential
 14 reduction in irrigated lands within the Delta may result in reduced discharges of agricultural field
 15 drainage with elevated boron concentrations, which would be considered an improvement
 16 compared to the No Action Alternative (ELT and LLT). Consequently, as they pertain to boron,
 17 implementation of the Environmental Commitments would not be expected to adversely affect any
 18 of the beneficial uses of the affected environment.

19 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
 20 Alternative 4A would not present new or substantially changed sources of boron to the affected
 21 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas. As such,
 22 their implementation would not be expected to substantially increase the frequency with which
 23 applicable Basin Plan objectives or other criteria would be exceeded in water bodies of the affected
 24 environment located upstream of the Delta, within the Delta, or in the SWP/CVP Export Service
 25 Areas or substantially degrade the quality of these water bodies, with regard to boron. Based on
 26 these findings, this impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 28 **Maintenance**

29 ***Upstream of the Delta***

30 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 4A in the ELT there would be
 31 no expected change to the sources of bromide in the Sacramento River and eastside tributary
 32 watersheds. Thus, changes in the magnitude and timing of reservoir releases north and east of the
 33 Delta would have negligible, if any, effect on the sources, and ultimately the concentration of
 34 bromide in the Sacramento River, the eastside tributaries, and the various reservoirs of the related
 35 watersheds. The modeled annual average lower San Joaquin River flow at Vernalis would decrease
 36 slightly (1%) compared to Existing Conditions and would remain virtually the same as the No Action
 37 Alternative (ELT), and thus flow changes would not result in substantial bromide increases
 38 (Appendix 8E, *Bromide*, Table 24). Moreover, there are no existing municipal intakes on the lower
 39 San Joaquin River, which is the beneficial use most sensitive to elevated bromide concentrations.
 40 Consequently, Alternative 4A in the ELT would not be expected to adversely affect the MUN
 41 beneficial use, or any other beneficial uses, of the Sacramento River, the San Joaquin River, the
 42 eastside tributaries, or their associated reservoirs upstream of the Delta due to changes in bromide
 43 concentrations.

1 Effects of Alternative 4A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
2 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
3 change and sea level rise that would occur in the LLT would not affect bromide sources in these
4 areas.

5 **Delta**

6 Estimates of bromide concentrations at Delta assessment locations were generated using a mass
7 balance approach, and using relationships between EC and chloride and between chloride and
8 bromide and DSM2 EC output. See Section 8.3.1.3, *Plan Area*, for more information regarding these
9 modeling approaches. The assessment below identifies changes in bromide at Delta assessment
10 locations based on both approaches.

11 Based on the mass balance modeling approach for bromide, relative to Existing Conditions,
12 Alternative 4A long-term average bromide concentrations would increase in the S. Fork Mokelumne
13 River at Staten Island, and decrease at all other assessment locations (Appendix 8E, *Bromide*, Table
14 22). Average bromide concentrations at Staten Island would increase from 50 µg/L under Existing
15 Conditions to 54 µg/L (8% increase) for the modeled 16-year hydrologic period (1976–1991).
16 However, multiple interior and western Delta assessment locations would have an increased
17 frequency of exceedance of 50 µg/L, which is the CALFED Drinking Water Program goal for bromide
18 as a long-term average applied to drinking water intakes (Appendix 8E, *Bromide*, Table 22). These
19 locations are the S. Fork Mokelumne River at Staten Island, Franks Tract, Old River at Rock Slough,
20 Sacramento River at Emmaton, San Joaquin River at Antioch, and Sacramento River at Mallard
21 Island. The greatest increase in frequency of exceedance of the CALFED Drinking Water Program
22 long-term goal of 50 µg/L would occur in the S. Fork Mokelumne River (7% increase) and
23 Sacramento River at Emmaton (4% increase). The increase in frequency of exceedance of the
24 50 µg/L threshold at the other locations would be 2% or less. Similarly, these locations and the
25 Contra Costa Pumping Plant #1 would have an increased frequency of exceedance of 100 µg/L,
26 which is the concentration believed to be sufficient to meet currently established drinking water
27 criteria for disinfection byproducts (Appendix 8E, *Bromide*, Table 22). The greatest increase in
28 frequency of exceedance of 100 µg/L would occur at Sacramento River at Emmaton (5% increase)
29 and San Joaquin River at Antioch and Franks Tract (4% increase). The increase in frequency of
30 exceedance of the 100 µg/L threshold at the other locations would be 3% or less.

31 Changes in long-term average bromide concentrations and changes in threshold exceedance
32 frequencies relative to the No Action Alternative (ELT) are generally of similar magnitude to those
33 previously described relative to Existing Conditions (Appendix 8E, *Bromide*, Table 22). However,
34 unlike the Existing Conditions comparison, relative to the No Action Alternative (ELT), long-term
35 average bromide concentrations in the San Joaquin River at Buckley Cove and the North Bay
36 Aqueduct at Barker Slough would increase under Alternative 4A, although the increases would be
37 relatively small (<1%). Further, at the North Bay Aqueduct, the frequency of exceedance of 50 µg/L
38 would increase from 35% to 40%; there would be no increased exceedance of the 100 µg/L
39 threshold. The increase in the frequency of exceedance of the 50 µg/L threshold at the other
40 locations would be 3% or less, The frequency of exceedance of the 100 µg/L at the other locations
41 would increase relative to the No Action Alternative (ELT) by 2% or less in the Mokelumne River at
42 Staten Island, Franks Tract, in Old River at Rock Slough, in the San Joaquin River at Antioch, in the
43 Sacramento River at Mallard Island, and at Contra Costa. There would not be an increased
44 exceedance of the 100 µg/L threshold at Emmaton.

1 Results of the modeling approach which used relationships between EC and chloride and between
2 chloride and bromide were consistent with the discussion above, and assessment of bromide using
3 these modeling results leads to the same conclusions as are presented above for the mass balance
4 approach (Appendix 8E, *Bromide*, Table 23).

5 The magnitude of bromide concentration increases at Mallard Slough and in the San Joaquin River at
6 Antioch during their historical months of use, relative to Existing Conditions and the No Action
7 Alternative (ELT) would be generally similar to those described for Alternative 4 (Appendix 8E,
8 *Bromide*, Table 25), and the frequency of exceedance of bromide thresholds would be similar
9 (Appendix 8E, *Bromide*, Table 22). As described for Alternative 4, the use of seasonal intakes at these
10 locations is largely driven by acceptable water quality, and thus has historically been opportunistic.
11 Opportunity to use these intakes would remain, and the predicted increases in bromide
12 concentrations at Antioch and Mallard Slough would not be expected to adversely affect MUN
13 beneficial uses, or any other beneficial use, at these locations.

14 The effects of Alternative 4A in the LLT in the Delta region, relative to Existing Conditions and the
15 No Action Alternative (LLT), would be expected to be similar to that described above. There may be
16 higher bromide concentrations in the LLT in the western Delta, but this would be associated with
17 sea level rise, not the project alternative, because the primary source of bromide to the Delta is sea
18 water intrusion.

19 ***SWP/CVP Export Service Areas***

20 Under Alternative 4A, long-term average bromide concentrations at the Banks and Jones pumping
21 plants, based on the mass balance modeling approach, would decrease. Long-term average bromide
22 concentrations for the modeled 16-year hydrologic period at the pumping plants would decrease by
23 as much as 46% relative to Existing Conditions and 43% relative to the No Action Alternative (ELT)
24 (Appendix 8E, *Bromide*, Table 22). As a result, less frequent exceedances of the 50 µg/L and 100
25 µg/L assessment thresholds would occur and an overall improvement in SWP/CVP Export Service
26 Areas water quality would occur respective to bromide. Commensurate with the decrease in
27 exported bromide, an improvement in lower San Joaquin River bromide would also occur since
28 bromide in the lower San Joaquin River is principally related to irrigation water deliveries from the
29 Delta. Results of the modeling approach which used relationships between EC and chloride and
30 between chloride and bromide are consistent with the mass balance results, and assessment of
31 bromide using these modeling results leads to the same conclusions as are presented for the mass
32 balance approach (Appendix 8E, *Bromide*, Table 23).

33 The effects of Alternative 4A in the LLT in the SWP/CVP Export Service Areas, relative to Existing
34 Conditions and the No Action Alternative (LLT), would be expected to be similar to that described
35 above, because the sea level rise that could occur in the LLT would not be expected to result in
36 substantial bromide contributions to the water exported at Banks and Jones pumping plants.

37 Maintenance of SWP and CVP facilities under Alternative 4A would not be expected to create new
38 sources of bromide or contribute towards a substantial change in existing sources of bromide in the
39 affected environment. Maintenance activities would not be expected to cause any substantial change
40 in bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected
41 anywhere in the affected environment.

42 ***NEPA Effects:*** In summary, the operations and maintenance activities under Alternative 4A, relative
43 to the No Action Alternative (ELT and LLT) would result in an increased frequency of exceedance of

1 both the 50 µg/L and 100 µg/L bromide thresholds for protecting against the formation of
2 disinfection byproducts in treated drinking water at the S. Fork Mokelumne River at Staten Island,
3 Franks Tract, San Joaquin River at Antioch, and Sacramento River at Mallard Island. In addition,
4 there would be an increased frequency of exceedance of the 50 µg/L threshold at Emmaton and the
5 North Bay Aqueduct at Barker Slough, and an increased frequency of exceedance of the 100 µg/L
6 threshold in the Old River at Rock Slough and at Contra Costa Pumping Plant #1. However, long-
7 term average bromide concentrations would increase only in the S. Fork Mokelumne River at Staten
8 Island, the San Joaquin River at Buckley Cove, and the North Bay Aqueduct at Barker Slough; there
9 would be decreases in long-term average bromide concentrations at the other assessment locations.
10 The long-term bromide concentration in the S. Fork Mokelumne River at Staten Island would be less
11 than the concentration believed to be sufficient to meet currently established drinking water criteria
12 for disinfection byproducts, and the increase in the San Joaquin River at Buckley Cove and the North
13 Bay Aqueduct at Barker Slough would be minimal (<2%). Thus, these increased bromide
14 concentrations are not expected to result in adverse effects to MUN beneficial uses, or any other
15 beneficial use, at these locations. Based on these findings, this effect is determined to not be adverse.

16 **CEQA Conclusion:** While greater water demands under Alternative 4A would alter the magnitude
17 and timing of reservoir releases north and east of the Delta, these activities would have negligible, if
18 any, effect on the sources of bromide, and ultimately the concentration of bromide in the
19 Sacramento River, the San Joaquin River, the eastside tributaries, and the various reservoirs of the
20 related watersheds, as described for Alternative 4 (see Section 8.3.3.9).

21 Under Alternative 4A there would be an increased frequency of exceedance of both the 50 µg/L and
22 100 µg/L bromide thresholds for protecting against the formation of disinfection byproducts in
23 treated drinking water at the S. Fork Mokelumne River at Staten Island, Franks Tract, Old River at
24 Rock Slough, Sacramento River at Emmaton, San Joaquin River at Antioch, and Sacramento River at
25 Mallard Island. Also, there would be an increased frequency of exceedance of the 100 µg/L threshold
26 at the Contra Costa Pumping Plant #1. However, long-term average bromide concentrations would
27 increase only in the S. Fork Mokelumne River at Staten Island and decrease at all other assessment
28 locations. The long-term bromide concentration in the S. Fork Mokelumne River at Staten Island (54
29 µg/L) would be less than the 100 µg/L believed to be sufficient to meet currently established
30 drinking water criteria for disinfection byproducts. Further, as described for Alternative 4 (see
31 Section 8.3.3.9), the use of seasonal intakes at Antioch and Mallard Island is largely driven by
32 acceptable water quality, and thus has historically been opportunistic and opportunity to use these
33 intakes would remain. Thus, these increased bromide concentrations would not be expected to
34 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

35 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
36 of changes in bromide concentrations at Banks and Jones pumping plants. Long-term average
37 bromide concentrations at the Banks and Jones pumping plants are predicted to decrease by as
38 much as 46% relative to Existing Conditions and there would be less frequent exceedance of
39 bromide concentration thresholds.

40 Based on the above, Alternative 4A would not cause exceedance of applicable state or federal
41 numeric or narrative water quality objectives/criteria because none exist for bromide. Alternative
42 4A would not result in any substantial change in long-term average bromide concentration or
43 exceed 50 and 100 µg/L assessment threshold concentrations by frequency, magnitude, and
44 geographic extent that would result in adverse effects on any beneficial uses within affected water
45 bodies. Bromide is not a bioaccumulative constituent and thus concentrations under this alternative

1 would not result in bromide bioaccumulating in aquatic organisms. Increases in exceedances of the
2 100 µg/L assessment threshold concentration would be 5% or less at all locations assessed, which is
3 considered to be less than substantial long-term degradation of water quality. The levels of bromide
4 degradation that may occur under the Alternative 4A would not be of sufficient magnitude to cause
5 substantially increased risk for adverse effects on any beneficial uses of water bodies within the
6 affected environment. Bromide is not CWA Section 303(d) listed and thus the minor increases in
7 long-term average bromide concentrations would not affect existing beneficial use impairment
8 because no such use impairment currently exists for bromide. Based on these findings, this impact is
9 less than significant. No mitigation is required.

10 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of** 11 **Environmental Commitments 3, 4, 6-12, 15, and 16**

12 **NEPA Effects:** Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 would present
13 no new sources of bromide to the affected environment, including areas Upstream of the Delta,
14 within the Plan Area, and the SWP/CVP Export Service Areas. Some habitat restoration activities
15 would occur on lands in the Delta formerly used for irrigated agriculture. Such replacement or
16 substitution of land use activity would not be expected to result in new or increased sources of
17 bromide to the Delta. Therefore, as they pertain to bromide, implementation of these Environmental
18 Commitments would not be expected to adversely affect MUN beneficial use, or any other beneficial
19 uses, of the affected environment.

20 Environmental Commitment 4 would result in some tidal habitat restoration, however, the areal
21 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
22 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
23 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
24 bromide concentration changes.

25 In summary, implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 under
26 Alternative 4A relative to the No Action Alternative (ELT and LLT), would have negligible, if any,
27 effects on bromide concentrations. Therefore, the effects on bromide from implementing
28 Environmental Commitments 3, 4, 6-12, 15, and 16 are determined to not be adverse.

29 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 under
30 Alternative 4A would not present new or substantially changed sources of bromide to the affected
31 environment. Some Environmental Commitments may replace or substitute for existing irrigated
32 agriculture in the Delta. This replacement or substitution would not be expected to substantially
33 increase or present new sources of bromide. Thus, implementation of Environmental Commitments
34 3, 4, 6-12, 15, and 16 would have negligible, if any, effects on bromide concentrations throughout
35 the affected environment, would not cause exceedance of applicable state or federal numeric or
36 narrative water quality objectives/criteria because none exist for bromide, and would not cause
37 changes in bromide concentrations that would result in significant impacts on any beneficial uses
38 within affected water bodies. Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16
39 would not cause significant long-term water quality degradation such that there would be greater
40 risk of significant impacts on beneficial uses, would not cause greater bioaccumulation of bromide,
41 and would not further impair any beneficial uses due to bromide concentrations because no uses are
42 currently impaired due to bromide levels. Based on these findings, this impact is considered less
43 than significant. No mitigation is required.

1 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 2 **Maintenance**

3 ***Upstream of the Delta***

4 The effects of Alternative 4A on chloride concentrations in reservoirs and rivers upstream of the
5 Delta would be the similar to those effects described for Alternative 4 (see Section 8.3.3.9). Chloride
6 loading in these watersheds would remain unchanged and resultant changes in flows from altered
7 system-wide operations would have negligible, if any, effects on the concentration of chloride in the
8 rivers and reservoirs of these watersheds. There would be no expected change to the sources of
9 chloride in the Sacramento River and eastside tributary watersheds, and changes in the magnitude
10 and timing of reservoir releases north and east of the Delta would have negligible, if any, effect on
11 the sources, and ultimately the concentration of chloride in the Sacramento River, the eastside
12 tributaries, and the various reservoirs of the related watersheds. The modeled annual average lower
13 San Joaquin River flow at Vernalis would decrease slightly (1%) compared to Existing Conditions
14 and would remain virtually the same as the No Action Alternative (ELT), and thus flow changes
15 would not result in substantial chloride increases. Moreover, there are no existing municipal intakes
16 on the lower San Joaquin River. Consequently, Alternative 4A in the ELT would not be expected to
17 cause exceedances of chloride objectives/criteria or substantially degrade water quality with
18 respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River,
19 the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

20 Effects of Alternative 4A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
21 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
22 change and sea level rise that would occur in the LLT would not affect chloride sources in these
23 areas.

24 ***Delta***

25 Estimates of chloride concentrations at Delta assessment locations were generated using a mass
26 balance approach and EC-chloride relationships and DSM2 EC output. See Section 8.3.1.3, *Plan Area*,
27 for more information regarding these modeling approaches. The assessment below identifies
28 changes in chloride at Delta assessment locations based on both approaches.

29 Modeling of chloride using both the mass balance approach and EC-chloride relationship predicts
30 that Alternative 4A in the ELT would result in reduced long-term average chloride concentrations,
31 relative to Existing Conditions, for the 16-year period modeled at all assessment locations except for
32 the S. Fork Mokelumne River at Staten Island. The increase in long-term average chloride
33 concentration at Staten Island would be 1 mg/L (7%) based on the mass balance modeling and
34 <1 mg/L (3%) based on the EC-chloride relationship (Appendix 8G, *Chloride*, Tables Cl-69 and Cl-
35 70). These increases are extremely small in absolute terms and relative to applicable water quality
36 objectives, and are within the estimated modeling uncertainty. The results differ from Alternative 4,
37 under which there would be increased long-term average chloride concentrations also at the North
38 Bay Aqueduct at Barker Slough. The change in long-term average chloride concentrations relative to
39 the No Action Alternative (ELT) would be similar to those relative to Existing Conditions.

40 The following outlines the modeled chloride changes relative to the applicable objectives and
41 beneficial uses of Delta waters.

1 *Municipal Beneficial Uses Relative to Existing Conditions*

2 Estimates of chloride concentrations generated using EC-chloride relationships were used to
3 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses on a
4 basis of the percentage of years the chloride objective is exceeded for the modeled 16-year period.
5 The objective is exceeded if chloride concentrations exceed 150 mg/L for a specified number of days
6 in a given water year at Antioch and Contra Costa Pumping Plant #1. For Alternative 4A, the
7 modeled frequency of objective exceedance would decrease at the Contra Costa Pumping Plant #1
8 from 7% of years under Existing Conditions, to 0% of years (Appendix 8G, *Chloride*, Table Cl-64).

9 Evaluation of the 250 mg/L Bay-Delta WQCP objective for chloride utilized results from both the
10 mass balance approach and EC-chloride relationship. The basis for the evaluation was the predicted
11 number of days the objective would be exceeded for the modeled 16-year period.

12 Based on the mass balance approach, there would be a decreased frequency of exceedance of the
13 250 mg/L objective under Alternative 4A, relative to Existing Conditions, at all locations except in
14 the Sacramento River at Mallard Island and Emmaton, and San Joaquin River at Antioch. In the
15 Sacramento River at Mallard Island, the frequency of objective exceedance would increase from 85%
16 under Existing Conditions to 86% under Alternative 4A for the entire period modeled (Appendix 8G,
17 *Chloride*, Table Cl-81). At Emmaton, there would be an increase in chloride objective exceedance
18 during the drought period modeled, from 55% to 58%. In the San Joaquin River at Antioch, there
19 would be an increase in the chloride objective exceedance during the drought period modeled from
20 82% to 83%. These changes are within the uncertainty of the modeling approach.

21 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
22 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
23 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
24 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
25 year period. For Alternative 4A, the modeled frequency of objective exceedance would decrease,
26 from 6% of modeled days under Existing Conditions, to 4% of modeled days under Alternative 4A
27 (Appendix 8G, *Chloride*, Table Cl-63).

28 The mass balance results also indicate reduced assimilative capacity with respect to the 250 mg/L
29 objective during certain months and at certain locations. In the San Joaquin River at Antioch, there
30 would be a reduction in assimilative capacity in March and April of up to 21% for the 16-year period
31 modeled, and 71% for the drought period modeled (Appendix 8G, *Chloride*, Table Cl-71).
32 Assimilative capacity at the Contra Costa Pumping Plant #1 would be reduced in March, April, and
33 June by up to 4% for the entire period modeled and in April, May and June by up to 4% for the
34 drought period modeled. These estimates include the effect of climate change and sea level rise, as
35 well as the alternative. Comparisons to the No Action Alternative (ELT) below provide an
36 assessment of the effect of the alternative alone.

37 When utilizing the EC-chloride relationship to model chloride concentrations for the 16-year period,
38 trends in frequency of exceedance and use of assimilative capacity would be similar to those
39 discussed when utilizing the mass balance modeling approach (Appendix 8G, *Chloride*, Tables Cl-72
40 and Cl-82). However, the EC-chloride relationships predicted changes of lesser magnitude, where
41 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
42 thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the
43 approach that yielded the more conservative predictions was used as the basis for determining
44 adverse impacts.

1 *CWA Section 303(d) Listed Water Bodies—Relative to Existing Conditions*

2 Tom Paine Slough in the southern Delta is on the state’s CWA Section 303(d) list for chloride with
3 respect to the secondary MCL of 250 mg/L. Monthly average chloride concentrations at the Old
4 River at Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled
5 location to Tom Paine Slough, would be generally similar under Alternative 4A in the ELT relative to
6 Existing Conditions, and thus, would not be further degraded on a long-term basis and Alternative
7 4A in the ELT would thus not make this impairment discernibly worse (Appendix 8G, *Chloride*,
8 Figure CI-17).

9 Suisun Marsh also is on the state’s CWA Section 303(d) list for chloride in association with the Bay-
10 Delta WQCP objectives for maximum allowable salinity during the months of October through May,
11 which establish appropriate seasonal salinity conditions for fish and wildlife beneficial uses. In the
12 Sacramento River at Mallard Island, monthly average chloride concentrations for the 16-year period
13 modeled would generally decrease under Alternative 4A in the ELT relative to Existing Conditions in
14 October through February by 2–18%, and increase in March through May by 1–17% (Appendix 8G,
15 *Chloride*, Figure CI-18). In the Sacramento River at Collinsville monthly average chloride
16 concentrations for the 16-year period modeled would similarly decrease under Alternative 4A in the
17 ELT relative to Existing Conditions in October through February by 3–22% and increase in March
18 and April by 11–21% (Appendix 8G, *Chloride*, Figure CI-19). In Montezuma Slough at Beldon’s
19 Landing monthly average chloride concentrations for the 16-year period modeled would similarly
20 decrease under Alternative 4A in the ELT relative to Existing Conditions in October through
21 February by 1–15% and increase in March through May by 2–12% (Appendix 8G, *Chloride*, Figure
22 CI-20). Chloride levels in Suisun Marsh are highly dynamic on a sub-daily basis as a result of tidal
23 influences. The changes identified above are small relative to normal day-to-day variability in
24 chloride in Suisun Marsh. For these reasons, any changes in chloride in Suisun Marsh are expected to
25 have no adverse effect on marsh beneficial uses. These changes reflect the effect of climate change
26 and sea level rise, as well as the alternative. Comparisons to the No Action Alternative (ELT) below
27 provide an assessment of the effect of the alternative alone.

28 *Municipal Beneficial Uses Relative to No Action Alternative (ELT)*

29 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
30 generated from EC-chloride relationships were used to evaluate the 150 mg/L Bay-Delta WQCP
31 objective for municipal and industrial beneficial uses. For Alternative 4A in the ELT, the modeled
32 frequency of objective exceedance would not change at the Contra Costa Pumping Plant #1—both
33 the No Action Alternative (ELT) and Alternative 4A would have no exceedances (Appendix 8G,
34 *Chloride*, Table CI-64).

35 Based on the mass balance approach, the frequency of exceedance of the 250 mg/L objective under
36 Alternative 4A in the ELT would be the same, or would decrease, at all locations relative to the No
37 Action Alternative (ELT) (Appendix 8G, *Chloride*, Table CI-81).

38 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
39 EC output (see Section 8.3.1.3) were also used to evaluate the 250 mg/L Bay-Delta WQCP objective
40 for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The basis for
41 the evaluation was the predicted number of days the objective was exceeded for the modeled 16-
42 year period. For Alternative 4A, the modeled frequency of objective exceedance would decrease,
43 from 8% of modeled days under the No Action Alternative (ELT), to 4% of modeled days under
44 Alternative 4A (Appendix 8G, *Chloride*, Table CI-63).

1 Estimates of long-term use of assimilative capacity using the mass balance results indicated the
2 potential for reduced assimilative capacity with respect to the 250 mg/L objective for certain
3 months and locations. Calculations using the long-term monthly average concentrations showed
4 that in the San Joaquin River at Antioch, there would be a reduction in assimilative capacity in April
5 of 5% for the entire period modeled and 48% for the drought period modeled (Appendix 8G,
6 *Chloride*, Table Cl-71). However, this approach used long-term average chloride concentrations,
7 which can be heavily influenced by changes in a small number of years when chloride
8 concentrations would already be very high. Additionally, when long term averages are just below
9 the objective, very small changes in chloride that are within the modeling uncertainty can result in
10 very high estimates of use of assimilative capacity. To further investigate the potential for water
11 quality degradation with respect to chloride, the concentrations of chloride during individual water
12 years was examined.

13 This further examination was limited to the mass balance approach, since when utilizing the EC-
14 chloride relationship to model monthly average chloride concentrations for the 16-year period,
15 trends in frequency of exceedance and use of assimilative capacity were similar to those discussed
16 for the mass balance modeling approach (Appendix 8G, *Chloride*, Tables Cl-82 and Cl-72). However,
17 utilizing the EC-chloride relationships predicted changes of lesser magnitude, where predictions of
18 change utilizing the mass balance approach were generally of greater magnitude, and thus more
19 conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the approach
20 that yielded the more conservative predictions was used as the basis for determining adverse
21 impacts.

22 Figure Cl-21 in Appendix 8G, *Chloride* shows chloride concentrations in April during the 5-year
23 drought period (1987–1991) at Antioch, where Table Cl-71 in Appendix 8G, *Chloride* indicated up to
24 48% use of assimilative capacity. The figure shows that during 2 of the 5 years, chloride
25 concentrations increased relative to the No Action Alternative (ELT) and decreased in the other 3
26 years. The absolute differences estimated are fairly small and may be within modeling uncertainty.
27 Figures Cl-22 and Cl-23 in Appendix 8G show a box and whisker plot and exceedance plot for April
28 at Antioch for all dry and critical water years modeled (not just the 1987–1991 drought period).
29 These graphs show that while the median chloride concentration is increased relative to the No
30 Action Alternative (ELT), the maximums, 25th percentile, and 75th percentile values are either
31 similar or decreased. Based on this analysis, long-term degradation is not expected at Antioch in
32 April during drought years.

33 Based on the low level of water quality degradation estimated for the western Delta, and the lack of
34 exceedance of water quality objectives, Alternative 4A is not expected to have substantial adverse
35 effects on municipal and industrial beneficial uses in the western Delta.

36 *CWA Section 303(d) Listed Water Bodies—Relative to No Action Alternative (ELT)*

37 With respect to the state’s CWA Section 303(d) listing for chloride, monthly average chloride
38 concentrations at Tom Paine Slough would not be further degraded on a long-term basis, based on
39 the overall small changes that would occur in Old River at Tracy Road (Appendix 8G, *Chloride*, Figure
40 Cl-17). In the Sacramento River at Mallard Island, monthly average chloride concentrations for the
41 16-year period modeled would increase slightly under Alternative 4A in the ELT relative to the No
42 Action Alternative (ELT) in March and April by 1–4%, and decrease in May and October through
43 February by up to 12% (Appendix 8G, *Chloride*, Figure Cl-18). In the Sacramento River at Collinsville
44 monthly average chloride concentrations for the 16-year period modeled would similarly increase

1 in March and April by 3%, and decrease in May and October through February by up to 18%
 2 (Appendix 8G, *Chloride*, Figure CI-19). In Montezuma Slough at Beldon’s Landing monthly average
 3 chloride concentrations for the 16-year period modeled would increase in December, March and
 4 April by 1–2%, and decrease in May, October, November, January and February by 6–10% (Appendix
 5 8G, *Chloride*, Figure CI-20). Chloride levels in Suisun Marsh are highly dynamic on a sub-daily basis
 6 as a result of tidal influences. The changes identified above are small relative to normal day-to-day
 7 variability in chloride in Suisun Marsh. For these reasons, any changes in chloride in Suisun Marsh
 8 are expected to have no adverse effect on marsh beneficial uses.

9 The effects of Alternative 4A in the LLT in the Delta region, relative to Existing Conditions and the
 10 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
 11 climate change and sea level rise, additional outflow may be required at certain times to prevent
 12 increases in chloride in the west Delta. Small increases in chloride concentrations may occur in some
 13 areas, but it is not expected that these increases would cause exceedance of Bay-Delta WQCP
 14 objectives of cause substantial long-term degradation that would impact municipal and industrial
 15 beneficial uses.

16 ***SWP/CVP Export Service Areas***

17 Under Alternative 4A in the ELT, long-term average chloride concentrations at the Banks and Jones
 18 pumping plants, based on the mass balance analysis of modeling results for the 16-year period,
 19 would decrease relative to Existing Conditions. Chloride concentrations would be reduced by 45%
 20 at Banks pumping plant (Appendix 8G, *Chloride*, Table CI-69). At Jones pumping plant, chloride
 21 concentrations would be reduced 43% (Appendix 8G, *Chloride*, Table CI-69). The frequency of
 22 exceedances of applicable water quality objectives would decrease relative to Existing Conditions,
 23 for both the 16-year period and the drought period modeled (Appendix 8G, *Chloride*, Table CI-81).
 24 The chloride concentration changes relative to the No Action Alternative (ELT) would be similar.
 25 Consequently, water exported into the SWP/CVP Export Service Areas would generally be of similar
 26 or better quality with regard to chloride relative to Existing Conditions and the No Action
 27 Alternative (ELT). Results of the modeling approach which utilized a EC-chloride relationship are
 28 consistent these results, and assessment of chloride using these modeling output results in the same
 29 conclusions as for the mass balance approach (Appendix 8G, *Chloride*, Tables CI-70 and CI-82).

30 Commensurate with the reduced chloride concentrations in water exported to the SWP/CVP Export
 31 Service Area, reduced chloride loading in the lower San Joaquin River would be anticipated which
 32 would likely reduce chloride concentrations at Vernalis.

33 The effects of Alternative 4A in the LLT in the SWP/CVP Export Service Areas, relative to Existing
 34 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
 35 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
 36 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

37 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
 38 contribute towards a substantial change in existing sources of chloride in the affected environment.
 39 Maintenance activities would not be expected to cause any substantial change in chloride such that
 40 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
 41 affected anywhere in the affected environment.

42 ***NEPA Effects:*** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 4A
 43 would not result in substantially increased chloride concentrations upstream of the Delta, in the

1 Delta, or in the SWP/CVP Export Service Area on a long-term average basis that would result in
 2 adverse effects on the municipal and industrial water supply beneficial use, or any other beneficial
 3 use. Additional exceedance of the 150 mg/L and 250 mg/L objectives is not expected, and
 4 substantial long-term degradation is not expected that would result in adverse effects on the
 5 municipal and industrial water supply beneficial use, or any other beneficial use. Based on these
 6 findings, this effect is determined to not be adverse.

7 **CEQA Conclusion:** Chloride is not a constituent of concern in the Sacramento River watershed
 8 upstream of the Delta; therefore, river flow rate and reservoir storage reductions that would occur
 9 under Alternative 4A relative to Existing Conditions, would not be expected to result in a substantial
 10 adverse change in chloride levels. Additionally, relative to Existing Conditions, Alternative 4A would
 11 not result in reductions in river flow rates (i.e., less dilution) or increased chloride loading such that
 12 there would be any substantial increase in chloride concentrations upstream of the Delta in the San
 13 Joaquin River watershed.

14 Relative to Existing Conditions, Alternative 4A would not result in substantially increased chloride
 15 concentrations in the Delta on a long-term average basis that would result in adverse effects on the
 16 municipal and industrial water supply beneficial use. Additional exceedance of the 150 mg/L and
 17 250 mg/L objectives is not expected, and substantial long-term degradation is not expected that
 18 would result in adverse effects on the municipal and industrial water supply beneficial use.

19 Chloride concentrations would be reduced under Alternative 4A in water exported from the Delta to
 20 the SWP/CVP Export Service Areas thus reflecting a potential improvement to chloride loading in
 21 the lower San Joaquin River.

22 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the
 23 Alternative 4A would not result in substantial chloride bioaccumulation impacts on aquatic life or
 24 humans. Alternative 4A maintenance would not result in any substantial changes in chloride
 25 concentration upstream of the Delta or in the SWP/CVP Export Service Areas

26 Based on these findings, this impact is determined to be less than significant. No mitigation is
 27 required. Despite the fact that no mitigation is required, DWR proposed to further reduce any
 28 impacts by implementing Mitigation Measure WQ-7e.

29 **Mitigation Measure WQ-7e: Implement Terms of the Contra Costa Water District**
 30 **Settlement Agreement**

31 DWR and Contra Costa Water District (CCWD) entered into a settlement agreement
 32 (Agreement) for reducing potential impacts to CCWD water supply in the Delta related to
 33 construction and operation of the BDCP/California WaterFix. This mitigation measure includes
 34 conveyance of water to CCWD that meets specified water quality requirements, in quantities and
 35 on a schedule defined in the Agreement. The Agreement ensures that the quality of the water
 36 CCWD delivers to its customers is not impacted as a result of the BDCP/California WaterFix. The
 37 Agreement does not increase the total amount of water that CCWD would otherwise be entitled
 38 to divert.

39 DWR would convey mitigation water to CCWD in one of two ways: 1) the primary method of
 40 conveying the water would be through the existing Freeport Regional Water Authority Intake
 41 (Freeport Intake) and the existing interconnection between EBMUD's Mokelumne Aqueduct and
 42 CCWD's Los Vaqueros Pipeline; and 2) the secondary method of conveying the water would be
 43 through the BDCP/California WaterFix's northern intakes and new Interconnection Facilities

1 between the water conveyance facilities and existing CCWD facilities. Two different options for
 2 the new Interconnection Facilities are being considered: one on Victoria Island between the
 3 water conveyance facilities and the existing CCWD Middle River pipeline; and one at Clifton
 4 Court Forebay between the Clifton Court Forebay and the CCWD Los Vaqueros pipeline. No new
 5 facilities are required for the EBMUD/Freeport Intake conveyance method. DWR would be
 6 responsible for design and construction of the Victoria Island or Clifton Court Forebay facilities.

7 The Agreement requires an initial conveyance to CCWD of 30 TAF of water. For each year after
 8 the initial conveyance, a specified amount of water based on the prior year's operations would
 9 be conveyed in arrears. Under the Agreement, CCWD would take the same quantity of water that
 10 it would take absent the agreement, but the location and timing of diversions would change.
 11 Annual average diversions of mitigation water would be on the order of 30 TAF, and the rate of
 12 diversion of the mitigation water would be 150 cfs, with a maximum rate of diversion of 250 cfs
 13 upon mutual agreement between DWR and CCWD.

14 Additional description of the Agreement actions and analysis of the potential effects of this
 15 mitigation measures are provided in Appendix 31B. Terms of the Agreement are presented in
 16 Attachment 1 to Appendix 31B.

17 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of**
 18 **Environmental Commitments 3, 4, 6–12, 15, and 16**

19 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 20 Alternative 4A would present no new direct sources of chloride to the affected environment,
 21 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 22 Consequently, as they pertain to chloride, implementation of these Environmental Commitments
 23 would not be expected to adversely affect any of the beneficial uses of the affected environment.
 24 Moreover, some habitat restoration activities would occur on lands within the Delta currently used
 25 for irrigated agriculture. The potential reduction in irrigated lands within the Delta may result in
 26 reduced discharges of agricultural field drainage with elevated chloride concentrations, which
 27 would be considered an improvement relative to the No Action Alternative (ELT and LLT).
 28 Therefore, the effects on chloride from implementing Environmental Commitments 3, 4, 6–12, 15,
 29 and 16 are considered to be not adverse.

30 **CEQA Conclusion:** Implementation of the Environmental Commitments 3, 4, 6–12, 15, and 16 under
 31 Alternative 4A would not present new or substantially changed sources of chloride to the affected
 32 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas.
 33 Replacement of irrigated agricultural land uses in the Delta with habitat restoration may result in
 34 some reduction in discharge of agricultural field drainage with elevated chloride concentrations,
 35 thus resulting in improved water quality conditions. Based on these findings, this impact is
 36 considered to be less than significant. No mitigation is required.

37 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 38 **Maintenance**

39 As described in detail for Alternative 4 (see Section 8.3.3.9), DO levels are primarily affected by
 40 water temperature, flow velocity, turbulence, amounts of oxygen demanding substances present
 41 (e.g., ammonia, organics), and rates of photosynthesis (which is influenced by nutrient levels),
 42 respiration, and decomposition. Water temperature and salinity affect the maximum DO saturation
 43 level (i.e., the highest amount of oxygen the water can dissolve). Flow velocity affects the turbulence

1 and re-aeration of the water (i.e., the rate at which oxygen from the atmosphere can be dissolved in
2 water). High nutrient content can support aquatic plant and algae growth, which in turn generates
3 oxygen through photosynthesis and consumes oxygen through respiration and decomposition.

4 As described for Alternative 4, amounts of oxygen demanding substances present (e.g., ammonia,
5 organics) in the reservoirs and rivers upstream of the Delta, rates of photosynthesis (which is
6 influenced by nutrient levels/loading), and respiration and decomposition of aquatic life is not
7 expected to change sufficiently under Alternative 4A (ELT and LLT) to substantially alter DO levels
8 relative to Existing Conditions or the No Action Alternative (ELT and LLT). Further, the rivers
9 upstream of the Delta are well oxygenated and experience periods of supersaturation (i.e., when DO
10 level exceeds the saturation concentration). Because these are large, turbulent rivers, any reduced
11 DO saturation level that would be caused by an increase in temperature under Alternative 4A would
12 not be expected to cause DO levels to be outside of the range seen historically. Flow changes that
13 would occur under Alternative 4A would not be expected to have substantial effects on river DO
14 levels; likely, the changes would be immeasurable. This is because sufficient turbulence and
15 interaction of river water with the atmosphere would continue to occur to maintain water
16 saturation levels (due to these factors) at levels similar to that of Existing Conditions and the No
17 Action Alternative (ELT and LLT).

18 Also as described for Alternative 4, salinity changes would generally have relatively minor effects on
19 Delta DO levels. Further, the relative degree of tidal exchange of flows and turbulence, which
20 contributes to exposure of Delta waters to the atmosphere for reaeration, would not be expected to
21 substantially change relative to Existing Conditions or the No Action Alternative (ELT and LLT), such
22 that these factors would reduce Delta DO levels below objectives or levels that protect beneficial
23 uses. Similarly, increased temperature under Alternative 4A (ELT and LLT), which would be due to
24 climate change, would generally have relatively minor effects on Delta DO levels, relative to Existing
25 Conditions.

26 Similar to Alternative 4, flows in the San Joaquin River at Stockton were evaluated for Alternative 4A
27 and are shown in Figure 8-65b. The figure shows that while flows would change somewhat, they
28 would generally be within the range of flows seen under Existing Conditions and the No Action
29 Alternative. Reports indicate that the aeration facility performs adequately under the range of flows
30 from 250–1,000 cfs (ICF International 2010). Based on the above, the expected changes in flows in
31 the San Joaquin River at Stockton are not expected to substantially move the point of minimum DO,
32 and therefore the aeration facility would likely still be located appropriately to keep DO levels above
33 Basin Plan objectives. Overall, assuming continued operation of the aerators, the alternative is not
34 expected to have a substantial adverse effect on DO in the Deep Water Ship Channel. It is expected
35 that DO levels in the Deep Water Ship Channel, which is CWA Section 303(d) listed as impaired due
36 to low DO, would remain similar to those under Existing Conditions and the No Action Alternative
37 (ELT and LLT) or improve as TMDL-required studies are completed and actions are implemented to
38 improve DO levels. DO levels in other Clean Water Act Section 303(d)-listed waterways would not
39 be expected to change relative to Existing Conditions or the No Action Alternative (ELT and LLT), as
40 the circulation of flows, tidal flow exchange, and re-aeration would continue to occur.

41 In the SWP/CVP Export Service Areas, the primary factor that would affect DO in the conveyance
42 channels and ultimately the receiving reservoirs would be changes in the levels of nutrients and
43 oxygen-demanding substances and DO levels in the exported water. Because the biochemical oxygen
44 demand of the exported water would not be expected to substantially differ from that under Existing
45 Conditions or the No Action Alternative (ELT and LLT) due to water quality regulations, canal

1 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
 2 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
 3 downstream reservoirs.

4 **NEPA Effects:** Because DO levels are not expected to change substantially relative to the No Action
 5 Alternative (ELT and LLT), the effects on DO from implementing Alternative 4A (ELT and LLT) are
 6 determined to not be adverse.

7 **CEQA Conclusion:** The effects of Alternative 4A on DO levels in surface waters upstream of the Delta,
 8 in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would be
 9 similar to those described for Alternative 4 (see Section 8.3.3.9). Reservoir storage reductions that
 10 would occur under Alternative 4A, relative to Existing Conditions, would not be expected to result in
 11 a substantial adverse change in DO levels in the reservoirs, because oxygen sources (surface water
 12 aeration, aerated inflows, vertical mixing) would remain. Similarly, river flow rate reductions would
 13 not be expected to result in a substantial adverse change in DO levels in the rivers upstream of the
 14 Delta, given that mean monthly flows would remain within the ranges historically seen under
 15 Existing Conditions and the affected river are large and turbulent. Any reduced DO saturation level
 16 that may be caused by increased water temperature would not be expected to cause DO levels to be
 17 outside of the range seen historically. Finally, amounts of oxygen demanding substances and salinity
 18 would not be expected to change sufficiently to affect DO levels.

19 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 20 Delta source water percentages under this alternative or substantial degradation of these water
 21 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state regulates
 22 the discharges of, and this loading would not be expected to lower DO levels relative to Existing
 23 Conditions based on historical DO levels. Further, the anticipated changes in salinity would have
 24 relatively minor effects on DO levels, and tidal exchange, which contribute to the reaeration of Delta
 25 waters would not be expected to change substantially.

26 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 27 Export Service Areas waters, relative to Existing Conditions. Because the biochemical oxygen
 28 demand of the exported water would not be expected to substantially differ from that under Existing
 29 Conditions (due to water quality regulations), canal turbulence and exposure of the water to the
 30 atmosphere and the algal communities that exist within the canals would establish an equilibrium
 31 for DO levels within the canals. The same would occur in downstream reservoirs.

32 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 33 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 34 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 35 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 36 uses would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for
 37 low DO, but because no substantial decreases in DO levels would be expected, greater degradation
 38 and DO-related impairment of these areas would not be expected. Based on these findings, this
 39 impact would be less than significant. No mitigation is required.

40 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of Environmental**
 41 **Commitments 3, 4, 6-12, 15, and 16**

42 **NEPA Effects:** Environmental Commitments 3, 4, and 6-11 would involve habitat restoration
 43 actions. The increased habitat provided by these Environmental Commitments could contribute to

1 an increased biochemical or sediment demand, through contribution of organic carbon and plants
 2 decaying, though the areal extent of the effects would be less than under Alternative 4, because less
 3 land would be converted under Alternative 4A. The areal extent of new habitat implemented for the
 4 Environmental Commitments would be small relative to the existing and No Action Alternative tidal
 5 area, and similar habitat exists currently in the Delta and is not identified as contributing to adverse
 6 DO conditions. Although additional DOC loading to the Delta may occur (see impact WQ-18), the
 7 amount expected would be minimal and only a fraction of the DOC is available to microorganisms
 8 that would consume oxygen as part of the decay and mineralization process. Since decreases in
 9 dissolved organic carbon are not typically observed in Delta waterways due to these processes, any
 10 increase in DOC is unlikely to contribute to adverse DO levels in the Delta.

11 CM14, which under Alternative 4 would fund improvements to the oxygen aeration facility in the
 12 Stockton Deep Water Ship Channel to meet TMDL objectives established by the Central Valley Water
 13 Board, would not be implemented under Alternative 4A. However, the existing aeration facility
 14 would continue to be operated to enhance DO levels in the channel. Thus, DO levels would be
 15 expected similar those under the No Action Alternative (ELT and LLT).

16 CM19, which under Alternative 4 would fund projects to contribute to reducing pollutant discharges
 17 in stormwater, also would not be implemented under Alternative 4A. Thus, the potential for reduced
 18 biochemical oxygen demand load described for Alternative 4 would not occur in the near-term and
 19 loading of these constituents and, thus DO levels, would be expected to be similar to that which
 20 would occur under the No Action Alternative (ELT and LLT).

21 The remaining Environmental Commitments would not affect DO levels because they are actions
 22 that do not affect the presence of oxygen-demanding substances.

23 Based on the above findings, the effects on DO from implementing Environmental Commitments 3,
 24 4, 6–12, 15, and 16 under Alternative 4A are determined to not be adverse.

25 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
 26 or in the SWP/CVP Export Service Areas following implementation of Environmental Commitments
 27 3, 4, 6–12, 15, and 16 under Alternative 4A would not be substantially different from existing DO
 28 conditions, because these would contribute to a minimal, localized change in oxygen-demanding
 29 substances associated with habitat restoration, if at all. Therefore, these Environmental
 30 Commitments are not expected to cause additional exceedance of applicable water quality objectives
 31 by frequency, magnitude, and geographic extent that would result in significant impacts on any
 32 beneficial uses within affected water bodies. Because no substantial changes in DO levels would be
 33 expected, long-term water quality degradation would not be expected, and, thus, beneficial uses
 34 would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for low
 35 DO, but because no substantial decreases in DO levels would be expected, greater degradation and
 36 impairment of these areas would not be expected. Based on these findings, this impact would be less
 37 than significant. No mitigation is required.

38 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 39 **Operations and Maintenance**

40 ***Upstream of the Delta***

41 The effects of Alternative 4A on EC levels in reservoirs and rivers upstream of the Delta would be
 42 similar to those effects described for Alternative 4 (see Section 8.3.3.9). The extent of new urban

1 growth would be less in the ELT, thus discharges of EC-elevating parameters in runoff and
 2 wastewater discharges to water bodies upstream of the Delta would be expected to be less than in
 3 the LLT. However, the state is regulating point source discharges of EC-related parameters and
 4 implementing a program to further decrease loading of EC-related parameters to tributaries. Based
 5 on these considerations, and those described in Section 8.3.3.9, EC levels (highs, lows, typical
 6 conditions) in the Sacramento River and its tributaries, the eastside tributaries, or their associated
 7 reservoirs upstream of the Delta would not be expected to be outside the ranges occurring under
 8 Existing Conditions.

9 For the San Joaquin River, increases in EC levels under Alternative 4A could occur, but would be
 10 slightly less than those described for Alternative 4 (see Section 8.3.3.9). This is because the effects of
 11 climate change on flows, which could affect dilution of high EC discharges, would be less in the ELT.
 12 The implementation of the adopted TMDL for the San Joaquin River at Vernalis and the ongoing
 13 development of the TMDL for the San Joaquin River upstream of Vernalis are expected to contribute
 14 to improved EC levels. Based on these considerations, substantial changes in EC levels in the San
 15 Joaquin River relative to Existing Conditions would not be expected to be of sufficient magnitude
 16 and geographic extent that would result in adverse effects on any beneficial uses, or substantially
 17 degrade the quality of these water bodies, with regard to EC.

18 **Delta**

19 Relative to Existing Conditions and the No Action Alternative (ELT), initial review of modeling
 20 results indicated that Alternative 4A would potentially result in an increase in the number of days
 21 the Bay-Delta WQCP EC objectives would be exceeded in the Sacramento River at Emmaton and San
 22 Joaquin River at Prisoners Point (Appendix 8H, *Electrical Conductivity*, Table EC-26). To understand
 23 and interpret these results, considerations must be made regarding uncertainty in the modeling and
 24 results from sensitivity analyses. In addition, modeling results indicate there would be small
 25 increases in long-term monthly average EC at modeled Suisun Marsh locations relative to Existing
 26 Conditions. These locations are addressed in detail below. At all other locations, the level of
 27 exceedance and modeled average EC levels under the alternative were approximately equivalent or
 28 lower than under Existing Conditions and the No Action Alternative (ELT).

29 *Sacramento River at Emmaton*

30 Modeling results indicated that the Emmaton EC objective would be exceeded more often under
 31 Alternative 4A than under Existing Conditions and the No Action Alternative (ELT), and that
 32 increases in EC could cause substantial water quality degradation in summer months of below
 33 normal, dry and critical water years. However, these increases in exceedance of the objective and
 34 degradation are expected to be addressed via real-time operations, including real time management
 35 of the north Delta and south Delta intakes, as well as Delta Cross Channel operation. Further
 36 discussion is provided below.

37 Modeling results indicated that the percentage of days the Emmaton EC objective would be
 38 exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing
 39 Conditions, or 12% under the No Action Alternative (ELT), to 16%, and the percentage of days out of
 40 compliance would increase from 11% under Existing Conditions, or 21% under the No Action
 41 Alternative (ELT), to 27% (Appendix 8H, *Electrical Conductivity*, Table EC-26).

42 Sensitivity analyses were performed that modeled Alternative 4 Scenario H3 at the LLT with
 43 Emmaton as the compliance point. These sensitivity analyses were only run at the LLT, but it is

1 expected that the findings can generally be extended to the ELT, because the factors affecting
2 salinity findings in the sensitivity analysis (e.g., modeling assumptions, physical hydrodynamic
3 mechanisms) are similar between the ELT and LLT (see Appendix 8H, *Electrical Conductivity*,
4 Attachment 1). Table 2 of Appendix 8H, *Electrical Conductivity*, Attachment 1, indicates that most of
5 these exceedances are a result of modeling artifacts, but some exceedances are due to deadpool
6 conditions that occurred under Alternative 4 and not under the No Action Alternative. As discussed
7 in Chapter 5, *Water Supply*, Section 5.3.1, *Methods for Analysis*, under extreme hydrologic and
8 operational conditions where there is not enough water supply to meet all requirements, CALSIM II
9 uses a series of operating rules to reach a solution that is a simplified version of the very complex
10 decision processes that SWP and CVP operators would use in actual extreme conditions. Thus, it is
11 unlikely that the Emmaton objective would actually be exceeded due to dead pool conditions.
12 However, these results indicate that water supply could be either under greater stress or under
13 stress earlier in the year.

14 The results of the EC modeling indicate there would be months with substantial degradation relative
15 to the No Action Alternative (ELT), particularly during the drought period modeled. Long-term
16 monthly average EC levels at Emmaton would increase in the months of April, and July through
17 September by 3–30% for the entire period modeled (1976–1991) and 6–41% during the drought
18 period modeled (1987–1991), relative to the No Action Alternative (ELT) (Appendix 8H, *Electrical*
19 *Conductivity*, Table EC-29). The largest increases in EC would occur in below normal, dry and critical
20 water year types. However, as stated above, these periods of degradation are expected to be
21 addressed via real-time operations. The level to which modeling output depicts degradation of
22 water quality with respect to EC is primarily a function of the modeling not being able to fully
23 capture how the system would be operated in real-time to minimize or avoid such degradation.

24 Discussions with SWP operators indicated that real-time operations would ensure that the Bay-
25 Delta WQCP EC objectives at Emmaton, applicable from April 1 through August 15, would be met. In
26 latter August and September, the Threemile Slough standard in the North Delta Water Agency
27 Agreement and the Bay-Delta WQCP municipal and industrial objective at Rock Slough are in effect.
28 During this period of the year, the coordinated operations of the SWP/CVP system strives to meet
29 both standards in the most water-efficient method available to the CVP and SWP. Real-time
30 operation would result in less EC degradation than depicted by modeling output because in order to
31 comply with Bay-Delta WQCP objectives and the the North Delta Water Agency Agreement during
32 the summer period, operators could, for example, increase upstream reservoir releases for
33 necessary periods of time, reduce North Delta diversions, and/or close (short-term) the Delta Cross
34 Channel. These options as well as real-time and forecasted tides, winds and barometric pressure are
35 considered when the projects schedule daily operations, which the modeling does not fully capture.

36 Alternative 4A does not change the Bay-Delta WQCP objectives or the the North Delta Water Agency
37 Agreement which are primary drivers of operations and resulting water quality in the Sacramento
38 River at at Emmaton during late August and September. Therefore, the EC degradation at Emmaton
39 that would occur upon implementation of Alternative 4A would be lesser than that shown by the
40 modeling and would not be expected to differ substantially from that which would occur under the
41 No Project Alternative because the compliance targets are not changing due to Alternative 4A during
42 these months and real-time operations would achieve the compliance targets.

43 The modeling results also show that in the remaining months there would be decreases in EC
44 relative to the No Action Alternative (ELT) of 3–21% for the entire period modeled and 2–28% for
45 the drought period modeled. These decreases would contribute to the long-term average EC levels

1 decreasing by 1% for the entire period modeled and drought period modeled (Appendix 8H,
2 *Electrical Conductivity*, Table EC-29).

3 *San Joaquin River at Prisoners Point*

4 Modeling results indicated that the EC objective that applies to the San Joaquin River between Jersey
5 Point and Prisoners Point would be exceeded at Prisoners Point more often under Alternative 4A
6 than under Existing Conditions and the No Action Alternative (ELT). However, these exceedances
7 also are expected to be able to be addressed via real-time operations, including real time
8 management of the north Delta and south Delta intakes, as well as Head of Old River Barrier
9 management. Further discussion is provided below.

10 Modeling results estimated that the percentage of days the Prisoners Point EC objective would be
11 exceeded would increase from 6% under Existing Conditions, or 2% under the No Action Alternative
12 (ELT), to 12%, and the percentage of days out of compliance with the EC objective would increase
13 from 10% under Existing Conditions, or 2% under the No Action Alternative (ELT), to 13%
14 (Appendix 8H, *Electrical Conductivity*, Table EC-26). The magnitude of the exceedances is estimated
15 to be very small—the objective is 440 $\mu\text{mhos/cm}$, and the EC during times of exceedance was
16 between 440 and 600 $\mu\text{mhos/cm}$ —and the exceedances generally occurred in drier water years (4
17 of the 5 years in which there were exceedances were dry water year type), when flows would be
18 lower (Appendix 8H, *Electrical Conductivity*, Figures EC-1 through EC-5). During these times, the EC
19 in the San Joaquin River at Vernalis is greater than in the Sacramento River entering the Delta, and is
20 high enough on its own to cause an exceedance of the Prisoners Point EC objective.

21 There are two main drivers of the increase in exceedances under the alternative: an increase in San
22 Joaquin River flow at Prisoners Point during April and May under the alternative, relative to Existing
23 Conditions and the No Action Alternative (ELT), and a reduction in the amount of Sacramento River
24 water moving past Prisoners Point under the alternative. The result is increased San Joaquin River
25 water at Prisoners Point, and a reduction in the dilution that the Sacramento River provides the
26 higher EC San Joaquin River. The increase in San Joaquin River flow at Prisoners Point is due to a
27 reduction in pumping from the south Delta under the alternative, as well as due to the presence of
28 the Head of Old River Barrier, which increases flow in the San Joaquin River downstream of Old
29 River by preventing flow from entering Old River. The reduction in Sacramento River water
30 influence is due to less pumping at the south Delta pumping plants (i.e., greater pumping draws
31 more Sacramento River water through the Delta).

32 Sensitivity analyses conducted for Alternative 4 Scenario H3 at the LLT indicated that if the Head of
33 Old River Barrier was open in April and May, exceedances would be reduced by about 5 percentage
34 points. These sensitivity analyses were only run at the LLT, but it is expected that the findings can
35 generally be extended to the ELT. Results of the sensitivity analyses indicate that the exceedances
36 are partly due also to operations of the alternative itself, due to Head of Old River Barrier
37 assumptions, and south Delta export differences (see Appendix 8H, Attachment 1, for more
38 discussion of these sensitivity analyses). Appendix 8H, Attachment 2, contains a more detailed
39 assessment of the likelihood of exceedances estimated via modeling adversely affecting aquatic life
40 beneficial uses. Specifically, Appendix 8H, Attachment 2, discusses whether these exceedances might
41 have indirect effects on striped bass spawning in the Delta, and concludes that the high level of
42 uncertainty precludes making a definitive determination for those alternatives. Additionally, by
43 adaptively managing the Head of Old River Barrier and the fraction of south Delta versus north Delta

1 diversions, EC levels at Prisoners Point would likely be decreased to a level that would not adversely
2 affect aquatic life beneficial uses.

3 *Suisun Marsh*

4 For Suisun Marsh October–May is the period when Bay-Delta WQCP EC objectives for protection of
5 fish and wildlife apply. Modeling results indicate that average EC for the entire period modeled
6 would increase in the Sacramento River at Collinsville during the months of March and April relative
7 to Existing Conditions, by 0.1–0.2 mS/cm (Appendix 8H, *Electrical Conductivity*, Table EC-32). In
8 Montezuma Slough at National Steel, average EC levels would increase in March through May by
9 0.2 mS/cm (Appendix 8H, Table EC-33). There would be similarly small increases in long-term
10 average EC in the months of March through May in Montezuma Slough near Beldon’s Landing,
11 Chadbourne Slough near Sunrise Duck Club, and Suisun Slough near Volanti Slough, ranging 0.1–0.4
12 mS/cm depending on month and location (Appendix 8H, Tables EC-34 through EC-36). Relative to
13 the No Action Alternative (ELT), the modeled long-term average EC under the alternative would be
14 similar or lower from October through May for these locations (Appendix 8H, Tables EC-32 through
15 EC-36).

16 The Suisun Marsh EC objectives are expressed as a monthly average of daily high tide EC, which
17 does not have to be met if it can be demonstrated “equivalent or better protection will be provided
18 at the location” (State Water Resources Control Board 2006:14). Long-term average EC increases
19 relative to Existing Conditions may, or may not, contribute to adverse effects on beneficial uses,
20 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
21 water is managed, and future actions taken with respect to the Marsh. Given the Bay-Delta WQCP
22 narrative objective regarding “equivalent or better protection” in lieu of meeting specific numeric
23 objectives, the small increases in EC under Alternative 4A, relative to Existing Conditions, would not
24 be expected to adversely affect beneficial uses of Suisun Marsh. While Suisun Marsh is CWA Section
25 303(d) listed as impaired because of elevated EC, the potential increases in long-term average EC
26 concentrations, relative to Existing Conditions, would not be expected to contribute to additional
27 impairment, because the increase would be so small (<1 mS/cm) relative to the daily fluctuations in
28 EC levels as to not be measurable and beneficial uses would not be adversely affected.

29 Further, the EC changes in Suisun Marsh relative to Existing Conditions reflect the influence of both
30 operations of the alternative and sea level rise due to climate change, whereas the changes relative
31 to the No Action Alternative (ELT) are due solely to operations of the alternative. As described
32 above, there would be no increase in the long-term average EC at modeled Suisun Marsh locations,
33 and for some locations long-term average EC would decrease. Therefore, it is expected that this
34 alternative would not contribute to exceedances of EC objectives or additional impairment of
35 beneficial uses, as affected by EC or other salinity-related parameters.

36 The effects of Alternative 4A in the LLT in the Delta region, relative to Existing Conditions and the
37 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
38 climate change and sea level rise, additional outflow may be required at certain times to prevent
39 increases in EC in the west Delta, but this requirement would not be due to the alternative.

40 ***SWP/CVP Export Service Areas***

41 Under Alternative 4A, at the Banks pumping plant, the frequency of exceedance of the EC objective
42 would be 1% for the entire period modeled and 2% for the drought period modeled (Appendix 8H,
43 *Electrical Conductivity*, Table EC-27). Relative to Existing Conditions, average EC levels under

1 Alternative 4A would decrease 25% for the entire period modeled and 20% during the drought
2 period modeled (Appendix 8H, Table EC-29). Relative to the No Action Alternative (ELT), average EC
3 levels would similarly decrease, by 22% for the entire period modeled and 18% during the drought
4 period modeled (Appendix 8H, Table EC-29).

5 At the Jones pumping plant, the frequency of exceedance of the EC objective would be 0% for the
6 entire period modeled and the drought period modeled (Appendix 8H, *Electrical Conductivity*, Table
7 EC-27). Relative to Existing Conditions, average EC levels under Alternative 4A would decrease 26%
8 for the entire period modeled and 24% during the drought period modeled (Appendix 8H, Table EC-
9 29). Relative to the No Action Alternative (ELT), average EC levels would similarly decrease, by 23%
10 for the entire period modeled and 21% during the drought period modeled (Appendix 8H, Table EC-
11 29).

12 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
13 pumping plants, Alternative 4A would not cause degradation of water quality with respect to EC in
14 the SWP/CVP Export Service Areas. Rather, Alternative 4A would improve long-term average EC
15 conditions in the SWP/CVP Export Service Areas.

16 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
17 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
18 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
19 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
20 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
21 increase in EC at Vernalis related to decreased annual average San Joaquin River flows.

22 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
23 elevated EC. Alternative 4A would result in lower average EC levels relative to Existing Conditions
24 and the No Action Alternative (ELT) and, thus, would not contribute to additional beneficial use
25 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

26 The effects of Alternative 4A in the LLT in the SWP/CVP Export Service Areas, relative to Existing
27 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
28 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
29 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

30 **NEPA Effects:** In summary, based on the results of the modeling and sensitivity analyses conducted,
31 it is unlikely that there would be increased frequency of exceedance of agricultural EC objectives in
32 the western, interior, or southern Delta. However, modeling results indicate that there could be
33 increased long-term and drought period average EC levels during the summer months that would
34 occur in the western Delta (i.e., in the Sacramento River at Emmaton) under Alternative 4A relative
35 to the No Action Alternative (ELT), that could contribute to adverse effects on the agricultural
36 beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin River at
37 Prisoners Point EC objective could contribute to adverse effects on fish and wildlife beneficial uses
38 (specifically, indirect adverse effects on striped bass spawning), though there is a high degree of
39 uncertainty associated with this impact. Suisun Marsh is CWA Section 303(d) listed as impaired due
40 to elevated EC, but EC levels are not expected to increase under Alternative 4A, relative to the No
41 Action Alternative (ELT), and thus it is not expected to contribute to additional beneficial use
42 impairment. The increases in EC in the Sacramento River at Emmaton, particularly during summer
43 months of below normal, dry and critical water years, and the additional exceedances of water
44 quality objectives in the San Joaquin River at Prisoners Point constitute an adverse effect on water

1 quality. Mitigation Measure WQ-11 would be available to reduce these effects so that they are not
2 adverse.

3 **CEQA Conclusion:** River flow rate and reservoir storage reductions that would occur under
4 Alternative 4A, relative to Existing Conditions, would not be expected to result in a substantial
5 adverse change in EC levels in the reservoirs and rivers upstream of the Delta, given that: changes in
6 the quality of watershed runoff and reservoir inflows would not be expected to occur in the future;
7 the state's regulation of point-source discharge effects on Delta salinity-elevating parameters and
8 the expected further regulation as salt management plans are developed; the salt-related TMDLs
9 adopted and being developed for the San Joaquin River; and the expected improvement in lower San
10 Joaquin River average EC levels commensurate with the lower EC of the irrigation water deliveries
11 from the Delta.

12 Relative to Existing Conditions, Alternative 4A would not result in any substantial increases in long-
13 term average EC levels in the SWP/CVP Export Service Areas, and exceedance of the Bay-Delta
14 WQCP EC objective would be infrequent. Average EC levels for the entire period modeled would
15 decrease at both the Banks and Jones pumping plants and, thus, this alternative would not
16 contribute to additional beneficial use impairment related to elevated EC in the SWP/CVP Export
17 Service Areas waters. Rather, this alternative would improve long-term EC levels in the SWP/CVP
18 Export Service Areas, relative to Existing Conditions.

19 Further, relative to Existing Conditions, Alternative 4A would not result in substantial increases in
20 long-term average EC in Suisun Marsh. Thus, EC levels in Suisun Marsh are not expected to further
21 degrade existing EC levels and thus would not contribute additionally to adverse effects on the fish
22 and wildlife beneficial uses. Because EC is not bioaccumulative, any changes in long-term average EC
23 levels would not directly cause bioaccumulative problems in fish and wildlife. Suisun Marsh is CWA
24 Section 303(d) listed as impaired due to elevated EC, but EC levels are not expected to change
25 substantially under Alternative 4A, relative to Existing Conditions, and thus it is not expected that
26 they would contribute to additional beneficial use impairment.

27 In the Plan Area, Alternative 4A is not expected to result in an increase in the frequency with which
28 Bay-Delta WQCP EC objectives are exceeded, except for at the San Joaquin River at Prisoners Point
29 (fish and wildlife objective; 6% increase). The increased frequency of exceedance of the fish and
30 wildlife objective at Prisoners Point could contribute to adverse effects on aquatic life (specifically,
31 indirect adverse effects on striped bass spawning), though there is a high degree of uncertainty
32 associated with this impact. However, by adaptively managing the Head of Old River Barrier and the
33 fraction of south Delta versus north Delta diversions, EC levels at Prisoners Point would likely be
34 decreased to a level that would not adversely affect aquatic life beneficial uses.

35 Average EC levels at Emmaton were modeled to increase by 9% during the drought period. The
36 largest monthly average increases in EC would occur during the summer months of the drought
37 period, and more generally in below normal, dry and critical water year types. The increases in
38 drought period average EC levels modeled could cause substantial water quality degradation that
39 would potentially contribute to adverse effects on the agricultural beneficial uses in the western
40 Delta. The comparison to Existing Conditions reflects changes in EC due to both Alternative 4A
41 operations and climate change/sea level rise. The adverse effects expected to occur at Emmaton
42 would be due in part to the effects of climate change/sea level rise, and in part due to Alternative 4A
43 operations. This is evidenced by the increases in EC in the No Action Alternative (ELT) at Emmaton
44 relative to Existing Conditions, as well as the fact that a lesser level of adverse effects is expected at

1 Emmaton under Alternative 4A relative to the No Action Alternative (ELT). During summer of below
 2 normal, dry and critical water years, additional flow in the Sacramento River at Emmaton would
 3 reduce or eliminate increases in EC. It is expected that for July–September of below normal, dry and
 4 critical water years, real-time operations that would include more precise management of upstream
 5 reservoir releases on a daily basis and less pumping from the north Delta intakes and greater
 6 reliance on south Delta intakes than that modeled would allow for enough flow in the Sacramento
 7 River at Emmaton to reduce water quality degradation to levels closer to the No Action Alternative
 8 that would not be expected to adversely affect beneficial uses. Because EC is not bioaccumulative,
 9 the increases in long-term average EC levels would not directly cause bioaccumulative problems in
 10 aquatic life or humans. The western Delta is CWA Section 303(d) listed for elevated EC and the
 11 increased EC degradation that was modeled in the western Delta could make beneficial use
 12 impairment measurably worse.

13 Based on these findings, this impact in the Plan Area is considered to be significant. Implementation
 14 of Mitigation Measure WQ-11 would be expected to reduce these effects to a less-than-significant
 15 level.

16 **Mitigation Measure WQ-11: Avoid or Minimize Reduced Water Quality Conditions**

17 The implementation of mitigation actions shall be focused on avoiding or minimizing those
 18 incremental effects attributable to implementation of Alternative 4A operations only. Mitigation
 19 actions to avoid or minimize the incremental EC effects attributable to climate change/sea level
 20 rise are not required because these changed conditions would occur with or without
 21 implementation of Alternative 4A. The goal of specific actions is to reduce/avoid additional
 22 exceedances of Delta EC objectives and reduce long-term average EC concentration increases to
 23 levels that would not adversely affect beneficial uses within the Delta, and would not make
 24 beneficial use impairment measurably worse. Implementation of Mitigation Measure WQ-11
 25 would be expected to reduce effects on EC to a less-than-significant level.

26 **Mitigation Measure WQ-11e: Implement Real-time Operations, Including Adaptively 27 Managing Diversions at the North and South Delta Intakes, to Reduce or Eliminate Water 28 Quality Degradation in the Western Delta**

29 Modeling results for Alternative 4A indicate water quality degradation for EC in the Sacramento
 30 River at Emmaton in the months of July through September of below normal, dry and critical
 31 water year types, relative to the No Action Alternative (ELT). This mitigation measure
 32 establishes performance standards to address the modeled exceedances of Bay-Delta WQCP EC
 33 objectives and EC degradation such that impacts to beneficial uses affected by remaining
 34 degradation, following mitigation, would be less than significant.

35 The Bay-Delta WQCP establishes water quality objectives for EC at Emmaton applicable from
 36 April 1 through August 15 for the protection of agricultural beneficial uses. To address
 37 exceedances of Bay-Delta WQCP EC objectives and EC degradation at Emmaton that has been
 38 modeled to occur in July and the first half of August of below normal, dry, and critical water
 39 years, the project proponents shall rely upon real-time operations (which cannot be fully
 40 captured in the modeling) to ensure that Bay-Delta WQCP Emmaton EC objectives are met. As a
 41 component of real-time operations, the project proponents shall ensure adequate releases from
 42 upstream reservoirs on a daily time-step and adaptively manage the split between north and
 43 south Delta diversions to achieve the Bay-Delta WQCP EC objectives at Emmaton. The project

1 proponents are required to operate to meet these objectives under Existing Conditions, and
2 would be required to operate to these objectives under the No Action Alternative. Thus,
3 operation of the project alternative to achieve the Bay-Delta WQCP EC objectives would be
4 consistent with Existing Conditions and the No Action Alternative and result in a minimization
5 of EC degradation at Emmaton during July and the first half of August of below normal, dry,
6 and critical water year types. Hence, the performance standard for July and the first half of
7 August shall be the Bay-Delta WQCP Emmaton EC objectives.

8 The Bay-Delta WQCP does not establish an EC objective at Emmaton for the latter half of August
9 or September. To address EC degradation at Emmaton that has been modeled to occur during
10 this period of the year with the project alternative, the project proponents shall manage
11 upstream reservoir releases on a daily basis and adaptively manage the split between north and
12 south Delta diversions of below normal, dry and critical water years. The performance standard
13 for late August and September shall be compliance with the Threemile Slough standard in the
14 North Delta Water Agency Agreement and the Bay-Delta WQCP municipal and industrial
15 objective at Rock Slough as implemented within Decision 1641 or as modified in the future.
16 Allowing sufficient flow in the Sacramento River at Emmaton, through real-time operations,
17 would contribute to reduced EC levels at this location, relative to that modeled for the project
18 alternative, and would reduce EC degradation at Emmaton in late August and September to less-
19 than-significant levels.

20 This mitigation measure is consistent with the adaptive management and real-time operations
21 that would be utilized to minimize the project alternative's water quality effects to *Microcystis*
22 in the summer months (discussed in Impact WQ-32). This mitigation measure also is consistent
23 with the Other (Non-Environmental) Commitment to address reverse flows in the Sacramento
24 River at Freeport that may occur with the project alternative, which are most likely to occur in
25 low flow months of dry and critical years.

26 **Mitigation Measure WQ-11f: Adaptively Manage Head of Old River Barrier and Diversions**
27 **at the North and South Delta Intakes to Reduce or Eliminate Exceedances of the Bay-Delta**
28 **WQCP Objective at Prisoners Point**

29 Modeling results for Alternative 4A indicated additional exceedances of the Bay-Delta WQCP
30 objective for protection of striped bass between Jersey Point and Prisoners Point, at Prisoners
31 Point. It is expected that by adaptively managing the Head of Old River Barrier and the fraction
32 of south Delta versus north Delta diversions, exceedances of the EC objective at Prisoners Point
33 could be avoided, and EC levels at Prisoners Point would be decreased to a level that would not
34 adversely affect aquatic life beneficial uses. The project proponents shall adaptively manage the
35 Head of Old River Barrier and the split between north and south Delta diversions during April-
36 May to avoid exceedances of the objective at Prisoners Point. These actions would not be
37 required in critical water years, when the objective does not apply. The project proponents will
38 consult with CDFW, USFWS, NMFS, and Reclamation to ensure that such actions are warranted
39 to avoid adverse impacts of salinity on striped bass spawning in the San Joaquin River between
40 Jersey Point and Prisoners Point, and to minimize adverse effects these mitigation actions may
41 have on other species. As such, the mitigation performance standard for April and May shall be
42 compliance with the Bay-Delta WQCP EC objective at Prisoners Point.

1 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of**
 2 **Environmental Commitments 3, 4, 6–12, 15 and 16**

3 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would
 4 present no new direct sources of EC to the affected environment, including areas upstream of the
 5 Delta, within the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC,
 6 implementation of these Environmental Commitments would not be expected to adversely affect
 7 any of the beneficial uses of the affected environment. Moreover, some habitat restoration activities
 8 would occur on lands within the Delta currently used for irrigated agriculture. Such replacement or
 9 substitution of land use activity is not expected to result in new or increased sources of EC to the
 10 Delta and, in fact, could decrease EC through elimination of high EC agricultural runoff.

11 Environmental Commitment 4 would result in some tidal habitat restoration; however, the areal
 12 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
 13 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
 14 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
 15 EC changes.

16 In summary, implementation of the Environmental Commitments would not be expected to
 17 adversely affect EC levels in the affected environment and thus would not adversely affect beneficial
 18 uses or substantially degrade water quality with regard to EC within the affected environment.
 19 Therefore, the effects on EC from implementing Environmental Commitments 3, 4, 6–12, 15, and 16
 20 are determined to not be adverse.

21 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 22 Alternative 4A would not present new or substantially changed sources of EC to the affected
 23 environment. Some Environmental Commitments may replace or substitute for existing irrigated
 24 agriculture in the Delta. This replacement or substitution is not expected to substantially increase or
 25 present new sources of EC, and could actually decrease EC loads to Delta waters, because
 26 agricultural drainage can be a source of elevated EC. Thus, implementation of Environmental
 27 Commitments 3, 4, 6–12, 15, and 16 would have negligible, if any, adverse effects on EC levels
 28 throughout the affected environment and would not cause exceedance of applicable state or federal
 29 numeric or narrative water quality objectives/criteria that would result in adverse effects on any
 30 beneficial uses within affected water bodies. Further, implementation of Environmental
 31 Commitments 3, 4, 6–12, 15, and 16 would not cause significant long-term water quality
 32 degradation such that there would be greater risk of adverse effects on beneficial uses. Based on
 33 these findings, this impact is considered to be less than significant. No mitigation is required.

34 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and**
 35 **Maintenance**

36 ***Upstream of the Delta***

37 The effects of the Alternative 4A on mercury levels in surface waters upstream of the Delta relative
 38 to Existing Conditions and the No Action Alternative (ELT) would be similar to those described for
 39 Alternative 4 (see Section 8.3.3.9). This is because factors that affect mercury concentrations in
 40 surface waters upstream of the Delta are similar under Alternatives 4 and 4A. The changes in flow in
 41 the Sacramento River under Alternative 4A relative to Existing Conditions and the No Action
 42 Alternative (ELT) would not be of the magnitude of storm flows, in which substantial sediment-
 43 associated mercury is mobilized. Therefore, mercury loading should not be substantially different

1 due to changes in flow. In addition, even though they may be flow-affected, total mercury
 2 concentrations remain well below criteria at upstream locations. Any negligible changes in mercury
 3 concentrations that may occur in the water bodies of the affected environment located upstream of
 4 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
 5 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
 6 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
 7 are expected to remain above guidance levels at upstream of Delta locations, but would not change
 8 substantially because the anticipated changes in flow are not expected to substantially change
 9 mercury loading relative to Existing Conditions or the No Action Alternative (ELT).

10 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
 11 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
 12 Mercury Control Program. These projects will target specific sources of mercury and methylation
 13 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
 14 The implementation of these projects could help to ensure that upstream of Delta environments will
 15 not be substantially degraded for water quality with respect to mercury or methylmercury.

16 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 17 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 18 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 19 effects on mercury in the LLT are expected to be similar to those described above.

20 **Delta**

21 The effects of Alternative 4A on waterborne concentrations of mercury (Appendix 8I, *Mercury*, Table
 22 I-17) and methylmercury (Appendix 8I, Table I-18), and fish tissue mercury concentrations for
 23 largemouth bass fillet (Appendix 8I, Tables I-20a and I-20b) were evaluated for nine Delta locations.

24 Increases in long-term average mercury concentrations relative to Existing Conditions and the No
 25 Action Alternative (ELT) would be very small, 0.3 ng/L or less. Also, use of assimilative capacity for
 26 mercury relative to the 25 ng/L ecological threshold under Alternative 4A, relative to Existing
 27 Conditions and the No Action Alternative (ELT), would be very low, about 2% or less, as a long-term
 28 average, for all Delta locations (Appendix 8I, *Mercury*, Table I-23). These concentration changes and
 29 small changes in assimilative capacity for mercury are not expected to result in adverse (or positive)
 30 effects to beneficial uses.

31 Changes in methylmercury concentrations in water also are expected to be very small. The greatest
 32 annual average methylmercury concentration under Alternative 4A would be 0.166 ng/L for the San
 33 Joaquin River at Buckley Cove, for the drought period modeled, which would be slightly higher than
 34 Existing Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (ELT) (0.168
 35 ng/L) (Appendix 8I, *Mercury*, Table I-18). All methylmercury concentrations in water were
 36 estimated to exceed the TMDL guidance objective of 0.06 ng/L under Existing Conditions and,
 37 therefore, no assimilative capacity exists.

38 Fish tissue estimates for largemouth bass fillet show small or no increases in mercury
 39 concentrations under Alternative 4A relative to Existing Conditions and the No Action Alternative
 40 (ELT) based on long-term annual average concentrations for mercury at the Delta locations
 41 (Appendix 8I, *Mercury*, Tables I-20a and I-20b). Concentrations expected for Alternative 4A with
 42 Equation 1 show increases of 6% or less relative to Existing Conditions and the No Action
 43 Alternative (ELT) (Appendix 8I, Table I-20a). Concentrations expected for Alternative 4A with

1 Equation 2 show increases of 8% or less relative to Existing Conditions and the No Action
2 Alternative (ELT) (Appendix 8I, Table I-20b). Concentrations expected for Alternative 4A with
3 Equation 1 show decreases of 1% relative to Existing Conditions at the North Bay Aqueduct at
4 Barker Slough Pumping Plant in all years and 1% relative to the No Action Alternative at San Joaquin
5 River at Buckley Cove in all years and the drought period (Appendix 8I, *Mercury*, Table I-20a).
6 Concentrations expected for Alternative 4A with Equation 2 show decreases in the North Bay
7 Aqueduct at Barker Slough relative to Existing Conditions in all years of 1%, and a decrease of 2%
8 relative to the No Action Alternative (ELT) in all years and the drought period (Appendix 8I, Table I-
9 20b).

10 Because the increases are relatively small, and it is not evident that substantive increases are
11 expected at numerous locations throughout the Delta, these changes are expected to be within the
12 uncertainty inherent in the modeling approach, and would likely not be measurable in the
13 environment. See Appendix 8I, *Mercury*, for a complete discussion of the uncertainty associated with
14 the fish tissue estimates. Briefly, the bioaccumulation models contain multiple sources of
15 uncertainty associated with their development. These are related to analytical variability; temporal
16 and/or seasonal variability in Delta source water concentrations of methylmercury; interconversion
17 of mercury species (i.e., the non-conservative nature of methylmercury as a modeled constituent);
18 and limited sample size (both in number of fish and time span over which the measurements were
19 made), among others. Although there is considerable uncertainty in the models used, the results
20 serve as reasonable approximations of a very complex process. Considering the uncertainty, small
21 (i.e., < 20–25%) increases or decreases in modeled fish tissue mercury concentrations at a few Delta
22 locations (i.e., 2–3) should be interpreted to be within the uncertainty of the overall approach, and
23 not predictive of actual adverse effects. Larger increases, or increases evident throughout the Delta,
24 can be interpreted as more reliable indicators of potential adverse effects.

25 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
26 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
27 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
28 effects on mercury in the LLT are expected to be similar to those described above.

29 ***SWP/CVP Export Service Areas***

30 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
31 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
32 methylmercury concentrations for Alternative 4A at the Jones and Banks pumping plants, would be
33 lower than Existing Conditions and the No Action Alternative (ELT) (Appendix 8I, *Mercury*, Tables I-
34 17 and I-18). Therefore, mercury shows an increased assimilative capacity at these locations
35 (Appendix 8I, Table I-23).

36 The largest improvements in bass tissue mercury concentrations and exceedance quotients ([EQs];
37 modeled tissue divided by TMDL guidance concentration) for Alternative 4A, relative to Existing
38 Conditions and the No Action Alternative (ELT) at any location within the Delta, are expected for the
39 Banks and Jones pumping plant export pump locations. Concentrations expected for Alternative 4A
40 at the export pump locations with Equation 1 in all years show decreases relative to Existing
41 Conditions (8% to 10%) and relative to the No Action Alternative (ELT) (9% to 11%) (Appendix 8I,
42 *Mercury*, Table I-20a). Concentrations expected for Alternative 4A with Equation 2 in all years show
43 decreases at Banks and Jones pumping plants relative to Existing Conditions (11% to 14%) and the
44 No Action Alternative (ELT) (13% to 15%) (Appendix 8I, Table I-20b).

1 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
2 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
3 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
4 effects on mercury in the LLT are expected to be similar to those described above.

5 **NEPA Effects:** Based on the above discussion, Alternative 4A would not cause concentrations of
6 mercury and methylmercury in water and fish tissue in the affected environment to be substantially
7 different from the No Action Alternative (ELT and LLT) and, thus, would not cause additional
8 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
9 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
10 Because mercury concentrations are not expected to increase substantially, no long-term water
11 quality degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
12 Because any increases in mercury or methylmercury concentrations are not likely to be measurable,
13 changes in mercury concentrations or fish tissue mercury concentrations would not make any
14 existing mercury-related impairment measurably worse. In comparison to the No Action Alternative
15 (ELT and LLT), Alternative 4A would not be expected to increase levels of mercury by frequency,
16 magnitude, and geographic extent such that the affected environment would be expected to have
17 measurably higher body burdens of mercury in aquatic organisms, thereby substantially increasing
18 the health risks to wildlife (including fish) or humans consuming those organisms. Based on these
19 findings, the effects of Alternative 4A on mercury in the affected environment are considered to be
20 not adverse.

21 **CEQA Conclusion:** Under Alternative 4A, greater water demands and climate change would alter the
22 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
23 River watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury
24 and methylmercury upstream of the Delta would not be substantially different relative to Existing
25 Conditions due to the lack of important relationships between mercury/methylmercury
26 concentrations and flow for the major rivers.

27 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
28 capacity exists. However, monthly average waterborne concentrations of total and methylmercury
29 over the period of record under Alternative 4A would be very similar to Existing Conditions.
30 Similarly, estimates of fish tissue mercury concentrations show that small differences would occur
31 among sites for Alternative 4A as compared to Existing Conditions for Delta sites.

32 Assessment of effects of mercury in the SWP/CVP Export Service Areas were based on effects on
33 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
34 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
35 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 4A, as
36 compared to Existing Conditions.

37 As such, Alternative 4A is not expected to cause additional exceedance of applicable water quality
38 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
39 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
40 not expected to increase substantially, no long-term water quality degradation is expected to occur
41 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
42 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
43 or fish tissue mercury concentrations would not make any existing mercury-related impairment
44 measurably worse. In comparison to Existing Conditions, Alternative 4A would not increase levels of

1 mercury by frequency, magnitude, and geographic extent such that the affected environment would
2 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
3 substantially increasing the health risks to wildlife (including fish) or humans consuming those
4 organisms. Based on these findings, this impact is considered to be less than significant. No
5 mitigation is required.

6 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of**
7 **Environmental Commitments 3, 4, 6-12, 15, and 16**

8 **NEPA Effects:** The potential types of effects on mercury resulting from implementation of the
9 Environmental Commitments under Alternative 4A would be generally similar to those described
10 under Alternative 4 (see Section 8.3.3.9). However, the magnitude of effects on mercury and
11 methylmercury at locations upstream of the Delta, in the Delta, and the SWP/CVP Export Service
12 Areas related to habitat restoration would be considerably lower than described for Alternative 4.
13 This is because the amount of habitat restoration to be implemented under Alternative 4A would be
14 very low compared to the total proposed restoration area that would be implemented under
15 Alternative 4. The small amount of habitat restoration to be implemented under Alternative 4A may
16 occur on lands in the Delta formerly used for irrigated agriculture. Habitat restoration proposed
17 under Alternative 4A has the potential to increase water residence times and increase accumulation
18 of organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
19 vicinity of the restored habitat areas. Design of restoration sites would be guided by Environmental
20 Commitment 12, which requires development of site-specific mercury management plans as
21 restoration actions are implemented. The effectiveness of minimization and mitigation actions
22 implemented according to the mercury management plans is not known at this time, although the
23 potential to reduce methylmercury concentrations exists based on current research. Although
24 Environmental Commitment 12 would be implemented with the goal to reduce this potential effect,
25 there remain uncertainties related to site-specific restoration conditions and the potential for
26 increases in methylmercury concentrations in the Delta in the vicinity of the restored areas.
27 Therefore, the effect of Environmental Commitments 3, 4, 6-12, 15, and 16 on mercury and
28 methylmercury is considered to be adverse.

29 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
30 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
31 the SWP/CVP Export Service Areas due to implementation of Environmental Commitments 3, 4, 6-
32 12, 15, and 16 relative to Existing Conditions. However, in the Delta, due to the small amount of tidal
33 restoration areas proposed, relative to Existing Conditions, uptake of mercury from water and/or
34 methylation of inorganic mercury may increase in localized areas as part of the creation of new,
35 marshy, shallow, or organic-rich restoration areas. Although not quantifiable, on a local level,
36 increases in methylmercury concentrations may be measurable. Methylmercury is CWA Section
37 303(d)-listed within the affected environment, and therefore any potential measurable increase in
38 methylmercury concentrations would make existing mercury-related impairment measurably
39 worse. Because mercury is bioaccumulative, increases in water-borne mercury or methylmercury
40 that could occur in some areas could bioaccumulate to somewhat greater levels in aquatic organisms
41 and would, in turn, pose health risks to fish, wildlife, or humans. Design of restoration sites would be
42 guided by Environmental Commitment 12, which requires development of site-specific mercury
43 management plans as restoration actions are implemented. The effectiveness of minimization and
44 mitigation actions implemented according to the mercury management plans is not known at this
45 time, although the potential to reduce methylmercury concentrations exists based on current

1 research. Although Environmental Commitment 12 would be implemented with the goal to reduce
 2 this potential effect, the uncertainties related to site specific restoration conditions and the potential
 3 for increases in methylmercury concentrations in the Delta result in this potential impact being
 4 considered significant because, as described above, any potential measurable increase in
 5 methylmercury concentrations would make existing mercury-related impairment measurably
 6 worse. No mitigation measures would be available until specific restoration actions are proposed.
 7 Therefore, this impact is considered significant and unavoidable.

8 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 9 **Maintenance**

10 ***Upstream of the Delta***

11 As described for Alternative 4 (in Section 8.3.3.9), nitrate levels in the major rivers (Sacramento,
 12 Feather, American) are low, generally due to ample dilution available in the reservoirs and rivers
 13 relative to the magnitude of the point and non-point source discharges, and there is no correlation
 14 between historical water year average nitrate concentrations and water year average flow in the
 15 Sacramento River at Freeport. Consequently, any modified reservoir operations and subsequent
 16 changes in river flows under Alternative 4A, relative to Existing Conditions or the No Action
 17 Alternative (ELT), are expected to have negligible, if any, effects on average reservoir and river
 18 nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

19 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento River
 20 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
 21 between historical water year average nitrate concentrations and water year average flow in the San
 22 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
 23 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
 24 regression $r^2=0.49$; Figure 2 in Appendix 8J, *Nitrate*). Under Alternative 4A, long-term average flows
 25 at Vernalis would decrease an estimated 1% relative to Existing Conditions and would remain
 26 virtually the same relative to the No Action Alternative (ELT). Given the relatively small decreases in
 27 flows and the weak correlation between nitrate and flows in the San Joaquin River, it is expected
 28 that nitrate concentrations in the San Joaquin River would be minimally affected, if at all, by
 29 anticipated changes in flow rates under the No Action Alternative (ELT).

30 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 31 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 32 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 33 effects on nitrate in the LLT are expected to be similar to those described above.

34 Any negligible changes in nitrate concentrations that may occur under Alternative 4A in the water
 35 bodies of the affected environment located upstream of the Delta would not be of frequency,
 36 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 37 degrade the quality of these water bodies, with regard to nitrate.

38 ***Delta***

39 Mass balance calculations indicate that under Alternative 4A relative to Existing Conditions and the
 40 No Action Alternative (ELT), nitrate concentrations throughout the Delta are anticipated to remain
 41 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Table 34). Although changes
 42 at specific Delta locations and for specific months may be substantial on a relative basis (Appendix

1 8J, Table 37), the absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N)
 2 in relation to the drinking water MCL of 10 mg/L-N, as well as all other thresholds (see *Nitrate*
 3 under Section 8.3.1.7, *Constituent-Specific Considerations Used in the Assessment*). Long-term average
 4 nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 Delta assessment
 5 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 6 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 7 concentrations would be somewhat reduced under Alternative 4A relative to Existing Conditions,
 8 and slightly increased relative to the No Action Alternative (ELT). No additional exceedances of the
 9 MCL are anticipated at any location under Alternative 4A (Appendix 8J, Table 34).

10 Use of assimilative capacity relative to the drinking water MCL of 10 mg/L-N under Alternative 4A
 11 would be low or negligible (i.e., <4%) in comparison to both Existing Conditions and the No Action
 12 Alternative (ELT), for all locations and months, for all modeled years (1976–1991), and for the
 13 drought period (1987–1991) (Appendix 8J, *Nitrate*, Table 38).

14 As described for Alternative 4, actual nitrate concentrations would likely be higher than the
 15 modeling results indicate in certain locations under Alternative 4A. This is the mass balance
 16 modeling does not account for contributions from the SRWTP, which would be implementing
 17 nitrification/partial denitrification, or Delta wastewater treatment plant dischargers that practice
 18 nitrification, but not denitrification. However, as described for Alternative 4, any increases in nitrate
 19 concentrations that may occur at certain locations within the Delta under Alternative 4A would not
 20 be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 21 substantially degrade the water quality at these locations, with regard to nitrate.

22 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 23 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 24 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 25 effects on nitrate in the LLT are expected to be similar to those described above.

26 **SWP/CVP Export Service Areas**

27 Assessment of effects of Alternative 4A on nitrate in the SWP/CVP Export Service Areas is based on
 28 effects on nitrate at the Banks and Jones pumping plants. Relative to Existing Conditions and the No
 29 Action Alternative (ELT), nitrate concentrations at Banks and Jones pumping plants under
 30 Alternative 4A are anticipated to decrease on a long-term average annual basis by 27% at the Banks
 31 pumping plant and 29% at the Jones pumping plant (Appendix 8J, *Nitrate*, Table 37). During the late
 32 summer, particularly in the drought period assessed, concentrations are expected to increase, but
 33 the absolute value of these changes (i.e., in mg/L-N) would be small. Additionally, given the many
 34 factors that contribute to potential algal blooms in the SWP and CVP canals within the Export
 35 Service Areas, and the lack of studies that have shown a direct relationship between nutrient
 36 concentrations in the canals and reservoirs and problematic algal blooms in these water bodies,
 37 there is no basis to conclude that these small (i.e., generally <0.2 mg/L-N), seasonal increases in
 38 nitrate concentrations would increase the potential for problem algal blooms in the SWP/CVP
 39 Export Service Areas. No additional exceedances of the MCL are anticipated under Alternative 4A
 40 relative to Existing Conditions and the No Action Alternative (ELT) (Appendix 8J, *Nitrate*, Table 34).
 41 On a monthly average basis and on a long-term annual average basis, for all modeled years and for
 42 the drought period only, use of assimilative capacity available under Existing Conditions and the No
 43 Action Alternative (ELT), relative to the 10 mg/L-N MCL, would be negligible (<2%) for both Banks
 44 and Jones pumping plants (Appendix 8J, Table 38).

1 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
2 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
3 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
4 effects on nitrate in the LLT are expected to be similar to those described above.

5 Any increases in nitrate concentrations that may occur in water exported via Banks and Jones
6 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
7 degrade the quality of exported water, with regard to nitrate.

8 **NEPA Effects:** Modified reservoir operations and subsequent changes in river flows under
9 Alternative 4A, relative to the No Action Alternative (ELT and LLT), are expected to have negligible,
10 if any, effects on reservoir and river nitrate concentrations upstream of Freeport in the Sacramento
11 River watershed and upstream of the Delta in the San Joaquin River watershed. In the Delta, nitrate
12 concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to
13 adopted objectives. No additional exceedances of the 10 mg/L-N MCL are anticipated at any Delta
14 location, and use of assimilative capacity available under the No Action Alternative, relative to the
15 drinking water MCL of 10 mg/L-N, would be low. Long-term average nitrate concentrations at Banks
16 and Jones pumping plants are anticipated to differ negligibly relative to the No Action Alternative
17 (ELT and LLT) and no additional exceedances of the 10 mg/L-N MCL are anticipated. Therefore, the
18 effects on nitrate from implementing water conveyance facilities are considered to be not adverse.

19 **CEQA Conclusion:** Nitrate concentrations are generally low in the reservoirs and rivers of the
20 watersheds, owing to substantial dilution available for point sources and the lack of substantial
21 nonpoint sources of nitrate upstream of the SRWTP in the Sacramento River watershed, and in the
22 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although
23 higher in the San Joaquin River watershed, nitrate concentrations are not well-correlated with flow
24 rates. Consequently, any modified reservoir operations and subsequent changes in river flows under
25 Alternative 4A, relative to Existing Conditions, are expected to have negligible, if any, effects on
26 reservoir and river nitrate concentrations upstream of Freeport in the Sacramento River watershed
27 and upstream of the Delta in the San Joaquin River watershed.

28 In the Delta, results of the mass balance calculations indicate that under Alternative 4A, relative to
29 Existing Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4
30 mg/L-N) relative to adopted objectives. No additional exceedances of the 10 mg/L-N MCL are
31 anticipated at any location, and use of assimilative capacity available under Existing Conditions,
32 relative to the drinking water MCL of 10 mg/L-N, would be low or negligible (i.e., <4%) for all for
33 virtually all locations and months.

34 Assessment of effects of nitrate in the SWP/CVP Export Service Areas is based on effects on nitrate
35 concentrations at the Banks and Jones pumping plants. Results of the mass balance calculations
36 indicate that under Alternative 4A relative to Existing Conditions, long-term average nitrate
37 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
38 additional exceedances of the 10 mg/L-N MCL are anticipated, and use of assimilative capacity
39 available under Existing Conditions, relative to the MCL would be negligible (i.e., <2%) for both
40 Banks and Jones pumping plants for all months.

41 Based on the above, there would be no substantial, long-term increase in nitrate concentrations in
42 the rivers and reservoirs upstream of the Delta, in the Plan Area, or the SWP/CVP Export Service
43 Areas under Alternative 4A relative to Existing Conditions. As such, this alternative is not expected
44 to cause additional exceedance of applicable water quality objectives/criteria by frequency,

1 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
2 in the affected environment. Because nitrate concentrations are not expected to increase
3 substantially, no long-term water quality degradation is expected to occur and, thus, no adverse
4 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
5 environment and thus any increases that may occur in some areas and months would not make any
6 existing nitrate-related impairment measurably worse because no such impairments currently exist.
7 Because nitrate is not bioaccumulative, increases that may occur in some areas and months would
8 not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
9 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
10 significant. No mitigation is required.

11 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of**
12 **Environmental Commitments 3, 4, 6–12, 15, and 16**

13 **NEPA Effects:** Some habitat restoration activities included in Environmental Commitments 3, 4, and
14 6–11 would occur on lands within the Delta formerly used for agriculture. As discussed for Impact
15 WQ-2, increased biota that may result in those areas may increase ammonia, which in turn may be
16 converted to nitrate by established microbial communities. However, the areal extent of new habitat
17 implemented for the Environmental Commitments would be less than the existing and No Action
18 Alternative habitat areas, and similar habitat exists currently in the Delta and is not identified as
19 contributing to adverse nitrate conditions. Thus, these land use changes would not be expected to
20 substantially increase nitrate concentrations in the Delta. Implementation of Environmental
21 Commitments 12, 15, and 16 do not include actions that would affect nitrate sources or loading.
22 Based on these findings, the effects on nitrate from implementing Environmental Commitments 3, 4,
23 6–12, 15, and 16 are considered to be not adverse.

24 **CEQA Conclusion:** Land use changes that would occur from the Environmental Commitments are
25 not expected to substantially increase nitrate concentrations, because the amount of area to be
26 converted would be small relative to existing habitat, and existing habitats are not known for
27 contributing to adverse nitrate conditions. Thus, it is expected that implementation of
28 Environmental Commitments 3, 4, 6–12, 15, and 16 would not cause additional exceedance of
29 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
30 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
31 nitrate concentrations are not expected to increase substantially due to these Environmental
32 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
33 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
34 environment and thus any minor increases that may occur in some areas would not make any
35 existing nitrate-related impairment measurably worse because no such impairments currently exist.
36 Because nitrate is not bioaccumulative, minor increases that may occur in some areas would not
37 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
38 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
39 significant. No mitigation is required.

1 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 2 **Operations and Maintenance**

3 ***Upstream of the Delta***

4 The effects of Alternative 4A on DOC concentrations in reservoirs and rivers upstream of the Delta
5 would be similar to those effects described for Alternative 4 because factors affecting DOC
6 concentrations (e.g., source and non-point source inputs) in these water bodies would be similar.
7 Moreover, long-term average flow and DOC levels in the Sacramento River at Hood and San Joaquin
8 River at Vernalis are poorly correlated. Thus changes in system operations and resulting reservoir
9 storage levels and river flows under Alternative 4A would not be expected to cause substantial long-
10 term changes in DOC concentrations in the water bodies upstream of the Delta. Any changes in DOC
11 levels in water bodies upstream of the Delta under Alternative 4A, relative to Existing Conditions
12 and the No Action Alternative (ELT and LLT), would not be of sufficient frequency, magnitude and
13 geographic extent that would adversely affect any beneficial uses or substantially degrade the
14 quality of these water bodies.

15 ***Delta***

16 Under Alternative 4A, the geographic extent of effects pertaining to long-term average DOC
17 concentrations in the Delta would be similar to that described for Alternative 4, although the
18 magnitude of predicted long-term change and relative frequency of concentration threshold
19 exceedances would be lower. The effects of Alternative 4A relative to Existing Conditions and the No
20 Action Alternative (ELT) are discussed together because the direction and magnitude of predicted
21 change are similar. Relative to the Existing Conditions and No Action Alternative (ELT), Alternative
22 4A would result in small increases in long-term average DOC concentrations for both the modeled
23 16-year period (1976–1991) and drought period (1987–1991) at several interior Delta locations
24 (increases up to 0.2 mg/L at the S. Fork Mokelumne River at Staten Island, Franks Tract, Old River at
25 Rock Slough, and Contra Costa Pumping Plant #1) (Appendix 8K, *Organic Carbon*, Table DOC-11).
26 The increases in average DOC concentrations would correspond to more frequent concentration
27 threshold exceedances, with the greatest change occurring at the Contra Costa Pumping Plant #1
28 location exceeding the 3 mg/L threshold (i.e., increase from 52% under Existing Conditions to 64%
29 under Alternative 4A for the modeled 16-year period). The change in frequency of threshold
30 concentration exceedances at other assessment locations would be similar or lower.

31 While Alternative 4A would lead to slightly higher long-term average DOC concentrations at some
32 municipal water intakes and Delta interior locations, the predicted change would not be expected to
33 adversely affect MUN beneficial uses, or any other beneficial use. As discussed for Alternative 4,
34 substantial changes in ambient DOC concentrations would need to occur before significant changes
35 in drinking water treatment plant design or operations are triggered. The increases in long-term
36 average DOC concentrations estimated to occur at various Delta locations under Alternative 4A are
37 of sufficiently small magnitude that they would not require existing drinking water treatment plants
38 to substantially upgrade treatment for DOC removal above levels currently employed.

39 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
40 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
41 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
42 effects on DOC in the LLT are expected to be similar to those described above.

1 Relative to Existing Conditions and the No Action Alternative (ELT and LLT), Alternative 4A would
 2 lead to predicted improvements in long-term average DOC concentrations at Barker Slough, as well
 3 as Banks and Jones pumping plants (discussed below).

4 ***SWP/CVP Export Service Areas***

5 Under the Alternative 4A, long-term average DOC concentrations would decrease at Barker Slough
 6 by 0.1 mg/L, and at both the Banks and Jones pumping plants by 0.4 mg/L, relative to Existing
 7 Conditions. Reductions would be similar compared to No Action Alternative (ELT) (Appendix 8K,
 8 *Organic Carbon*, Table DOC-11). Decreases in long-term average DOC would result in generally lower
 9 exceedance frequencies for concentration thresholds, although the frequency of exceedances of the
 10 3 mg/L threshold during the modeled drought period would increase at the Banks and Jones
 11 pumping plants. Relative to Existing Conditions, exceedance of the 3 mg/L threshold would increase
 12 from 57% to 72% at Banks pumping plant and from 72% to 88% at Jones pumping plant. There
 13 would be little to no increase in exceedance of the 3 mg/L threshold relative to the No Action
 14 Alternative (ELT).

15 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 16 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 17 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 18 effects on DOC in the LLT are expected to be similar to those described above.

19 Maintenance of SWP and CVP facilities under Alternative 4A would not be expected to create new
 20 sources of DOC or contribute towards a substantial change in existing sources of DOC in the affected
 21 area.

22 ***NEPA Effects:*** In summary, the operations and maintenance activities under Alternative 4A, relative
 23 to the No Action Alternative (ELT and LLT), would not cause a substantial long-term change in DOC
 24 concentrations in the water bodies upstream of the Delta, in the Delta, or in the SWP/CVP Export
 25 Service Areas. The long-term average DOC concentrations at Banks and Jones pumping plants are
 26 predicted to decrease by 0.4 mg/L, while long-term average DOC concentrations for some Delta
 27 interior locations are predicted to increase by as much as 0.2 mg/L. However, the increase in long-
 28 term average DOC concentration that could occur within the Delta interior would not be of sufficient
 29 magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters.
 30 Based on these findings, the effect of operations and maintenance activities on DOC under
 31 Alternative 4A is determined to be not adverse.

32 ***CEQA Conclusion:*** For the same reasons described for Alternative 4, the operations and
 33 maintenance activities under Alternative 4A, relative to the Existing Conditions, would not cause a
 34 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta, in
 35 the Delta, or in the SWP/CVP Export Service Areas. Any modified reservoir operations and
 36 subsequent changes in river flows under Alternative 4A, relative to Existing Conditions, would not
 37 be expected to result in a substantial adverse change in DOC levels upstream of the Delta. Moreover,
 38 long-term average flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are
 39 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
 40 long-term change in DOC concentrations upstream of the Delta.

41 Relative to Existing Conditions, the Alternative 4A would result in relatively small increases (i.e.,
 42 ≤ 0.2 mg/L) in long-term average DOC concentrations at some interior Delta locations. The predicted
 43 increases would not substantially increase the frequency with which long-term average DOC

1 concentrations exceeds 2, 3, or 4 mg/L. Because this alternative would lead to only slightly higher
 2 long-term average DOC concentrations at the interior Delta locations and some municipal water
 3 intakes, the predicted changes would not be expected to adversely affect MUN beneficial uses, or any
 4 other beneficial use.

5 Relative to Existing Conditions, the Alternative 4A would result in reduced long-term average DOC
 6 concentrations at the Banks and Jones pumping plants and Barker Slough. However, Alternative 4A
 7 would result in slightly greater frequency of exceedance of the 3 mg/L DOC concentration threshold
 8 during the modeled drought period. Nevertheless, an overall improvement in DOC-related water
 9 quality would be predicted in the SWP/CVP Export Service Areas.

10 Based on the above, the operations and maintenance activities of Alternative 4A would not result in
 11 any substantial change in long-term average DOC concentration. The increases in long-term average
 12 DOC concentration that could occur within the Delta would not be of sufficient magnitude to
 13 adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters or waters of the
 14 SWP/CVP Service Area. Because DOC is not bioaccumulative, the increases in long-term average
 15 DOC concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 16 Finally, DOC is not causing beneficial use impairments and thus is not CWA Section 303(d) listed for
 17 any water body within the affected environment. Because long-term average DOC concentrations
 18 are not expected to increase substantially, no long-term water quality degradation with respect to
 19 DOC is expected to occur and, thus, no adverse effects on beneficial uses would occur. Based on
 20 these findings, this impact is considered to be less than significant. No mitigation is required.

21 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 22 **Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16**

23 The potential types of effects on DOC resulting from implementation of the Environmental
 24 Commitments under Alternative 4A would be generally similar to those described under Alternative
 25 4 (see Section 8.3.3.9). However, the magnitude of effects on DOC at locations upstream of the Delta,
 26 in the Delta, and the SWP/CVP export service areas would be considerably lower than described for
 27 Alternative 4.

28 As described for Alternative 4, Environmental Commitments 3, 9, 11, 12, 15, and 16 would present
 29 no major sources of DOC to the affected environment, including areas Upstream of the Delta, within
 30 the Plan Area, and the SWP/CVP Export Service Area that would adversely affect beneficial uses.
 31 Environmental Commitments 4, 6, 7, and 10 include habitat restoration activities known to be
 32 sources of DOC. However, the amount of new habitat restoration to be implemented would be very
 33 small compared to the areal extent of existing habitat and that proposed for the No Action
 34 Alternative. Based on the amount of habitat restoration proposed, DOC loading from these areas
 35 would be very low in these water bodies. Consequently, relative to the Existing Conditions and No
 36 Action Alternative (ELT and LLT), the potential DOC loading to the Delta would be minimal, and thus
 37 not contribute substantially to the amounts of DOC in raw drinking water supplies.

38 **NEPA Effects:** Relative to existing habitat and that to be developed under the No Action Alternative
 39 (ELT and LLT), the area of new habitat restoration implemented for the Environmental
 40 Commitments would be very small. Implementation of non-habitat restoration Environmental
 41 Commitments would not be expected to have substantial, if even measurable, effect on DOC
 42 concentrations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas,
 43 because they would present no major sources of DOC to the affected environment. Consequently,
 44 any increases in average DOC levels in the affected environment are not expected to be of sufficient

1 frequency, magnitude and geographic extent that would adversely affect the MUN beneficial use, or
 2 any other beneficial uses, of the affected environment, nor would potential increases substantially
 3 degrade water quality with regard to DOC. Based on these findings, the effect of the Environmental
 4 Commitments on DOC is determined to be not adverse.

5 **CEQA Conclusion:** Implementation of habitat restoration Environmental Commitments is not
 6 expected to cause a substantial long-term change in DOC concentrations in the water bodies
 7 upstream of the Delta, in the Delta, or in the SWP/CVP Export Service Areas, relative to the Existing
 8 Conditions, because the land area proposed for restoration would be relatively small compared to
 9 existing land area and sources of DOC. Implementation of other Environmental Commitments also
 10 would not be expected to have substantial, if even measurable, effect on DOC concentrations
 11 upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas, because they
 12 would present no major sources of DOC to the affected environment. Consequently, increases in
 13 average DOC levels in the affected environment are not expected to be of sufficient frequency,
 14 magnitude and geographic extent that would adversely affect the MUN beneficial use, or any other
 15 beneficial uses, of the affected environment, nor would potential increases substantially degrade
 16 water quality with regard to DOC. Furthermore, DOC is not bioaccumulative, therefore changes in
 17 DOC concentrations would not cause bioaccumulative problems in aquatic life or humans. Finally,
 18 DOC is not causing beneficial use impairments and thus is not CWA Section 303(d) listed for any
 19 water body within the affected environment. Because long-term average DOC concentrations are not
 20 expected to increase substantially, no long-term water quality degradation with respect to DOC is
 21 expected to occur and, thus, no adverse effects on beneficial uses would occur. Based on these
 22 findings, this impact is considered to be less than significant. No mitigation is required.

23 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

24 The effects of operation of the water conveyance facilities under Alternative 4A on pathogen levels
 25 in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas
 26 relative to Existing Conditions would be similar to those effects described for Alternative 4 (see
 27 Section 8.3.3.9). As described for Alternative 4, pathogen concentrations in the Sacramento and San
 28 Joaquin Rivers have a minimal relationship to flow rate in these rivers. Further, urban runoff
 29 contributions during the dry season would be expected to be a relatively small fraction of the rivers'
 30 total flow rates. During wet weather events, when urban runoff contributions would be higher, the
 31 flows in the rivers also would be higher. Given the small magnitude of urban runoff contributions
 32 relative to the magnitude of river flows and that pathogen concentrations in the rivers have a
 33 minimal relationship to river flow rate, river flow rate and reservoir storage reductions that would
 34 occur under Alternative 4A, relative to Existing Conditions and the No Action Alternative (ELT and
 35 LLT), would not be expected to result in a substantial adverse change in pathogen concentrations in
 36 the reservoirs and rivers upstream of the Delta.

37 The effects of Alternative 4A relative to Existing Conditions and the No Action Alternative (ELT and
 38 LLT) would be changes in the relative percentage of water throughout the Delta being comprised of
 39 various source waters (i.e., water from the Sacramento River, San Joaquin River, Bay water, eastside
 40 tributaries, and agricultural return flow), due to potential changes in inflows particularly from the
 41 Sacramento River watershed. However, as described for Alternative 4, it is expected there would be
 42 no substantial change in Delta pathogen concentrations in response to a shift in the Delta source
 43 water percentages under this alternative or substantial degradation of these water bodies, with
 44 regard to pathogens, because it is expected that pathogen sources in close proximity to Delta sites
 45 would have a greater influence on pathogen levels at the site, rather than the primary source(s) of

1 water to the site. In-Delta potential pathogen sources, including water-based recreation, tidal
 2 habitat, wildlife, and livestock-related uses, would continue under this alternative. As such, there is
 3 not expected to be substantial, if even measurable, changes in pathogen concentrations in the
 4 SWP/CVP Export Service Area waters.

5 As such, Alternative 4A would not be expected to substantially increase the frequency with which
 6 applicable Basin Plan objectives or U.S. EPA-recommended pathogen criteria would be exceeded in
 7 water bodies of the affected environment located upstream of the Delta or substantially degrade the
 8 quality of these water bodies, with regard to pathogens.

9 **NEPA Effects:** Because pathogen levels are expected to be minimally affected relative to the No
 10 Action Alternative (ELT and LLT), the effects on pathogens from implementing Alternative 4A are
 11 determined to be not adverse.

12 **CEQA Conclusion:** The effects of Alternative 4A on pathogen levels in surface waters upstream of the
 13 Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would
 14 be similar to those described for Alternative 4 (see Section 8.3.3.9). This is because the factors that
 15 would affect pathogen levels in the surface waters of these areas would be similar. Therefore, this
 16 alternative is not expected to cause additional exceedance of applicable water quality objectives by
 17 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
 18 of waters in the affected environment. Because pathogen concentrations are not expected to
 19 increase substantially, no long-term water quality degradation for pathogens is expected to occur
 20 and, thus, no adverse effects on beneficial uses would occur. The San Joaquin River in the Stockton
 21 Deep Water Ship Channel is CWA Section 303(d) listed for pathogens. Because no measurable
 22 increase in Deep Water Ship Channel pathogen concentrations are expected to occur on a long-term
 23 basis, further degradation and impairment of this area is not expected to occur. Finally, pathogens
 24 are not bioaccumulative constituents. Based on these findings, this impact is considered to be less
 25 than significant. No mitigation is required.

26 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of Environmental**
 27 **Commitments 3, 4, 6–12, 15, and 16**

28 **NEPA Effects:** Environmental Commitments 3, 4, and 6–11 would involve habitat restoration
 29 actions. Tidal wetlands are known to be sources of coliforms originating from aquatic, terrestrial,
 30 and avian wildlife that inhabit these areas (Desmarais et al. 2001, Grant et al. 2001, Evanson and
 31 Ambrose 2006, Tetra Tech 2007). Specific locations of restoration areas for this alternative have not
 32 yet been established. However, most low-lying land suitable for restoration is unsuitable for
 33 livestock. Therefore, it is likely that the majority of land to be converted to wetlands would be crop-
 34 based agriculture or fallow/idle land. Because of a great deal of scientific uncertainty in the loading
 35 of coliforms from these various sources, the resulting change in coliform loading is uncertain, but it
 36 is anticipated that coliform loading to Delta waters would increase. Based on findings from the
 37 Pathogens Conceptual Model that pathogen concentrations are greatly influenced by the proximity
 38 to the source, this could result in localized increases in wildlife-related coliforms relative to the No
 39 Action Alternative (ELT and LLT). The geographic extent of the potential increases would be less
 40 than under Alternative 4, because less land would be converted under Alternative 4A. The Delta
 41 currently supports similar habitat types and, with the exception of the CWA Section 303(d) listing
 42 for the Stockton Deep Water Ship Channel, is not recognized as exhibiting pathogen concentrations
 43 that rise to the level of adversely affecting beneficial uses. As such, the potential increase in wildlife-

1 related coliform concentrations due to tidal habitat creation is not expected to adversely affect
2 beneficial uses.

3 The remaining Environmental Commitments would not be expected to affect pathogen levels,
4 because they are actions that do not affect the presence of pathogen sources.

5 Based on these findings, the effects on pathogens from implementing Environmental Commitments
6 3, 4, 6–12, 15, and 16 are determined to not be adverse.

7 **CEQA Conclusion:** Based on findings from the Pathogens Conceptual Model that pathogen
8 concentrations are greatly influenced by the proximity to the source, implementation of
9 Environmental Commitments 3, 4, and 6–11 could result in localized increases in wildlife-related
10 coliforms relative to Existing Conditions. The geographic extent of the increase would be less than
11 under Alternative 4, because less land would be converted under Alternative 4A. The Delta currently
12 supports similar habitat types and, with the exception of the CWA Section 303(d) listing for the
13 Stockton Deep Water Ship Channel, is not recognized as exhibiting pathogen concentrations that rise
14 to the level of adversely affecting beneficial uses. As such, the potential increase in wildlife-related
15 coliform concentrations due to tidal habitat creation is not expected to adversely affect beneficial
16 uses. Therefore, this alternative is not expected to cause additional exceedance of applicable water
17 quality objectives by frequency, magnitude, and geographic extent that would cause adverse effects
18 on any beneficial uses of waters in the affected environment. Because pathogen concentrations are
19 not expected to increase substantially, no long-term water quality degradation for pathogens is
20 expected to occur and, thus, no adverse effects on beneficial uses would occur. The San Joaquin
21 River in the Stockton Deep Water Ship Channel is CWA Section 303(d) listed for pathogens. Because
22 no measurable increase in Deep Water Ship Channel pathogen concentrations are expected to occur
23 on a long-term basis, further degradation and impairment of this area is not expected to occur.
24 Finally, pathogens are not bioaccumulative constituents. Based on these findings, this impact is
25 considered to be less than significant. No mitigation is required.

26 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 27 **Maintenance**

28 The effects of Alternative 4A operations and maintenance on pesticide levels in surface waters
29 upstream of the Delta, relative to Existing Conditions and the No Action Alternative (ELT), would be
30 similar to those expected to occur under Alternative 4 (see Section 8.3.3.9). This is because under
31 Alternative 4A, the primary factor that would influence pesticide concentrations in surface waters
32 upstream of the Delta—the effect of timing and magnitude of reservoir releases on dilution
33 capacity—is expected to change by a similar degree. Changes in average winter and summer flow
34 rates, relative to Existing Conditions and the No Action Alternative (ELT), are expected to be similar
35 to or less than changes in flow rates expected under Alternative 4 in the Sacramento River at
36 Freeport, American River at Nimbus, Feather River at Thermalito and the San Joaquin River at
37 Vernalis (Appendix 8L, *Pesticides*, Tables 1 through 4). Similarly, the primary factor that would
38 influence pesticide concentrations in surface waters of the Delta and in the SWP/CVP Export Service
39 Areas (i.e., changes in San Joaquin River, Sacramento River and Delta agriculture source water
40 fractions at various Delta locations, including Banks and Jones pumping plants) is expected to
41 change by a similar degree. The percentage change in monthly average source water fractions would
42 be similar to changes expected under Alternative 4 (Appendix 8D, *Source Water Fingerprinting*
43 *Results*).

1 It was concluded for Alternative 4, and thus for Alternative 4A based on similar flow changes, that
2 the potential average summer flow reductions would not be of sufficient magnitude to substantially
3 increase in-river pesticide concentrations or alter the long-term risk of pesticide-related effects on
4 aquatic life beneficial uses upstream of the Delta. Greater long-term average flow reductions, and
5 corresponding reductions in dilution/assimilative capacity, would be necessary before long-term
6 risk of pesticide related effects on aquatic life beneficial uses would be adversely altered. Similarly,
7 the modeled changes in the source water fractions of Sacramento River, San Joaquin River, and Delta
8 agriculture water under Alternative 4A would not be of sufficient magnitude to substantially alter
9 the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial
10 uses of the Delta. Based on the general observation that San Joaquin River, in comparison to the
11 Sacramento River, is a greater contributor of organophosphate insecticides in terms of greater
12 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
13 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
14 improvement in export water quality respective to pesticides.

15 The flow changes in the LLT would be expected in the ranges of that described above for Alternative
16 4A, relative to Existing Conditions and the No Action Alternative (ELT), and that described for
17 Alternative 4 relative to the No Action Alternative (LLT) in Section 8.3.3.9. Thus, similar to above
18 and Alternative 4, the flow changes that would occur in the LLT under Alternative 4A, relative to
19 Existing Conditions and the No Action Alternative (LLT), would not be expected to result in changes
20 in dilution of pesticides of sufficient magnitude to substantially alter the long-term risk of pesticide-
21 related toxicity to aquatic life, nor adversely affect other beneficial uses upstream of the Delta, in the
22 Delta, or the SWP/CVP Export Service Areas.

23 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
24 American, and San Joaquin Rivers under Alternative 4A relative to the No Action Alternative (ELT
25 and LLT) would be of insufficient magnitude to substantially increase the long-term risk of
26 pesticide-related water quality degradation and related toxicity to aquatic life in these water bodies
27 upstream of the Delta. Similarly, changes in source water fractions to the Delta would be of
28 insufficient magnitude to substantially alter the long-term risk of pesticide-related water quality
29 degradation and related toxicity to aquatic life in the Delta or CVP/SWP Export Service Areas.
30 Therefore, the effects on pesticides from the water conveyance facilities are determined not to be
31 adverse.

32 **CEQA Conclusion:** Based on the discussion above, the effects of Alternative 4A on pesticide levels in
33 surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative
34 to Existing Conditions would be similar to or slightly less than those described for the Alternative 4.
35 Alternative 4A would not result in any substantial change in long-term average pesticide
36 concentration or result in substantial increase in the anticipated frequency with which long-term
37 average pesticide concentrations would exceed aquatic life toxicity thresholds or other beneficial
38 use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for the Delta, or
39 the SWP/CVP service area. Numerous pesticides are currently used throughout the affected
40 environment, and while some of these pesticides may be bioaccumulative, those present-use
41 pesticides for which there is sufficient evidence for their presence in waters affected by SWP and
42 CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
43 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
44 problems in aquatic life or humans. Furthermore, while there are numerous CWA Section 303(d)
45 listings throughout the affected environment that name pesticides as the cause for beneficial use
46 impairment, the modeled changes in upstream river flows and Delta source water fractions under

1 Alternative 4A would not be expected to make any of these beneficial use impairments measurably
 2 worse. Because long-term average pesticide concentrations are not expected to increase
 3 substantially, no long-term water quality degradation with respect to pesticides is expected to occur
 4 and, thus, no adverse effects on beneficial uses would occur. Based on these findings, this impact is
 5 considered to be less than significant. No mitigation is required.

6 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of**
 7 **Environmental Commitments 3, 4, 6-12, 15, and 16**

8 As described for Alternative 4 (see Section 8.3.3.9), Environmental Commitments 3, 4, and 6-11
 9 could involve the conversion of active or fallow agricultural lands to natural landscapes, such as
 10 wetlands, grasslands, floodplains, and vernal pools. In the long-term, conversion of agricultural land
 11 to natural landscapes could possibly result in a limited reduction in pesticide use throughout the
 12 Delta. In the short-term, tidal and non-tidal wetland restoration over former agricultural lands may
 13 include the contamination of water with pesticide residues contained in the soils. Present use
 14 pesticides typically degrade fairly rapidly, and in such cases where pesticide containing soils are
 15 flooded, dissipation of those pesticides would be expected to occur rapidly. Environmental
 16 Commitments 12, 15, and 16 do not include actions that would affect pesticide sources or loading.
 17 Unlike under Alternative 4, *CM13 Invasive Aquatic Vegetation Control* and *CM19 Urban Stormwater*
 18 *Treatment* would not be implemented. Because of this, benefits to water quality from treatment
 19 measures that would reduce pesticide loading from urban land uses, as well as adverse impacts to
 20 water quality from application of herbicides directly to waters in the plan area that would occur
 21 under Alternative 4 would not occur under Alternative 4A.

22 **NEPA Effects:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that would
 23 contribute long-term additional loading of pesticides, and the potential short-term loading from
 24 former agricultural lands would be expected to degrade and dissipate rapidly. Therefore, relative to
 25 the No Action Alternative (ELT and LLT), the effects on pesticides from implementing
 26 Environmental Commitments 3, 4, 6-12, 15, and 16 are determined to be not adverse.

27 **CEQA Conclusion:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that
 28 would contribute long-term additional loading of pesticides, and the potential short-term loading
 29 from former agricultural lands would be expected to degrade and dissipate rapidly, such that
 30 pesticide levels would differ little from Existing Conditions. Therefore, implementation of
 31 Environmental Commitments 3, 4, 6-12, 15, and 16 would not cause substantial long-term increases
 32 in pesticide concentrations in the rivers and reservoirs upstream of the Delta, in the Delta Region, or
 33 the SWP/CVP Export Service Areas. As such, these Environmental Commitments are not expected to
 34 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 35 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 36 environment. Because pesticide concentrations are not expected to increase substantially, no long-
 37 term water quality degradation for pesticides is expected to occur and, thus, no adverse effects to
 38 beneficial uses would occur. Furthermore, any negligible changes in long-term pesticide
 39 concentrations that may occur throughout the affected environment would not be expected to make
 40 any existing beneficial use impairments measurably worse. Environmental Commitments 3, 4, 6-12,
 41 15, 16 do not include the use of pesticides known to be bioaccumulative in animals or humans, nor
 42 do the Environmental Commitments propose the use of any pesticide currently named in a CWA
 43 Section 303(d) listing of the affected environment. Based on these findings, this impact is considered
 44 to be less than significant. No mitigation is required.

1 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations** 2 **and Maintenance**

3 The effects of Alternative 4A on phosphorus concentrations in surface waters upstream of the Delta,
4 in the Delta, and in the SWP/CVP Export Service Areas would be similar to those described for
5 Alternative 4 (see Section 8.3.3.9). This is because factors which affect phosphorus concentrations in
6 surface waters of these areas are the same under Alternative 4 and Alternative 4A. As described for
7 Alternative 4, phosphorus loading to waters upstream of the Delta is not anticipated to change, and
8 because changes in flows do not necessarily result in changes in concentrations or loading of
9 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
10 anticipated under Alternative 4A, relative to Existing Conditions or the No Action Alternative (ELT),
11 upstream of the Delta. Phosphorus concentrations may increase during January through March at
12 locations in the Delta where the source fraction of San Joaquin River water increases, due to the
13 higher concentration of phosphorus in the San Joaquin River during these months compared to
14 Sacramento River water or San Francisco Bay water. However, based on the DSM2 fingerprinting
15 results (Figures 309 through 330 in Appendix 8D, *Source Water Fingerprinting Results*), together
16 with source water concentrations (in Figure 8-56), the magnitude of increases during these months
17 is expected to be negligible to low (i.e., <0.02 mg/L) at all Delta locations relative to Existing
18 Conditions and the No Action Alternative (ELT). Thus, phosphorus concentrations in the Delta and
19 waters exported from Banks and Jones pumping plants to the SWP/CVP Export Service Areas are
20 expected to be similar to Existing Conditions and the No Action Alternative (ELT).

21 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
22 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
23 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
24 effects on phosphorus in the LLT are expected to be similar to those described above.

25 **NEPA Effects:** In summary, operation of the water conveyance facilities would have little to no effect
26 on phosphorus concentrations in water bodies upstream of the Delta, in the Plan Area, and the
27 waters exported to the SWP/CVP Export Service Areas, relative to the No Action Alternative (ELT
28 and LLT). Thus, effects of the water conveyance facilities on phosphorus are considered to be not
29 adverse.

30 **CEQA Conclusion:** The effects of Alternative 4A on phosphorus levels in surface waters upstream of
31 the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions
32 would be similar to those described for the Alternative 4. There would be no substantial, long-term
33 increase in phosphorus concentrations in the rivers and reservoirs upstream of the Delta, in the Plan
34 Area, or the waters exported to the CVP and SWP service areas under Alternative 4A relative to
35 Existing Conditions. As such, this alternative is not expected to cause additional exceedance of
36 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
37 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
38 phosphorus concentrations are not expected to increase substantially, no long-term water quality
39 degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
40 Phosphorus is not CWA Section 303(d) listed within the affected environment and thus any minor
41 increases that may occur in some areas would not make any existing phosphorus-related
42 impairment measurably worse because no such impairments currently exist. Because phosphorus is
43 not bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to
44 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,

1 or humans. Based on these findings, this impact is considered to be less than significant. No
2 mitigation is required.

3 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
4 **Environmental Commitments 3, 4, 6–12, 15, and 16**

5 As described for Alternative 4 (see Section 8.3.3.9) Environmental Commitments 3, 4, and 6–11
6 would include activities that create additional aquatic habitat, which may affect phosphorus
7 dynamics and speciation in localized areas where the restoration would occur, but would not
8 contribute to additional phosphorus loading. Therefore, phosphorus concentrations are not
9 expected to change substantially in the affected environment as a result of these restoration
10 activities. Unlike under Alternative 4, *CM19 Urban Stormwater Treatment* would not be
11 implemented under Alternative 4A. Because urban stormwater is a potential source of phosphorus
12 in the affected environment, the slight decreases in phosphorus loading expected to occur as a result
13 of implementation of CM19 under Alternative 4, relative to Existing Conditions and the No Action
14 Alternative, would not occur under Alternative 4A. Environmental Commitments 12, 15, and 16 do
15 not include actions that would affect phosphorus sources or loading.

16 **NEPA Effects:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that would
17 contribute long-term additional loading of phosphorus. Therefore, relative to the No Action
18 Alternative (ELT and LLT), the effects on phosphorus from implementing Environmental
19 Commitments 3, 4, 6–12, 15, and 16 are considered to be not adverse.

20 **CEQA Conclusion:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that
21 would contribute long-term additional loading of phosphorus. Therefore, there would be no
22 substantial, long-term increase in phosphorus concentrations in the rivers and reservoirs upstream
23 of the Delta, in the Delta Region, or the waters exported to the SWP/CVP Export Service Areas due to
24 implementation of these Environmental Commitments relative to Existing Conditions. Because
25 phosphorus concentrations are not expected to increase substantially due to these Environmental
26 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
27 effects to beneficial uses would occur. Phosphorus is not CWA Section 303(d) listed within the
28 affected environment and, thus, the Environmental Commitments would not make any existing
29 phosphorus-related impairment measurably worse because no such impairments currently exist.
30 Because phosphorus is not bioaccumulative, any increases that may occur in some areas would not
31 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
32 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
33 significant. No mitigation is required.

34 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
35 **Maintenance**

36 ***Upstream of the Delta***

37 The effects of Alternative 4A on selenium concentrations in reservoirs and rivers upstream of the
38 Delta would be similar to those effects described for Alternative 4 (see Section 8.3.3.9), because
39 factors affecting selenium concentrations in these water bodies would be similar. Substantial point
40 sources of selenium do not exist upstream in the Sacramento River watershed, in the watersheds of
41 the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or upstream of the Delta in
42 the San Joaquin River watershed. Nonpoint sources of selenium within the watersheds of the
43 Sacramento River and the eastern tributaries also are relatively low, resulting in generally low

1 selenium concentrations in the reservoirs and rivers of those watersheds. Consequently, any
 2 modified reservoir operations and subsequent changes in river flows under Alternative 4A, relative
 3 to Existing Conditions or the No Action Alternative (ELT and LLT), are expected to have negligible, if
 4 any, effects on reservoir and river selenium concentrations upstream of Freeport in the Sacramento
 5 River watershed or in the eastern tributaries upstream of the Delta. Similarly, it is expected that
 6 selenium concentrations in the San Joaquin River would be minimally affected, if at all, by
 7 anticipated changes in flow rates under Alternative 4A, given the relatively small decreases in flows
 8 and the considerable variability in the relationship between selenium concentrations and flows in
 9 the San Joaquin River. Any negligible changes in selenium concentrations that may occur in the
 10 water bodies of the affected environment located upstream of the Delta would not be of frequency,
 11 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
 12 degrade the quality of these water bodies as related to selenium.

13 **Delta**

14 Alternative 4A would result in small changes in average selenium concentrations in water relative to
 15 Existing Conditions and No Action Alternative (ELT) at all modeled Delta assessment locations
 16 (Appendix 8M, *Selenium*, Table M-33). Long-term average concentrations at some interior and
 17 western Delta locations would increase by 0.01–0.03 µg/L for the entire period modeled (1976–
 18 1991). These small increases in selenium concentrations in water would result in small reductions
 19 (3% or less) in long-term average available assimilative capacity for selenium, relative to USEPA's
 20 draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-44). The long-term average
 21 selenium concentrations in water under Alternative 4A (range 0.09–0.40 µg/L) would be similar to
 22 Existing Conditions (range 0.09–0.41 µg/L) and the No Action Alternative (ELT) (range 0.09–0.39
 23 µg/L), and would be below the draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

24 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 4A would result in
 25 small changes (less than 1%) in estimated selenium concentrations in most biota (whole-body fish,
 26 bird eggs [invertebrate diet or fish diet], and fish fillets) throughout the Delta, with little difference
 27 among locations (Appendix 8M, *Selenium*, Tables M-34, and M-38). Level of Concern Exceedance
 28 Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for selenium
 29 concentrations in those biota for all years and for drought years are less than 1.0, indicating low
 30 probability of adverse effects. Similarly, Advisory Tissue Level Exceedance Quotients for selenium
 31 concentrations in fish fillets for all years and drought years are less than 1.0. Estimated selenium
 32 concentrations in sturgeon for the San Joaquin River at Antioch are predicted to increase by about
 33 15% relative to Existing Conditions and to the No Action Alternative (ELT) in all years (from about
 34 4.7 to about 5.4 mg/kg dry weight), and those for sturgeon in the Sacramento River at Mallard Island
 35 are predicted to increase by about 9–12% in all years (from about 4.4 to 4.9 mg/kg dry weight)
 36 (Appendix 8M, *Selenium*, Tables M-41 and M-42). Selenium concentrations in sturgeon during
 37 drought years are expected to increase by about 27% at those locations (Appendix 8M, Tables M-41
 38 and M-42). Detection of small changes in whole-body sturgeon such as those estimated for the
 39 western Delta would require very large sample sizes because of the inherent variability in fish tissue
 40 selenium concentrations. Low Toxicity Threshold Exceedance Quotients for selenium concentrations
 41 in sturgeon in the western Delta would exceed 1.0 for drought years at both locations (as they do for
 42 Existing Conditions and the No Action Alternative (ELT) and for all years in the San Joaquin River at
 43 Antioch (where quotient increases from 0.94 to 1.1) (Appendix 8M, Table M-43). The High Toxicity
 44 Threshold Quotient would be less than 1.0 at both locations for all years and drought years
 45 (Appendix 8M, Table M-43).

1 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
2 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
3 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
4 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
5 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
6 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
7 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
8 the two western Delta locations and used literature-derived uptake factors and trophic transfer
9 factors for the estuary from Presser and Luoma (2013). As noted in Appendix 8M, there was a
10 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
11 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
12 concentrations. There was no difference in bass selenium concentrations in the Sacramento River at
13 Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
14 despite a nearly 10-fold difference in waterborne selenium. Thus, there is more confidence in the
15 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
16 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
17 waterborne selenium concentration at the two locations in different time periods.

18 Residence time of water in the Delta is expected to increase relative to Existing Conditions primarily
19 as a result of habitat restoration (8,000 acres of tidal habitat restoration and enhancements to the
20 Yolo Bypass) that is assumed to occur under the No Action Alternative (ELT) separate from
21 Alternative 4A. The changes in flow paths of water through the Delta and change in operation of the
22 south Delta pumps that would occur due to facilities operations and maintenance of Alternative 4A
23 could result in localized increases in residence time in various Delta sub-regions and decreases in
24 residence time in other areas. Residence times during July through November was modeled for the
25 Biological Assessment for the California WaterFix (ICF International 2016). The Proposed Action
26 modeled in the Biological Assessment is Alternative 4A. Residence time tables for the lower
27 Sacramento River and lower San Joaquin River show slight increases in residence time (in days) in
28 the summer months and slight decreases in the fall months (ICF International 2016: Tables 6.1-32
29 and 6.1-33).

30 If increases in fish tissue or bird egg selenium were to occur as a result of increased residence time,
31 the increases would likely be of concern only where fish tissues or bird eggs are already elevated in
32 selenium to near or above thresholds of concern. That is, where biota concentrations are currently
33 low and not approaching thresholds of concern (which, as discussed above, is the case throughout
34 the Delta, except for sturgeon in the western Delta), changes in residence time alone would not be
35 expected to cause them to then approach or exceed thresholds of concern. Thus, the most likely area
36 in which biota tissues would be at levels high enough that additional bioaccumulation due to
37 increased residence time would be a concern is the western Delta and Suisun Bay for sturgeon.
38 Based on the expected minor increases in residence time in the western Delta, any increases are not
39 expected to be of sufficient magnitude to substantially affect selenium bioaccumulation.

40 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 4A would result in
41 essentially no change in selenium concentrations throughout the Delta for most biota (about 1% or
42 less), although larger increases in selenium concentrations are predicted for sturgeon in the western
43 Delta. Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a
44 low potential for effects. The modeling of bioaccumulation for sturgeon is less calibrated to site-
45 specific conditions than that for other biota, which was calibrated on a robust dataset for modeling
46 of bioaccumulation in largemouth bass as a representative species for the Delta. Overall, Alternative

1 4A would not be expected to substantially increase the frequency with which the applicable water
 2 quality criterion or toxicity and level of concern benchmarks would be exceeded in the Delta (there
 3 being only a small increase for sturgeon relative to the low benchmark and no exceedance of the
 4 high benchmark) or to substantially degrade the quality of water in the Delta, with regard to
 5 selenium. These changes would be similar to those described for Alternative 4.

6 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 7 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 8 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 9 effects on selenium in the LLT are expected to be similar to those described above.

10 ***SWP/CVP Export Service Areas***

11 Alternative 4A would result in small (0.04–0.09 µg/L) decreases in long-term average selenium
 12 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
 13 the No Action Alternative (ELT), for the entire period modeled (Appendix 8M, *Selenium*, Table M-
 14 33). These decreases in long-term average selenium concentrations in water would result in
 15 increases in available assimilative capacity for selenium at these pumping plants, relative to the
 16 USEPA’s draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-44). The long-term average
 17 selenium concentrations in water for Alternative 4A (range 0.16–0.20 µg/L) would be well below
 18 the draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

19 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 4A would result in
 20 small changes (about 1% or less) in estimated selenium concentrations in biota (whole-body fish,
 21 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, *Selenium*, TableM-
 22 38). Concentrations in biota would not exceed any selenium toxicity or level of concern benchmarks
 23 for Alternative 4A.

24 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 25 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 26 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 27 effects on selenium in the LLT are expected to be similar to those described above.

28 ***NEPA Effects:*** Relative to the No Action Alternative (ELT and LLT), Alternative 4A would result in
 29 essentially negligible changes in selenium concentrations in water upstream of the Delta. Similarly,
 30 there would be negligible changes in selenium water and most biota concentrations in the Delta,
 31 with no exceedances of benchmarks for biological effects. For sturgeon in the Delta, there would be
 32 only a small increase of threshold exceedance relative to the low benchmark for sturgeon and no
 33 exceedance of the high benchmark. At the Banks and Jones pumping plants, Alternative 4A would
 34 cause no increases in the frequency with which applicable benchmarks would be exceeded and
 35 would slightly improve the quality of water in selenium concentrations. Therefore, the effects on
 36 selenium (both as waterborne and as bioaccumulated in biota) from Alternative 4A are considered
 37 to be not adverse.

38 ***CEQA Conclusion:*** There are no substantial point sources of selenium in watersheds upstream of the
 39 Delta, and no substantial nonpoint sources of selenium in the watersheds of the Sacramento River
 40 and the eastern tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to
 41 the Delta will be controlled through a TMDL developed by the Central Valley Water Board (2001) for
 42 the lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
 43 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources

1 Control Board 2010b, 2010c) that are expected to result in decreasing discharges of selenium from
 2 the San Joaquin River to the Delta. Consequently, any modified reservoir operations and subsequent
 3 changes in river flows under Alternative 4A, relative to Existing Conditions, are expected to cause
 4 negligible changes in selenium concentrations in water. Any negligible changes in selenium
 5 concentrations that may occur in the water bodies of the affected environment located upstream of
 6 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
 7 any beneficial uses or substantially degrade the quality of these water bodies as related to selenium.

8 Relative to Existing Conditions, modeling estimates indicate Alternative 4A would result in
 9 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
 10 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
 11 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
 12 would increase slightly, from 0.94 for Existing Conditions to 1.1 for Alternative 4A. Concentrations
 13 of selenium in sturgeon would exceed only the lower benchmark, indicating a low potential for
 14 effects. Overall, Alternative 4A would not be expected to substantially increase the frequency with
 15 which applicable benchmarks would be exceeded in the Delta (there being only a small increase for
 16 sturgeon exceedance relative to the low benchmark for sturgeon and no exceedance of the high
 17 benchmark) or substantially degrade the quality of water in the Delta, with regard to selenium.

18 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
 19 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
 20 Alternative 4A would cause no increases in the frequency with which applicable benchmarks would
 21 be exceeded, and would slightly improve the quality of water in selenium concentrations at the
 22 Banks and Jones pumping plants.

23 Based on the above, selenium concentrations that would occur in water under Alternative 4A would
 24 not cause additional exceedances of applicable state or federal numeric or narrative water quality
 25 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment,
 26 by frequency, magnitude, and geographic extent that would result in adverse effects to one or more
 27 beneficial uses within affected water bodies. In comparison to Existing Conditions, water quality
 28 conditions under Alternative 4A would not increase levels of selenium by frequency, magnitude, and
 29 geographic extent such that the affected environment would be expected to have measurably higher
 30 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
 31 wildlife (including fish) or humans consuming those organisms. Water quality conditions under this
 32 alternative with respect to selenium would not cause long-term degradation of water quality in the
 33 affected environment, and therefore would not result in use of available assimilative capacity such
 34 that exceedances of water quality objectives/criteria would be likely and would result in
 35 substantially increased risk for adverse effects to one or more beneficial uses. This alternative would
 36 not further degrade water quality by measurable levels, on a long-term basis, for selenium and, thus,
 37 cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly worse.
 38 Based on these findings, this impact is considered to be less than significant. No mitigation is
 39 required.

40 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of** 41 **Environmental Commitments 3, 4, 6-12, 15, and 16**

42 As described for Alternative 4 (see Section 8.3.3.9) Environmental Commitments 12, 15, and 16 do
 43 not involve actions that would increase selenium loading or otherwise alter selenium concentrations
 44 or residence time such that there would be a change in selenium concentrations in water or biota.

1 Further, with the possible exception of changes in Delta hydrodynamics resulting from habitat
2 restoration, Environmental Commitments 3, 4, and 6–11 would not substantially increase selenium
3 concentrations in the water bodies of the affected environment.

4 While the implementation of Environmental Commitment 4 would create shallow backwater areas
5 that could result in local increased water residence times, the extent of these areas would be
6 minimal relative to the area of the Delta, and environmental changes associated with their
7 development are unlikely to be of magnitude that would measurably change selenium
8 concentrations in water or biota, relative to Existing Conditions. Further, although water residence
9 times associated restoration could increase, they are not expected to increase without bound, and
10 selenium concentrations in the water column would not continue to build up and be recycled in
11 sediments and organisms as may be the case within a closed water system. However, because
12 increases in bioavailable selenium in habitat restoration areas are uncertain, proposed avoidance
13 and minimization measures would require evaluating risks of selenium exposure at a project level
14 for each restoration area, minimizing to the extent practicable potential risk of additional
15 bioaccumulation, and monitoring selenium levels in fish and/or wildlife to establish whether, or to
16 what extent, additional bioaccumulation is occurring. See Appendix 3B, *Environmental*
17 *Commitments, AMMs, and CMs*, for a description of the environmental commitment project
18 proponents are making with respect to selenium management; and BDCP Appendix 3.C, *Avoidance*
19 *and Minimization Measures*, for additional detail on this avoidance and minimization measure
20 (AMM27).

21 **NEPA Effects:** Environmental Commitments 3, 4, 6–12, 15, and 16 would not increase selenium
22 loading, and the amount of restoration that would occur would be minimal relative to the area of the
23 Delta and implemented such that any localized changes in residence time are unlikely to measurably
24 change selenium concentrations in water or biota relative to the No Action Alternative (ELT and
25 LLT). Therefore, the effects on selenium from implementing Environmental Commitments 3, 4, 6–
26 12, 15, and 16 are determined to be not adverse.

27 **CEQA Conclusion:** Environmental Commitments 3, 4, 6–12, 15, and 16 would not increase selenium
28 loading, and the amount of restoration that would occur would be minimal relative to the area of the
29 Delta and implemented such that any localized changes in residence time are unlikely to measurably
30 change selenium concentrations in water or biota relative to Existing Conditions. Therefore, it is
31 expected that with implementation of these Environmental Commitments there would be no
32 substantial, long-term increase in selenium concentrations in water in the rivers and reservoirs
33 upstream of the Delta, water in the Delta, or the waters exported to the SWP/CVP Export Service
34 Areas, relative to Existing Conditions. As such, these Environmental Commitments would not cause
35 additional exceedances of applicable water quality objectives/criteria by frequency, magnitude, and
36 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
37 environment. Given the factors discussed in the assessment above and for Alternative 4 (see Section
38 8.3.3.9), any increases in bioaccumulation rates from waterborne selenium that could occur in some
39 areas as a result of increased water residence times would not be of sufficient magnitude and
40 geographic extent that any portion of the Delta would be expected to have measurably higher body
41 burdens of selenium in aquatic organisms, and therefore would not substantially increase risk for
42 adverse effects to beneficial uses. Environmental Commitments 3, 4, 6–12, 15, and 16 would not
43 cause long-term degradation of water quality resulting in sufficient use of available assimilative
44 capacity such that occasionally exceeding water quality objectives/criteria would be likely. Also,
45 these Environmental Commitments would not result in substantially increased risk for adverse
46 effects to any beneficial uses. Furthermore, although the Delta is a CWA Section 303(d)-listed water

1 body for selenium, given the discussion in the assessment above, it is unlikely that restoration areas
 2 would result in measurable increases in selenium in fish tissues or bird eggs such that the beneficial
 3 use impairment would be made discernibly worse.

4 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 5 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 6 and minimization measures that are designed to further minimize and evaluate the risk of such
 7 increases (see BDCP Appendix 3.C, *Avoidance and Minimization Measures*, for more detail on
 8 AMM27) as well as the Selenium Management environmental commitment (see Appendix 3B,
 9 *Environmental Commitments, AMMs, and CMs*), this impact is considered less than significant. No
 10 mitigation is required.

11 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 12 **and Maintenance**

13 The effects of operation of the water conveyance facilities under Alternative 4A on trace metal
 14 concentrations in surface waters upstream of the Delta, relative to Existing Conditions and the No
 15 Action Alternative (ELT and LLT) would be similar to those effects described for Alternative 4 (see
 16 Section 8.3.3.9). Given the poor association of dissolved trace metal concentrations with flow, river
 17 flow rate and reservoir storage reductions that would occur under Alternative 4A, relative to
 18 Existing Conditions and the No Action Alternative (ELT and LLT), would not be expected to result in
 19 a substantial adverse change in trace metal concentrations in the reservoirs and rivers upstream of
 20 the Delta.

21 In the Delta, for metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel,
 22 silver, and zinc), average and 95th percentile trace metal concentrations of the primary source
 23 waters to the Delta are very similar, and very large changes in source water fraction would be
 24 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 25 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 26 waters are all below their respective water quality criteria, including those that are hardness-based
 27 (see Tables 8-51 and 8-52 in Section 8.3.1.7, *Constituent-Specific Considerations Used in the*
 28 *Assessment*). No mixing of these three source waters could result in a metal concentration greater
 29 than the highest source water concentration, and given that the average and 95th percentile source
 30 water concentrations for copper, cadmium, chromium, lead, nickel, silver, and zinc do not exceed
 31 their respective criteria, more frequent exceedances of criteria in the Delta would not occur. For
 32 metals of primarily human health and drinking water concern (arsenic, iron, manganese), average
 33 and 95th percentile concentrations are also very similar (see Tables 8-10 in Appendix 8N, *Trace*
 34 *Metals*) and average concentrations are below human health criteria. No mixing of these three
 35 source waters could result in a metal concentration greater than the highest source water
 36 concentration, and given that the average water concentrations for arsenic, iron, and manganese do
 37 not exceed water quality criteria, more frequent exceedances of drinking water criteria in the Delta
 38 would not be expected to occur.

39 Because Alternative 4A would not result in substantial increases in trace metal concentrations in the
 40 water exported from the Delta or diverted from the Sacramento River through the proposed
 41 conveyance facilities, there is not expected to be substantial changes in trace metal concentrations
 42 in the SWP/CVP Export Service Areas, relative to Existing Conditions or the No Action Alternative
 43 (ELT).

1 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
2 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
3 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
4 effects on trace metals in the LLT are expected to be similar to those described above.

5 As such, Alternative 4A would not be expected to substantially increase the frequency with which
6 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
7 affected environment or substantially degrade the quality of these water bodies, with regard to trace
8 metals.

9 **NEPA Effects:** Alternative 4A would not be expected to substantially increase the frequency with
10 which applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
11 affected environment or substantially degrade the quality of these water bodies, with regard to trace
12 metals, relative to the No Action Alternative (ELT and LLT). Therefore, the effects on trace metals
13 from implementing Alternative 4A are determined to not be adverse.

14 **CEQA Conclusion:** While Alternative 4A would alter the magnitude and timing of reservoir releases
15 north, south and east of the Delta, this would have no substantial effect on the various watershed
16 sources of trace metals. Moreover, long-term average flow and trace metals at Sacramento River at
17 Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows
18 would not be expected to cause a substantial long-term change in trace metal concentrations
19 upstream of the Delta.

20 Average and 95th percentile trace metal concentrations are very similar across the primary source
21 waters to the Delta. Given this similarity, very large changes in source water fraction would be
22 necessary to effect a relatively small change in trace metal concentration at a particular Delta
23 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
24 waters are all below their respective water quality criteria. No mixing of these three source waters
25 could result in a metal concentration greater than the highest source water concentration, and given
26 that trace metals do not already exceed water quality criteria, more frequent exceedances of criteria
27 in the Delta would not be expected to occur under Alternative 4A.

28 Because Alternative 4A is not expected to result in substantial changes in trace metal concentrations
29 in Delta waters, which includes Banks and Jones pumping plants, effects on trace metal
30 concentrations in the SWP/CVP Export Service Area are expected to be negligible.

31 As such, this alternative is not expected to cause additional exceedance of applicable water quality
32 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
33 beneficial uses of waters in the affected environment. Because trace metal concentrations are not
34 expected to increase substantially, no long-term water quality degradation for trace metals is
35 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore, any
36 negligible changes in long-term trace metal concentrations that may occur in water bodies of the
37 affected environment would not be expected to make any existing beneficial use impairments
38 measurably worse. The trace metals discussed in this assessment are not considered
39 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
40 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
41 is required.

1 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
 2 **Environmental Commitments 3, 4, 6–12, 15, and 16**

3 Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 present no new sources of
 4 trace metals to the affected environment, including areas upstream of the Delta, within the Delta, or
 5 in the SWP/CVP Export Service Areas. CM19, which under Alternative 4 would fund projects to
 6 contribute to reducing pollutant discharges in urban stormwater, would not be implemented under
 7 Alternative 4A, thus the associated trace metal reduction described for Alternative 4 would not
 8 occur under this alternative. However, stormwater discharges would continue to be regulated by the
 9 state and contributions would be expected to be similar to Existing Conditions and the No Action
 10 Alternative (ELT and LLT). The remaining Environmental Commitments would not be expected to
 11 affect trace metal levels, because they are actions that do not affect the presence of trace metal
 12 sources. As they pertain to trace metals, implementation of these Environmental Commitments
 13 would not be expected to adversely affect beneficial uses of the affected environment or
 14 substantially degrade water quality with respect to trace metals.

15 **NEPA Effects:** Because Environmental Commitments 3, 4, 6–12, 15, and 16 present no new sources
 16 of trace metals to the affected environment, the effects on trace metal concentrations from
 17 implementing these Environmental Commitments are determined to be not adverse.

18 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would not
 19 cause substantial long-term increase in trace metal concentrations in the rivers and reservoirs
 20 upstream of the Delta, in the Delta Region, or the SWP/CVP Export Service Areas, because they
 21 present no new sources of trace metals to the affected environment. As such, this alternative is not
 22 expected to cause additional exceedance of applicable water quality objectives by frequency,
 23 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 24 in the affected environment. Because trace metal concentrations are not expected to increase
 25 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
 26 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
 27 trace metal concentrations that may occur throughout the affected environment would not be
 28 expected to make any existing beneficial use impairments measurably worse. The trace metals
 29 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
 30 bioaccumulative problems in aquatic life or humans. Based on these findings, this impact is
 31 considered to be less than significant. No mitigation is required.

32 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
 33 **Maintenance**

34 As described for Alternative 4 (see Section 8.3.3.9), the operation of the water conveyance facilities
 35 under Alternative 4A is expected to have a minimal effect on TSS and turbidity levels in surface
 36 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
 37 Existing Conditions and the No Action Alternative (ELT and LLT). This is because the factors that
 38 would affect TSS and turbidity levels in the surface waters of these areas would be the same. TSS
 39 concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1) TSS
 40 concentrations and turbidity levels of the water released from the upstream reservoirs, 2) erosion
 41 occurring within the river channel beds, which is affected by river flow velocity and bank protection,
 42 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and nonpoint
 43 runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and other
 44 biological material in the water. Within the Delta, TSS concentrations and turbidity levels in Delta

1 waters are affected by TSS concentrations and turbidity levels of inflows (and associated sediment
2 load), as well as fluctuation in flows within the channels due to the tides, with sediments depositing
3 as flow velocities and turbulence are low at periods of slack tide, and sediments becoming
4 suspended when flow velocities and turbulence increase when tides are near the maximum. TSS and
5 turbidity variations can also be attributed to phytoplankton, zooplankton and other biological
6 material in the water. These factors would be similar under Alternative 4A and Alternative 4, are
7 expected to be minimally different from Existing Conditions and the No Action Alternative (ELT and
8 LLT). Because Alternative 4A is expected to have minimal effect on TSS concentrations and turbidity
9 levels in Delta waters, including water exported at the south Delta pumps, relative to Existing
10 Conditions or the No Action Alternative (ELT and LLT), Alternative 4A also is expected to have
11 minimal effect on TSS concentrations and turbidity levels in the SWP/CVP Export Service Areas
12 waters.

13 **NEPA Effects:** Because TSS concentrations and turbidity levels are expected to be minimally affected
14 relative to the No Action Alternative (ELT and LLT), the effects on TSS and turbidity from
15 implementing Alternative 4A are determined to not be adverse.

16 **CEQA Conclusion:** As described for Alternative 4 (see Section 8.3.3.9) changes in river flow rate and
17 reservoir storage that would occur under Alternative 4A, relative to Existing Conditions, would not
18 be expected to result in a substantial adverse change in TSS concentrations and turbidity levels in
19 the reservoirs and rivers upstream of the Delta, given that suspended sediment concentrations are
20 more affected by season than flow. Within the Delta, geomorphic changes associated with sediment
21 transport and deposition are usually gradual, occurring over years, and high storm event inflows
22 would not be substantially affected. Thus, it is expected that the TSS concentrations and turbidity
23 levels in the affected channels would not be substantially different from the levels under Existing
24 Conditions. There is not expected to be substantial, if even measurable, changes in TSS
25 concentrations and turbidity levels in the SWP/CVP Export Service Areas waters under Alternative
26 4A, relative to Existing Conditions, because this alternative is not expected to result in substantial
27 changes in TSS concentrations and turbidity levels at the south Delta export pumps, relative to
28 Existing Conditions. Therefore, this alternative is not expected to cause additional exceedance of
29 applicable water quality objectives where such objectives are not exceeded under Existing
30 Conditions. Because TSS concentrations and turbidity levels are not expected to be substantially
31 different, long-term water quality degradation is not expected, and, thus, beneficial uses are not
32 expected to be adversely affected. Finally, TSS and turbidity are neither bioaccumulative nor CWA
33 Section 303(d) listed constituents. Based on these findings, this impact is considered to be less than
34 significant. No mitigation is required.

35 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of** 36 **Environmental Commitments 3, 4, 6–12, 15, and 16**

37 Environmental Commitments 3, 4, and 6–11 would involve habitat restoration actions. Creation of
38 habitat and open water through implementation of these Environmental Commitments could affect
39 Delta hydrodynamics and, thus, erosion and deposition potential in certain Delta channels, though
40 the geographic extent of the effects would be substantially less than under Alternative 4, because
41 less land would be converted under Alternative 4A. The magnitude of increases in TSS
42 concentrations and turbidity levels in the affected channels due to higher potential of erosion cannot
43 be readily quantified. The increases in TSS concentrations and turbidity levels in the affected
44 channels could be substantial in localized areas, depending on how rapidly the channels equilibrate
45 with the new tidal flux regime, after implementation of this alternative. However, geomorphic

1 changes associated with sediment transport and deposition are usually gradual, occurring over
2 years. Within the reconfigured channels there could be localized increases in TSS concentrations
3 and turbidity levels, but within the greater Plan Area it is expected that the TSS concentrations and
4 turbidity levels would not be substantially different from the levels under Existing Conditions or the
5 No Action Alternative (ELT and LLT).

6 CM19, which under Alternative 4 would fund projects to contribute to reducing pollutant discharges
7 in stormwater, would not be implemented under Alternative 4A, thus the associated TSS and
8 turbidity reduction described for Alternative 4 would not occur under this alternative. Nevertheless,
9 stormwater discharges would still be subject to the state's NPDES program requirements to
10 implement control measures, which would contribute to controlling TSS and turbidity in discharges.

11 The remaining Environmental Commitments would not be expected to affect TSS concentrations
12 and turbidity levels, because they are actions that do not affect the presence of TSS and turbidity
13 sources.

14 **NEPA Effects:** Localized, temporary changes in TSS and turbidity could occur associated with the
15 restoration actions of Environmental Commitments 3, 4, 6–12, 15, and 16. However, these changes
16 would be gradual and not expected to substantially differ from No Action Alternative (ELT and LLT)
17 conditions. Therefore, the effects on TSS and turbidity from implementing these Environmental
18 Commitments are determined to be not adverse.

19 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
20 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of
21 Environmental Commitments 3, 4, 6–12, 15, and 16 would not be substantially different relative to
22 Existing Conditions, except within localized areas of the Delta modified through creation of habitat
23 and open water. Therefore, this alternative is not expected to cause additional exceedance of
24 applicable water quality objectives where such objectives are not exceeded under Existing
25 Conditions. Because TSS concentrations and turbidity levels Upstream of the Delta, in the greater
26 Plan Area, and in the SWP/CVP Export Service Areas are not expected to be substantially different,
27 long-term water quality degradation is not expected relative to TSS and turbidity, and, thus,
28 beneficial uses are not expected to be adversely affected. Finally, TSS and turbidity are neither
29 bioaccumulative nor CWA Section 303(d) listed constituents. Based on these findings, this impact is
30 considered to be less than significant. No mitigation is required.

31 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities for the** 32 **Water Conveyance Facilities and Environmental Commitments**

33 The potential construction-related water quality effects that would occur under Alternative 4A
34 would be of a lower magnitude compared to the effects described for Alternative 4 (see Section
35 8.3.3.9). This is because the size and number of construction activities for some Environmental
36 Commitments under Alternative 4A would be reduced, or not occur, compared to Alternative 4. The
37 construction-related activities for the water conveyance facilities under Alternative 4A would be the
38 same as described for Alternative 4. However, there would be substantially less area of in-water
39 habitat restoration activities implemented under Alternative 4A compared to Alternative 4.
40 Therefore, the amount of construction activity under Alternative 4A would be lower than described
41 for Alternative 4, thus resulting in less potential for construction-related disturbances and
42 contaminant discharges to surface waters.

1 The construction-related activities for Alternative 4A would be most extensive for the new water
2 conveyance facilities. Construction of water conveyance facilities would involve vegetation removal,
3 material storage and handling, excavation, overexcavation for facility foundations, surface grading,
4 trenching, road construction, levee construction, construction site dewatering, soil stockpiling, RTM
5 dewatering basin construction and storage operations, and other general facility construction
6 activities (i.e., concrete, steel, carpentry, and other building trades) over approximately 7,500 acres
7 during the course of constructing the facilities. Vegetation would be removed (via grubbing and
8 clearing) and grading and other earthwork would be conducted at the intakes, pumping plants, the
9 intermediate forebay, the Byron Tract Forebay, canal and gates between the Byron Tract Forebay
10 tunnel shafts and the approach canal to the Banks Pumping Plant, borrow areas, RTM and spoil
11 storage areas, setback and transition levees, sedimentation basins, solids handling facilities,
12 transition structures, surge shafts and towers, substations, transmission line footings, access roads,
13 concrete batch plants, fuel stations, bridge abutments, barge unloading facilities, and laydown areas.
14 Construction of each intake would take nearly four years to complete.

15 Habitat restoration Environmental Commitments in the Delta, including restored tidal wetlands,
16 floodplain, and related channel margin and off-channel habitats, also would involve substantial in-
17 water construction-related activities in localized areas of the Delta. Other non-habitat restoration
18 Environmental Commitments are not anticipated to involve construction activities that would result
19 in substantial discharges of any constituents of concern.

20 **NEPA Effects:** Potential construction-related water quality effects may include discharges of
21 turbidity/TSS due to the erosion of disturbed soils and associated sedimentation entering surface
22 water bodies or other construction-related wastes (e.g., concrete, asphalt, cleaning agents, paint, and
23 trash). Construction activities also may result in temporary or permanent changes in stormwater
24 generation or drainage and runoff patterns (i.e., velocity, volume, and direction) that may cause or
25 contribute to soil erosion and offsite sedimentation, such as creation of additional impervious
26 surfaces (e.g., pavement, buildings, compacted soils), blockage or restriction of existing drainage
27 channels, or general surface drainage changes from grading and excavation activity. Additionally,
28 the use of heavy earthmoving equipment may result in spills and leakage of oils, gasoline, diesel fuel,
29 and related petroleum contaminants used in the fueling and operation of such construction
30 equipment.

31 Land surface grading and excavation activities, or exposure of disturbed sites immediately following
32 construction and prior to stabilization, could result in rainfall- and stormwater-related soil erosion,
33 runoff, and offsite sedimentation in surface water bodies. The initial runoff following construction,
34 or return of seasonal rains to previously disturbed sites, can result in runoff with peak pollutant
35 levels and is referred to as “first flush” storm events. Soil erosion and runoff can also result in
36 increased concentrations and loading of organic matter, nutrients (nitrogen and phosphorus), and
37 other contaminants contained in the soil such as trace metals, pesticides, or animal-related
38 pathogens. Graded and exposed soils also can be compacted by heavy machinery, resulting in
39 reduced infiltration of rainfall and runoff, thus increasing the rate of runoff (and hence
40 contaminants) to downstream water bodies.

41 Construction activities also would be anticipated to involve the transport, handling, and use of a
42 variety of hazardous substances and non-hazardous materials that may adversely affect water
43 quality if discharged inadvertently to construction sites or directly to water bodies. Typical
44 construction-related contaminants include petroleum products for refueling and maintenance of
45 machinery (e.g., fuel, oils, solvents), concrete, paints and other coatings, cleaning agents, debris and

1 trash, and human wastes. Construction activities also would involve large material storage and
 2 laydown areas, and occasional accidental spills of hazardous materials stored and used for
 3 construction may occur. Contaminants released or spilled on bare soil also may result in
 4 groundwater contamination. Dewatering operations may contain elevated levels of suspended
 5 sediment or other constituents that may cause water quality degradation.

6 The intensity of construction activity along with the fate and transport characteristics of the
 7 chemicals used, would largely determine the magnitude, duration, and frequency of construction-
 8 related discharges and resulting concentrations and degradation associated with the specific
 9 constituents of concern. The potential water quality concerns associated with the major categories
 10 of contaminants that might be discharged as a result of construction activity include the following.

- 11 • Suspended sediment: May increase turbidity (i.e., reduce water clarity) that can affect aquatic
 12 organisms and increase the costs and effort of removal in municipal/industrial water supplies.
 13 Downstream sedimentation can affect aquatic habitat, or cause a nuisance if it affects functions
 14 of agricultural or municipal intakes, or boat navigation.
- 15 • Organic matter: May contribute turbidity and oxygen demanding substances (i.e., reduce DO
 16 levels) that can affect aquatic organisms. Organic carbon may increase the potential for
 17 disinfection byproduct formation in municipal drinking water supplies.
- 18 • Nutrients: May contribute nitrogen, phosphorus, and other key nutrients that can contribute to
 19 nuisance biostimulation of algae and vascular aquatic plants, which may affect municipal water
 20 supplies, recreation, aquatic life, and aesthetics.
- 21 • Petroleum hydrocarbons: May contribute toxic compounds to aquatic life, and oily sheens may
 22 reduce oxygen/gas transfer in water, foul aquatic habitats, and reduce water quality for
 23 municipal supplies, recreation, and aesthetics.
- 24 • Trace constituents (metals, pesticides, synthetic organic compounds): Compounds in eroded soil
 25 or construction-related materials (e.g., paints, coatings, cleaning agents) may be toxic to aquatic
 26 life.
- 27 • Pathogens: Bacteria, viruses, and protozoans may affect aquatic life and increase human health
 28 risks via municipal water supplies, reduced recreational water quality, or contaminated shellfish
 29 beds.
- 30 • Other inorganic compounds: Construction-related materials can contain inorganic compounds
 31 such as acidic/basic materials which can change pH and may adversely affect aquatic life and
 32 habitats. Concrete contains lime which can increase pH levels, and drilling fluids may alter pH.

33 Some construction-related contaminants, such as PAHs that may be in some fuel and oil petroleum
 34 byproducts, may be bioaccumulative in aquatic and terrestrial organisms. Construction activities
 35 also may disturb areas where bioaccumulative constituents are present in the soil (e.g., mercury,
 36 selenium, organochlorine pesticides, PCBs, and dioxin/furan compounds), or may disturb soils that
 37 contain constituents included on the Section 303(d) lists of impaired water bodies in the affected
 38 environment. While the 303(d)-listed Delta channels impaired by mercury are widespread,
 39 impairment by selenium, pesticides, PCBs, and dioxin/furan compounds is more limited, and there
 40 are no 303(d) listings for PAH impairment. Bioaccumulation of constituents in the aquatic
 41 foodchain, and 303(d)-related impaired water bodies, arise as a result of long-term loading of a
 42 constituent or a pervasive and widespread source of constituent discharge (e.g., mercury). However,
 43 as a result of the generally localized disturbances, and intermittent and temporary nature of

1 construction-related activities, construction would not be anticipated to result in contaminant
2 discharges of substantial magnitude or duration to contribute to long-term bioaccumulation
3 processes, or cause measurable long-term degradation such that existing 303(d) impairments
4 would be made discernibly worse or TMDL actions to reduce loading would be adversely affected.

5 The environmental commitments for construction-related water quality protection would be
6 specifically designed as a part of the final design, included in construction contracts as a required
7 element, and would be implemented to avoid, prevent, and minimize the potential discharges of
8 constituents of concern to water bodies and associated adverse water quality effects and comply
9 with state water quality regulations. Additionally, temporary and permanent changes in stormwater
10 drainage and runoff would be minimized and avoided through construction of new or modified
11 drainage facilities, as described in the Chapter 3, *Description of Alternatives*. This alternative would
12 include installation of temporary drainage bypass facilities, long-term cross drainage, and
13 replacement of existing drainage facilities that would be disrupted due to construction of new
14 facilities.

15 Construction-related activities would be conducted in accordance with the environmental
16 commitment to develop and implement BMPs for all activities that may result in discharge of soil,
17 sediment, or other construction-related contaminants to surface water bodies, and obtain
18 authorization for the construction activities under the State Water Board's NPDES Stormwater
19 General Permit for Stormwater Discharges Associated with Construction and Land Disturbance
20 Activities (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002). The General Construction
21 NPDES Permit requires the preparation and implementation of SWPPPs, which are the principal
22 plans within the required PRDs that identify the proposed erosion control and pollution prevention
23 BMPs that would be used to avoid and minimize construction-related erosion and contaminant
24 discharges. The development of the SWPPPs, and applicability of other provisions of this General
25 Construction Permit depends on the "risk" classification for the construction which is determined
26 based on the potential for erosion to occur as well as the susceptibility of the receiving water to
27 potential adverse effects of construction. While the determination of project risk level, and planning
28 and development of the SWPPPs and BMPs to be implemented, would be completed as a part of final
29 design and contracting for the work, the responsibility for compliance with the provisions of the
30 General Construction Permit necessitates that BMPs are applied to all disturbance activities. In
31 addition to the BMPs, the SWPPPs would include BMP inspection and monitoring activities, and
32 identify responsibilities of all parties, contingency measures, agency contacts, and training
33 requirements and documentation for those personnel responsible for installation, inspection,
34 maintenance, and repair of BMPs. The General Construction Permit contains NALs and for pH and
35 turbidity, and specifies storm event water quality monitoring to determine if construction is
36 resulting in elevated discharges of these constituents, and monitoring for any non-visible
37 contaminants determined to have been potentially released. If an NAL is determined to have been
38 exceeded, the General Construction Permit requires the discharger to conduct a construction site
39 and run-on evaluation to determine whether contaminant sources associated with the site's
40 construction activity may have caused or contributed to the exceedance and immediately implement
41 corrective actions if they are needed.

42 The BMPs that are routinely implemented in the construction industry and have proven successful
43 at reducing adverse water quality effects include, but are not limited to, the following broad
44 categories of actions (letters refer to categories of specific BMPs identified in Appendix 3B,
45 *Environmental Commitments, AMMs, and CMs*), for which Appendix 3B identifies specific BMPs
46 within these categories:

- 1 • Waste Management and Spill Prevention and Response (BMP categories A.2 and A.3): Waste
2 management BMPs are designed to minimize exposure of waste materials at all construction
3 sites and staging areas such as waste collection and disposal practices, containment and
4 protection of wastes from wind and rain, and equipment cleaning measures. Spill prevention
5 and response BMPs involve planning, equipment, and training for personnel for emergency
6 event response.
- 7 • Erosion and Sedimentation Control (BMP categories A.4 and A.5): Erosion control BMPs are
8 designed to prevent erosion processes or events including scheduling work to avoid rain events,
9 stabilizing exposed soils; minimize offsite sediment runoff; remove sediment from onsite runoff
10 before it leaves the site; and slow runoff rates across construction sites. Identification of
11 appropriate temporary and long-term seeding, mulching, and other erosion control measures as
12 necessary. Sedimentation BMPs are designed to minimize offsite sediment runoff once erosion
13 has occurred involving drainage controls, perimeter controls, detention/sedimentation basins,
14 or other containment features.
- 15 • Good Housekeeping and Non-Stormwater Discharge Management (BMP category A.6 and A.7):
16 Good housekeeping BMPs are designed to reduce exposure of construction sites and materials
17 storage to stormwater runoff including truck tire tracking control facilities; equipment washing;
18 litter and construction debris; and designated refueling and equipment inspection/maintenance
19 practices Non-stormwater discharge management BMPs involve runoff measures for
20 contaminants not directly associated with rain or wind including vehicle washing and street
21 cleaning operations.
- 22 • Construction Site Dewatering and Pipeline Testing (BMP category A.8).Dewatering BMPs
23 involve actions to prevent discharge of contaminants present in dewatering of groundwater
24 during construction, discharges of water from testing of pipelines or other facilities, or the
25 indirect erosion that may be caused by dewatering discharges.
- 26 • BMP Inspection and Monitoring (BMP category A.9): Identification of clear objectives for
27 evaluating compliance with SWPPP provisions, and specific BMP inspection and monitoring
28 procedures, environmental awareness training, contractor and agency roles and responsibilities,
29 reporting procedures, and communication protocols.

30 In addition to the Category “A” BMPs for surface land disturbances identified in the environmental
31 commitments (Appendix 3B, *Environmental Commitments, AMMs, and CNs*), BMPs implemented also
32 would include the Category “B” BMPs for tunnel/pipeline construction that involves actions
33 primarily to avoid and minimize sediment and contaminant discharges associated with RTM
34 excavation, hauling, and RTM dewatering operations. Additionally, habitat restoration activities
35 under CM2 and CM4–CM10 would be subject to implementation of the Category “C” BMPs (In-Water
36 Construction BMPs) and Category “D” BMPs (Tidal and Wetland Restoration) designed to minimize
37 disturbance and direct discharge of turbidity/suspended solids to the water during in-water
38 construction activities. Category “E” BMPs identify general permanent post-construction actions that
39 would be implemented for all terrestrial, in-water, and habitat restoration activities and would
40 involve planning, design, and development of final site stabilization, revegetation, and drainage
41 control features.

42 Finally, acquisition of applicable environmental permits may be required for specific environmental
43 commitments, which may include specific WDRs or CWA Section 401 water quality certifications
44 from the appropriate Regional Water Boards, CDFW Streambed Alteration Agreements, and USACE
45 CWA Section 404 dredge and fill permits. These other permit processes may include requirements

1 to implement additional action-specific BMPs that may reduce potential adverse discharge effects of
2 constituents of concern.

3 The potential construction-related contaminant discharges that could result from this alternative
4 would not be anticipated to result in adverse water quality effects at a magnitude, frequency, or
5 regional extent that would cause substantial adverse effects to aquatic life. Relative to Existing
6 Conditions, this assessment indicates the following.

- 7 • Projects would be managed under state water quality regulations and project-defined actions to
8 avoid and minimize contaminant discharges.
- 9 • Individual projects would generally be dispersed, and involve infrequent and temporary
10 activities, thus not likely resulting in substantial exceedances of water quality standards or long-
11 term degradation.
- 12 • Potential construction-related contaminant discharges would not cause additional exceedance
13 of applicable water quality objectives where such objectives are not exceeded under Existing
14 Conditions. Long-term water quality degradation is not anticipated, and hence would not be
15 expected to adversely affect beneficial uses.
- 16 • By the intermittent and temporary frequency of construction-related activities and potential
17 contaminant discharges, the constituent-specific effects would not be of substantial magnitude
18 or duration to contribute to long-term bioaccumulation processes, or cause measureable long-
19 term degradation such that existing 303(d) impairments would be made discernibly worse or
20 TMDL actions to reduce loading would be adversely affected.

21 Consequently, because the construction-related activities for the conservation measures would be
22 conducted with implementation of environmental commitments, including but not limited to those
23 identified in Appendix 3B, *Environmental Commitments, AMMs, and CMs*, with respect to the No
24 Action Alternative conditions, this alternative would not be expected to cause constituent discharges
25 of sufficient frequency and magnitude to result in a substantial increase of exceedances of water
26 quality objectives/criteria, or substantially degrade water quality with respect to the constituents of
27 concern, and thus would not adversely affect any beneficial uses in the Delta.

28 In summary, with implementation of environmental commitments in Appendix 3B, the potential
29 construction-related water quality effects are considered to be not adverse.

30 **CEQA Conclusion:** As explained above, water quality effects resulting from construction-related
31 activities would be less under Alternative 4A compared to Alternative 4, which was determined to
32 be less than significant. Moreover, because environmental commitments would be implemented
33 under Alternative 4A for construction-related activities along with agency-issued permits that also
34 contain construction requirements to protect water quality, the construction-related effects, relative
35 to Existing Conditions, would not be expected to cause or contribute to substantial alteration of
36 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
37 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
38 degrade water quality with respect to the constituents of concern on a long-term average basis, and
39 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
40 Delta, or in the SWP/CVP Export Service Areas. Moreover, because the construction-related
41 activities would be temporary and intermittent in nature, the construction would involve negligible
42 discharges, if any, of bioaccumulative or CWA Section 303(d) listed constituents to water bodies of
43 the affected environment. As such, construction activities would not contribute measurably to

1 bioaccumulation of contaminants in organisms or humans or cause CWA Section 303(d)
2 impairments to be discernibly worse. Based on these findings, this impact is determined to be less
3 than significant. No mitigation is required.

4 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 5 **and Maintenance**

6 ***Upstream of the Delta***

7 Adverse effects from *Microcystis* upstream of the Delta have only been documented in lakes such as
8 Clear Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over
9 other phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
10 characterized by low nutrient concentrations, where other phytoplankton outcompete
11 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
12 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
13 Joaquin River upstream of the Delta under Existing Conditions, bloom development is limited by
14 high water velocity and low residence times. These conditions are not expected to change under
15 Alternative 4A or the No Action Alternative (ELT and LLT). Consequently, any modified reservoir
16 operations under Alternative 4A are not expected to promote *Microcystis* production upstream of
17 the Delta, relative to Existing Conditions and the No Action Alternative (ELT and LLT).

18 ***Delta***

19 During the June through October period when *Microcystis* blooms occur in the Delta, it is a
20 combination of flows, associated residence time, and water temperatures that are believed to most
21 influence *Microcystis* bloom formation.

22 Since Delta water temperatures are largely driven by air temperature, climate change that increases
23 air temperatures relative to Existing Conditions would be expected to increase ambient water
24 temperatures in the Delta by 1.3–2.5°F. These climate changes in the ELT are expected to occur in
25 the Delta under the No Action Alternative, relative to Existing Conditions. Alternative 4A operations
26 and maintenance is not expected to cause increased Delta water temperatures, relative to Existing
27 Conditions or the No Action Alternative.

28 Under Alternative 4A, a portion of the Sacramento River water which is conveyed through the Delta
29 to the south Delta intakes under Existing Conditions would be replaced at various locations
30 throughout the Delta by other source water due to diversion of Sacramento River water at the north
31 Delta intakes. To determine how hydrologic effects of Alternative 4A, relative to Delta hydrology
32 under the No Action Alternative (ELT), may affect *Microcystis* occurrence and bloom formation,
33 flows, residence time, and peak daily channel velocity were analyzed for various Delta locations.

34 Frequency of given flows were assessed in the Biological Assessment for the California WaterFix
35 (ICF International 2016) using flow in the San Joaquin River past Jersey Point and flow in the
36 Sacramento River at Rio Vista. The San Joaquin River analysis found that flow conditions conducive
37 to *Microcystis* blooms in the San Joaquin River would occur less frequently under the Proposed
38 Action, which is Alternative 4A, compared to the No Action Alternative. Based on flow analysis in the
39 Sacramento River, there could be a decrease in flows at Rio Vista compared to the No Action
40 Alternative. Because turbid conditions and sufficient flow to create channel turbulence are the norm
41 here, and are expected to remain consistent with Existing Conditions in the future, it is expected that

1 current conditions will continue and that *Microcystis* blooms will not increase here (ICF
2 International 2016).

3 Based on *Microcystis* life history strategy to outcompete other algal species and the inhibitory effect
4 of flow and turbulence on its ability to do so, maximum daily channel velocities (which creates
5 channel turbidity and turbulence) also were assessed using DSM2 velocity output for a number of
6 locations throughout the Delta (Appendix 8P). The evaluation of flow velocities shows little to no
7 effects on peak daily velocities under Alternative 4A compared to the No Action Alternative at each
8 location assessed. This indicates that areas of the Delta that are currently turbid will remain turbid
9 and vertical mixing of the water column will be similar under Alternative 4A and the No Action
10 Alternative. As stated in Section 8.3.1.7, *Microcystis* cannot effectively retain its buoyancy or
11 outcompete other faster growing phytoplankton in turbid, turbulent waters. Therefore, based on
12 Alternative 4A maintaining similar to equivalent peak daily flow velocities in Delta channels (and
13 turbidity and turbulence conditions), Alternative 4A would not be expected to substantially increase
14 the frequency or geographic extent of *Microcystis* blooms in the Delta, relative to what would occur
15 under the No Action Alternative.

16 Changes in flow paths of water through the Delta and change in operation of the south Delta pumps
17 that would occur due to facilities operations and maintenance of Alternative 4A could result in
18 localized increases in residence time in various Delta sub-regions and decreases in residence time in
19 other areas. In addition to the effects of operations and maintenance of Alternative 4A, increases in
20 water residence times are expected occur due to separate factors and actions concurrent with the
21 alternative, including habitat restoration (8,000 acres of tidal habitat and enhancements in the Yolo
22 Bypass) and sea level rise due to climate change.

23 Residence times in 19 Delta sub-regions during the *Microcystis* bloom season of July through
24 October was modeled for the Biological Assessment for the California WaterFix (ICF International
25 2016). The Proposed Action modeled in the Biological Assessment is Alternative 4A. Modeling
26 results show varying levels of change in residence time, depending on sub-region, month and water
27 year type (Tables 6.6-5 through 6.6-25, ICF International 2016). DSM2 PTM output indicates
28 residence times may increase in parts of the southern and central Delta. Because there is no
29 published analysis of the relationship between *Microcystis* occurrence and residence time, there is
30 uncertainty on how increased residence times may affect *Microcystis* occurrences (ICF International
31 2016). In some areas of the Delta currently affected by *Microcystis* blooms, decreasing median
32 residence times in some months (decreases from 0.1 – 3.8 days) has potential to lower the
33 magnitude and duration of *Microcystis* blooms. However, in other areas of the Delta that experience
34 *Microcystis* blooms, longer median residence times in some months (0.1 - 16.5 days) has potential to
35 increase the magnitude and duration of *Microcystis* blooms.

36 The changes in residence time are driven by a number of factors accounted for in the modeling,
37 including diversion of Sacramento River water at the proposed north Delta intake facilities, which
38 does not account for the flexibility of operations of the north and south Delta intakes or real-time
39 management of reservoir releases. To ensure project operations do not create increased *Microcystis*
40 blooms in the Delta, water flow through Delta channels would be managed through real-time
41 operations, particularly the balancing of the north and south Delta diversions. By operating the
42 south Delta pumps more frequently during periods conducive to increased *Microcystis* blooms,
43 residence times would be substantially reduced from those modeled for Alternative 4A. Reducing
44 residence times would decrease the potential for blooms to develop, and thus decrease potential
45 microcystin increases due to project operations. As such, effects of Alternative 4A on *Microcystis*

1 levels, and thus microcystin concentrations in the Delta, would not be made more adverse relative to
2 Existing Conditions and the No Action Alternative (ELT and LLT).

3 In summary, operations and maintenance of Alt 4A is not expected to result in flow or velocity
4 changes in the Delta that would cause substantial increases in the frequency, magnitude, and
5 geographic extent of *Microcystis* blooms, relative to Existing Conditions or the No Action Alternative.
6 In some areas of the Delta that experience *Microcystis* blooms, longer median residence times in
7 some months has potential to increase the magnitude and duration of *Microcystis* blooms. However,
8 factors that control *Microcystis* blooms in the Delta are still under study, so there is some
9 uncertainty regarding this impact finding. *Microcystis* blooms may also occur more frequently in the
10 Delta in the future, relative to Existing Conditions, due to factors unrelated to the project alternative,
11 including: 1) increased residence times resulting from restoration activities and climate change-
12 related sea level rise and 2) climate change-related increased Delta water temperatures. To ensure
13 project operations under Alternative 4A do not create significant increases in *Microcystis* blooms in
14 the Delta, that may be associated with increased residence times, water flow through Delta channels
15 would be managed through real-time operations.

16 **SWP/CVP Export Service Area**

17 As described above for the Delta, source waters to the south Delta intakes could be adversely
18 affected, relative to Existing Conditions, by *Microcystis* both from an increase in Delta water
19 temperatures associated with climate change and from an increase in water residence times. The
20 impacts from increased Delta water residence times would be primarily related to habitat
21 restoration (8,000 acres of tidal habitat restoration and enhancements in the Yolo Bypass) that is
22 assumed to occur separate from Alternative 4A. The combined effect of these factors on the
23 potential for *Microcystis* blooms in source waters to the south Delta intakes is expected to be much
24 greater than the influence of operations and maintenance of Alternative 4A, the effects of which will
25 be mitigated through real time operations. Increases in ambient air temperatures due to climate
26 change relative to Existing Conditions are expected under this alternative. Increases in ambient air
27 temperatures are expected to result in warmer ambient water temperatures, and thus conditions
28 more suitable to *Microcystis* growth, in the water bodies of the SWP/CVP Export Service Areas. The
29 incremental increase in long-term average air temperatures would be less at the ELT (2.0°F),
30 compared to the LLT (4.0°F).

31 As discussed in the Delta section above, Alternative 4A facilities operations and maintenance is not
32 expected to substantially adversely affect *Microcystis* blooms, relative to Existing Conditions and the
33 No Action Alternative (ELT and LLT). Additionally, residence time and water temperature
34 conditions in the SWP/CVP Export Service Areas are not expected to become more conducive to
35 *Microcystis* bloom formation due to the operations and maintenance of Alternative 4A, relative to
36 Existing Conditions and the No Action Alternative (ELT and LLT), because water residence times are
37 not projected to increase in the SWP/CVP Export Service Areas and any temperature increases there
38 would be due to climate change and not due to Alternative 4A.

39 **NEPA Effects:** Modified reservoir operations under Alternative 4A are not expected to promote
40 *Microcystis* production upstream of the Delta, relative to the No Action Alternative (ELT and LLT).
41 Similarly, operations and maintenance of Alternative 4A are not expected to substantially increase
42 water residence times or ambient water temperatures in the Delta, including at the Banks and Jones
43 pumping plants, and thus is not expected to result in adverse effects on *Microcystis* in the Delta,
44 relative to No Action Alternative (ELT and LLT). Lack of adverse effects on *Microcystis* in the Delta

1 would mean that Delta waters diverted into the SWP/CVP Export Service Areas would not be
 2 adversely affected. Finally, the potential for *Microcystis* bloom formation within the SWP/CVP
 3 Export Service Area water bodies and canals would not be expected to change substantially, if at all,
 4 because water residence times are not projected to increase in the SWP/CVP Export Service Areas
 5 and any temperature increases there would be due to climate change and not due to Alternative 4A.
 6 Thus, the effects on *Microcystis* in surface waters upstream of the Delta, in the Delta, and in the
 7 SWP/CVP Export Service Areas from implementing Alternative 4A are determined to be not adverse.

8 **CEQA Conclusion:** Modified reservoir operations under Alternative 4A are not expected to promote
 9 *Microcystis* production upstream of the Delta, relative to the Existing Conditions. Increased
 10 frequency and magnitude of *Microcystis* blooms may occur in the Delta in the future, relative to
 11 Existing Conditions, due to increased residence times resulting from restoration activities unrelated
 12 to the project alternative, as well as climate change and sea level rise that are expected to increase
 13 Delta water temperatures. Such increases in residence time and water temperatures would not be
 14 caused by implementation of Alternative 4A. Operations and maintenance of Alternative 4A,
 15 including the use of real-time operations, are not expected to result in flow and temperature
 16 conditions in the Delta, including at the Banks and Jones pumping plants, that would cause
 17 substantial increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms. As
 18 such, this alternative would not be expected to cause additional exceedance of applicable water
 19 quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 20 significant impacts on any beneficial uses of waters in the affected environment. *Microcystis* and
 21 microcystins are not CWA Section 303(d) listed within the affected environment and thus any
 22 increases that could occur in some areas of the Delta would not make any existing *Microcystis*
 23 impairment measurably worse because no such impairments currently exist. Microcystin, the toxin
 24 produced by *Microcystis*, is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential
 25 increases in *Microcystis* occurrences due to climate change and sea level rise may lead to increased
 26 microcystin presence in the Delta, relative to Existing Conditions. This has potential to cause
 27 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 28 risks to fish, wildlife or humans. While long-term water quality degradation related to microcystin
 29 levels may occur and, thus, impacts on beneficial uses could occur, these impacts are not related to
 30 implementation of Alternative 4A. Although there is uncertainty regarding this impact, the effects on
 31 *Microcystis* from implementing water conveyance facilities are determined to be less than
 32 significant. No mitigation is required.

33 **Impact WQ-33: Effects on *Microcystis* Bloom Formation Resulting from Environmental** 34 **Commitments**

35 Under Alternative 4A, fisheries enhancements to the Yolo Bypass would not be implemented, but
 36 under a plan separate and distinct from Alternative 4A, enhancements to the Yolo Bypass and 8,000
 37 acres of tidal habitat restoration would be implemented in the ELT. The Yolo Bypass enhancements
 38 are assumed to occur under the No Action Alternative, as well as 8,000 acres of tidal habitat
 39 restoration. These activities would create shallow backwater areas that could result in local warmer
 40 water and increased water residence time of magnitude and extent that could result in measurable
 41 changes on *Microcystis* levels in the Delta, relative to Existing Conditions. However, the area of tidal
 42 habitat restoration to be implemented as a component of Alternative 4A, relative to the No Action
 43 Alternative, is so small that it would have negligible effects compared to the development of 8,000
 44 acres of tidal habitat that would be developed independent of Alternative 4A. Thus, compared to the
 45 No Action Alternative, which isolates the effects of Alternative 4A habitat actions, Alternative 4A

1 Environmental Commitments are not expected to contribute to measurable changes on *Microcystis*
2 levels in the Delta.

3 **NEPA Effects:** Based on the discussion above, the effects on *Microcystis* from implementing
4 Environmental Commitments 3, 4, 6–12, 15, and 16 are determined to be not adverse.

5 **CEQA Conclusions:** Based on the discussion above, Environmental Commitments 3, 4, 6–12, 15, and
6 16 would not be expected to cause additional exceedance of applicable water quality
7 objectives/criteria by frequency, magnitude, and geographic extent that would cause significant
8 impacts on any beneficial uses of waters in the affected environment. *Microcystis* and microcystins
9 are not CWA Section 303(d) listed within the affected environment and thus any increases that
10 could occur in some areas would not make any existing *Microcystis* impairment measurably worse
11 because no such impairments currently exist. However, it is possible that increases in the frequency,
12 magnitude, and geographic extent of *Microcystis* blooms in the Delta would occur at the early long-
13 term for reasons unassociated with implementation of the Environmental Commitments, including
14 tidal habitat restoration. Further, microcystin is bioaccumulative in the Delta foodweb (Lehman
15 2010). Thus, potential increases in *Microcystis* occurrences may lead to increased microcystin
16 presence in the Delta relative to Existing Conditions. This has potential to cause microcystins to
17 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health risks to fish,
18 wildlife or humans. While long-term water quality degradation related to microcystins levels may
19 occur and, thus, significant impacts on beneficial uses could occur, these impacts are not related to
20 implementation of the Environmental Commitments. Therefore, the effects on *Microcystis* from
21 implementing the Environmental Commitments are determined to be less than significant. No
22 mitigation is required.

23 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities** 24 **Operations and Maintenance and Environmental Commitments**

25 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
26 that Alternative 4A would have a less-than-significant impact/no adverse effect on the following
27 constituents in the Delta:

- 28 • Boron
- 29 • Bromide
- 30 • Chloride
- 31 • DOC
- 32 • DO
- 33 • Pathogens
- 34 • Pesticides
- 35 • Trace metals
- 36 • Turbidity and TSS
- 37 • *Microcystis*

38 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
39 Chloride, DOC, and bromide concentrations also are of concern in drinking water supplies. However,
40 waters in the San Francisco Bay are not designated to support MUN and AGR beneficial uses.

1 Changes in Delta DO, pathogens, pesticides, trace metals, and turbidity and TSS are not anticipated
2 to be of a frequency, magnitude and geographic extent that would adversely affect any beneficial
3 uses or substantially degrade the quality of the Delta. Changes in *Microcystis* would be primarily due
4 to factors unassociated with the project alternative. Thus, changes in boron, bromide, chloride, DOC,
5 DO, pathogens, pesticides, trace metals, turbidity and TSS, and *Microcystis* in Delta outflow
6 associated with implementation of Alternative 4A, relative to Existing Conditions and the No Action
7 Alternative (ELT and LLT) are not anticipated to be of a frequency, magnitude and geographic extent
8 that would adversely affect any beneficial uses or substantially degrade the quality of the of San
9 Francisco Bay, as described for Alternative 4 (see Section 8.3.3.9).

10 Elevated EC is of concern for its effects on the AGR beneficial use and fish and wildlife beneficial
11 uses. San Francisco Bay does not have an AGR beneficial use designation. As described for
12 Alternative 4, salinity throughout San Francisco Bay is largely a function of the tides, as well as to
13 some extent the freshwater inflow from upstream. However, the changes in Delta outflow due to
14 Alternative 4A, relative to Existing Conditions and the No Action Alternative (ELT and LLT), would
15 be minor compared to tidal flows, and thus no substantial adverse effects on salinity, or fish and
16 wildlife beneficial uses, downstream of the Delta are expected.

17 Also, as described for Alternative 4, changes in nutrient loading would not be expected to contribute
18 to adverse effects to beneficial uses. Changes in nitrogen (ammonia and nitrate) loading to Suisun
19 and San Pablo Bays under Alternative 4A, relative to Existing Conditions and the No Action
20 Alternative (ELT and LLT), would not adversely impact primary productivity in these embayments
21 because light limitation and grazing currently limit algal production in these embayments. Nutrient
22 levels and ratios are not considered a direct driver of *Microcystis* and cyanobacteria levels in the
23 North Bay. The only postulated effect of changes in phosphorus loads to Suisun and San Pablo Bays
24 is related to the influence of nutrient stoichiometry on primary productivity. However, there is
25 uncertainty regarding the impact of nutrient ratios on phytoplankton community composition and
26 abundance. As described for Alternative 4, any effect on phytoplankton community composition
27 would likely be small compared to the effects of grazing from introduced clams and zooplankton in
28 the estuary. Therefore, changes in total nitrogen and phosphorus loading that would occur in Delta
29 outflow to San Francisco Bay, relative to Existing Conditions and the No Action Alternative (ELT and
30 LLT), shown in Appendix 80, *San Francisco Bay Analysis*, Table 80-1, are not expected to result in
31 degradation of water quality with regard to nutrients that would result in adverse effects to
32 beneficial uses.

33 Similar to Alternative 4, loads of mercury and methylmercury, from the Delta to San Francisco Bay
34 are estimated to change relatively little due to changes in source water fractions and net Delta
35 outflow that would occur under Alternative 4A, relative to Existing Conditions and the No Action
36 Alternative (ELT and LLT) (Appendix 80, *San Francisco Bay Analysis*, Table 80-2). Also, the
37 incremental increase in dissolved selenium concentrations in the North Bay, relative to Existing
38 Conditions, would be negligible (0.01 µg/L) under this alternative (Appendix 80, Table 80-3).

39 **NEPA Effects:** Based on the discussion above, Alternative 4A, relative to the No Action Alternative
40 (ELT and LLT), would not cause further degradation to water quality with respect to boron,
41 bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia,
42 nitrate, phosphorus), trace metals, turbidity and TSS, or *Microcystis* in the San Francisco Bay.
43 Further, changes in these constituent concentrations in Delta outflow would not be expected to
44 cause changes in Bay concentrations of frequency, magnitude, and geographic extent that would
45 adversely affect any beneficial uses. In summary, effects on the San Francisco Bay from

1 implementation of water conveyance facilities and Environmental Commitments 3, 4, 6–12, 15, and
2 16 are considered to be not adverse.

3 **CEQA Conclusion:** As with Alternative 4, Alternative 4A would not be expected to cause long-term
4 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
5 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
6 would result in substantially increased risk for adverse effects to one or more beneficial uses.
7 Further, this alternative would not be expected to cause additional exceedance of applicable water
8 quality objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent
9 that would cause significant impacts on any beneficial uses of waters in the affected environment.
10 Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay would not adversely
11 affect beneficial uses, because the uses most affected by changes in these parameters, MUN and AGR,
12 are not beneficial uses of the Bay. Further, no substantial changes in DO, pathogens, pesticides, trace
13 metals, turbidity or TSS, and *Microcystis* are anticipated in the Delta due to the implementation of
14 Alternative 4A, relative to Existing Conditions, therefore, no substantial changes to these
15 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
16 measurable changes in Bay salinity, as the change in Delta outflow would be two to three orders of
17 magnitude lower than (and thus minimal compared to) the Bay's tidal flow and thus, have minimal
18 influence on salinity changes. Changes in nutrient load, relative to Existing Conditions, are expected
19 to have minimal effect on water quality degradation, primary productivity, or phytoplankton
20 community composition. As with Alternative 4, the change in mercury and methylmercury load
21 (which is based on source water and Delta outflow), relative to Existing Conditions, would be within
22 the level of uncertainty in the mass load estimate and not expected to contribute to water quality
23 degradation, make the CWA Section 303(d) mercury impairment measurably worse or cause
24 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
25 turn, pose substantial health risks to fish, wildlife, or humans. Similarly, based on Alternative 4
26 estimates, the increase in selenium load would be minimal, and total and dissolved selenium
27 concentrations would be expected to be the same as Existing Conditions, and less than the target
28 associated with white sturgeon whole-body fish tissue levels for the North Bay. Thus, the change in
29 selenium load is not expected to contribute to water quality degradation, or make the CWA Section
30 303(d) selenium impairment measurably worse or cause selenium to bioaccumulate to greater
31 levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or
32 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
33 is required.

34 **8.3.4.3 Alternative 2D—Dual Conveyance with Modified** 35 **Pipeline/Tunnel and Intakes 1, 2, 3, 4 and 5 (15,000 cfs;** 36 **Operational Scenario B)**

37 Discussion of water quality impacts of Alternative 2D was first provided in the RDEIR/SDEIS. The
38 water quality assessments in the RDEIR/SDEIS for boron, bromide, chloride, DOC, EC, mercury,
39 nitrate, and selenium in the Delta and SWP/CVP Export Services Areas utilized results from water
40 quality modeling performed for Alternative 2A in the ELT, which included Yolo Bypass
41 improvements, 25,000 acres of tidal habitat restoration, and the EC compliance location at Emmaton
42 relocated to Threemile Slough. The analysis of effects of Alternative 2D, presented herein, on boron,
43 bromide, chloride, DOC, EC, mercury, nitrate, and selenium in the Delta and SWP/CVP Export Service
44 Areas is based on revised modeling, which assumed implementation of Yolo Bypass improvements,
45 the EC compliance location remaining at Emmaton, and no tidal habitat restoration. Because the

1 modeling of Alternative 2D and the No Action Alternative (ELT) included Yolo Bypass
 2 Improvements, but no tidal habitat restoration, comparison of modeling results for Alternative 2D to
 3 No Action Alternative (ELT) results in the impact discussions below allows for isolating and
 4 identifying effects solely due to implementation of Alternative 2D in the ELT.

5 As described in Chapter 3, *Description of Alternatives*, actions associated with Alternative 4 that are
 6 not proposed to be implemented under Alternative 2D would continue to be pursued as part of
 7 existing, but separate, projects and programs associated with the 2008 USFWS and 2009 NMFS
 8 BiOps, California EcoRestore, and the 2014 California Water Action Plan. Due to the reduced suite of
 9 Environmental Commitments in Alternative 2D compared to Alternative 4 (in particular,
 10 significantly less tidal habitat restoration), the impacts to water quality due to Alternative 2D are
 11 substantially less compared to Alternative 4, particularly in the Delta.

12 The water quality impact conclusions for Alternative 2D remain the same as those presented in the
 13 RDEIR/SDEIS. The revisions to the assessment are in the presentation of modeled changes in
 14 concentrations, water quality criteria/objective exceedances, and use of assimilative capacity, and
 15 refinements to mitigation measures for EC.

16 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 17 **Maintenance**

18 ***Upstream of the Delta***

19 As described for Alternative 4 (see Section 8.3.3.9), substantial point and non-point sources of
 20 ammonia-N do not exist upstream of the SRWTP at Freeport in the Sacramento River watershed, in
 21 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
 22 upstream of the Delta in the San Joaquin River watershed. Thus, like Alternative 4, operation of the
 23 water conveyance facilities under Alternative 2D would have negligible, if any, effect on ammonia
 24 concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and
 25 the No Action Alternative (ELT and LLT). Any negligible increases in ammonia-N concentrations that
 26 could occur in the water bodies of the affected environment located upstream of the Delta would not
 27 be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
 28 substantially degrade the quality of these water bodies, with regard to ammonia.

29 ***Delta***

30 As described for Alternative 4 (see Section 8.3.3.9), a substantial decrease in Sacramento River
 31 ammonia concentrations is expected under Alternative 2D relative to Existing Conditions, due to
 32 planned lowering of ammonia in the SRWTP effluent discharge, and this is expected to decrease
 33 ammonia concentrations for all areas of the Delta that are influenced by Sacramento River water.
 34 Concentrations of ammonia at locations not influenced notably by Sacramento River water would
 35 change little relative to Existing Conditions, due to the similarity in San Joaquin River and San
 36 Francisco Bay concentrations and the lack of expected changes in either of these concentrations.
 37 Thus, Alternative 2D would not result in substantial increases in ammonia concentrations in the
 38 Plan Area, relative to Existing Conditions.

39 Relative to the No Action Alternative (ELT and LLT), the primary mechanism that could potentially
 40 alter ammonia concentrations under Alternative 2D is decreased flows in the Sacramento River,
 41 which would lower dilution available to the SRWTP discharge. This flow change would be
 42 attributable only to operations of the water conveyance facilities, since the same assumptions

1 regarding SRWTP discharge ammonia concentrations, water demands, climate change, and sea level
 2 rise apply to both Alternative 2D and the No Action Alternative (ELT and LLT). A simple mass
 3 balance calculation was performed to calculate ammonia concentrations downstream of the SRWTP
 4 discharge (i.e., downstream of Freeport) under Alternative 2D and the No Action Alternative (ELT)
 5 to assess the effects of the flow changes. Monthly average CALSIM II flows at Freeport and the
 6 upstream ammonia concentration (0.04 mg/L-N; Central Valley Water Board 2010a:5) were used,
 7 together with the SRWTP permitted average dry weather flow (181 mgd) and seasonal ammonia
 8 limitations (1.5 mg/L-N in Apr–Oct, 2.4 mg/L-N in Nov–Mar), to estimate the average change in
 9 ammonia concentrations downstream of the SRWTP. Table 8-74 shows monthly average and long-
 10 term annual average predicted concentrations under Alternative 2D. As Table 8-74 shows, average
 11 monthly ammonia concentrations in the Sacramento River downstream of Freeport (upon full
 12 mixing of the SRWTP discharge with river water) under Alternative 2D and the No Action
 13 Alternative (ELT) are expected to be similar. In comparison to the No Action Alternative (ELT),
 14 minor increases in monthly average ammonia concentrations would occur during July through
 15 September, and November under Alternative 2D. Minor decreases in ammonia concentrations are
 16 expected for Alternative 2D in January through June, and October and December. The annual
 17 average concentration under Alternative 2D would be the same as that under the No Action
 18 Alternative (ELT). Relative to the No Action Alternative (LLT), Alternative 2D (LLT) is expected to
 19 result in similar minor increases in Sacramento River ammonia concentration, because the
 20 increased water demands, climate change, and sea level rise in the LLT would occur under both
 21 alternatives, and neither would affect ammonia sources or loading. The estimated concentrations in
 22 the Sacramento River downstream of Freeport under Alternative 2D would be similar to existing
 23 source water concentrations for the San Francisco Bay and San Joaquin River. Consequently,
 24 changes in source water fraction anticipated under Alternative 2D, relative to the No Action
 25 Alternative (ELT and LLT), are not expected to substantially increase ammonia concentrations at
 26 any Delta locations.

27 Ammonia concentrations downstream of Freeport in the Sacramento River under Alternative 2D
 28 would be similar to those under Alternative 4 (see Table 8-67 in Section 8.3.3.9). As stated for
 29 Alternative 4, any negligible increases in ammonia concentrations that could occur at certain
 30 locations in the Delta under Alternative 2D would not be of frequency, magnitude, and geographic
 31 extent that would adversely affect any beneficial uses or substantially degrade the water quality at
 32 these locations, with regard to ammonia.

33 **Table 8-74. Estimated Ammonia (mg/L as N) Concentrations in the Sacramento River Downstream of**
 34 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative Early Long-Term**
 35 **(ELT) and Alternative 2D**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative (ELT)	0.076	0.082	0.069	0.062	0.059	0.062	0.059	0.062	0.067	0.060	0.067	0.064	0.066
Alternative 2D ELT	0.075	0.086	0.068	0.061	0.058	0.061	0.058	0.061	0.062	0.062	0.070	0.067	0.066

36

1 **SWP CVP Export Service Areas**

2 As discussed above, for areas of the Delta that are influenced by Sacramento River water, including
3 Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease under
4 Alternative 2D, relative to Existing Conditions (in association with less diversion of water influenced
5 by the SRWTP). Like Alternative 4, this decrease in ammonia-N concentrations for water exported
6 via the south Delta pumps is not expected to result in an adverse effect on beneficial uses or
7 substantially degrade water quality of exported water, with regard to ammonia. Furthermore, as
8 discussed above, for all areas of the Delta, including Banks and Jones pumping plants, ammonia
9 concentrations are not expected to be substantially different under Alternative 2D (ELT) relative to
10 the No Action Alternative (ELT), and Alternative 2D (LLT) relative to the No Action Alternative
11 (LLT). Thus, any negligible increases in ammonia concentrations that could occur at Banks and Jones
12 pumping plants would not be of frequency, magnitude and geographic extent that would adversely
13 affect any beneficial uses or substantially degrade water quality at these locations, with regard to
14 ammonia.

15 **NEPA Effects:** In summary, ammonia concentrations in water bodies upstream of the Delta, in the
16 Plan Area, and the waters exported to the SWP/CVP Export Service Areas are not expected to be
17 substantially different under Alternative 2D relative to the No Action Alternative (ELT and LLT).
18 Thus, effects of the water conveyance facilities on ammonia are considered to be not adverse.

19 **CEQA Conclusion:** The magnitude and direction of changes in ammonia concentrations in water
20 bodies upstream of the Delta, in the Plan Area, or the waters exported to the SWP/CVP Export
21 Service Areas would be approximately the same as expected under Alternative 4, relative to Existing
22 Conditions. There would be no substantial, long-term increase in ammonia concentrations in the
23 rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the CVP and
24 SWP service areas under Alternative 2D relative to Existing Conditions. As such, Alternative 2D is
25 not expected to cause additional exceedance of applicable water quality objectives/criteria by
26 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
27 of waters in the affected environment. Because ammonia concentrations are not expected to
28 increase substantially, no long-term water quality degradation is expected to occur and, thus, no
29 adverse effects on beneficial uses would occur. Ammonia is not CWA Section 303(d) listed within
30 the affected environment and thus any minor increases that could occur in some areas would not
31 make any existing ammonia-related impairment measurably worse because no such impairments
32 currently exist. Because ammonia is not bioaccumulative, minor increases that could occur in some
33 areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose
34 substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
35 considered to be less than significant. No mitigation is required.

36 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of** 37 **Environmental Commitments 3, 4, 6–12, 15, and 16**

38 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
39 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
40 increased biota in those areas as a result of restored habitat may increase ammonia loading
41 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
42 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be
43 expected to substantially increase ammonia concentrations in the Delta. Implementation of
44 Environmental Commitments 12, 15, and 16 do not include actions that would affect ammonia

1 sources or loading. Based on these findings, the effects on ammonia from the implementation
 2 Environmental Commitments 3, 4, 6–12, 15, and 16 under Alternative 2D are determined to not be
 3 adverse.

4 **CEQA Conclusion:** Land use changes that would occur from the Environmental Commitments are
 5 not expected to contribute substantially increase ammonia concentrations, because the amount of
 6 area to be converted would be small relative to existing habitat, and any resulting ammonia would
 7 likely be rapidly converted to nitrate. Thus, there would be no substantial, long-term increase in
 8 ammonia concentrations in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the
 9 waters exported to the SWP/CVP Export Service Areas due to implementation of Environmental
 10 Commitments 3, 4, 6–12, 15, and 16 relative to Existing Conditions. As such, implementation of these
 11 Environmental Commitments would not be expected to cause additional exceedance of applicable
 12 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 13 significant impacts on any beneficial uses of waters in the affected environment. Because ammonia
 14 concentrations would not be expected to increase substantially from implementation of these
 15 Environmental Commitments, no long-term water quality degradation would be expected to occur
 16 and, thus, no significant impact on beneficial uses would occur. Ammonia is not CWA Section 303(d)
 17 listed within the affected environment and thus any minor increases that could occur in some areas
 18 would not make any existing ammonia-related impairment measurably worse because no such
 19 impairments currently exist. Because ammonia is not bioaccumulative, minor increases that could
 20 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
 21 turn, pose substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
 22 considered less than significant. No mitigation is required.

23 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 24 **Maintenance**

25 ***Upstream of the Delta***

26 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 2D there would be no
 27 expected change to the sources of boron in the Sacramento River and eastside tributary watersheds
 28 and, thus, resultant changes in flows from altered system-wide operations would have negligible, if
 29 any, effects on the concentration of boron in the rivers and reservoirs of these watersheds. The
 30 modeled annual average lower San Joaquin River flow at Vernalis would decrease by 1%, relative to
 31 Existing Conditions (in association with the different operational components of Alternative 2D in
 32 the ELT, climate change, and increased water demands) (Appendix 8F, *Boron*, Table Bo-32). The
 33 reduced flow relative to Existing Conditions would result in possible increases in long-term average
 34 boron concentrations of up to about 0.5% relative to the Existing Conditions. Flows would remain
 35 virtually the same as the No Action Alternative (ELT), and thus flow changes would not result in
 36 substantial boron increases relative to the No Action Alternative (ELT). The increased boron
 37 concentrations, relative to Existing Conditions, under Alternative 2D in the ELT would not increase
 38 the frequency of exceedances of any applicable objectives or criteria and would not be expected to
 39 cause further degradation at measurable levels in the lower San Joaquin River, and thus would not
 40 cause the existing impairment there to be discernibly worse. Consequently, Alternative 2D in the
 41 ELT would not be expected to cause exceedance of boron objectives/criteria or substantially
 42 degrade water quality with respect to boron, and thus would not adversely affect any beneficial uses
 43 of the Sacramento River, the eastside tributaries, associated reservoirs upstream of the Delta, or the
 44 San Joaquin River.

1 Effects of Alternative 2D in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
 2 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
 3 change and sea level rise that would occur in the LLT would not affect boron sources in these areas.

4 **Delta**

5 Effects of water conveyance facilities on boron under Alternative 2D in the Delta would be similar to
 6 the effects discussed for Alternative 4.

7 The effects of Alternative 2D relative to Existing Conditions and the No Action Alternative (ELT) are
 8 discussed together because the direction and magnitude of predicted change are similar. Relative to
 9 the Existing Conditions and No Action Alternative (ELT), Alternative 2D would result in increased
 10 long-term average boron concentrations for the 16-year period modeled at most of the interior
 11 Delta locations (increases up to 3% at the S. Fork Mokelumne River at Staten Island, 10% at Franks
 12 Tract, and 13% at Old River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-28). The long-term
 13 average boron concentrations at most of the western Delta assessment locations would not change
 14 measurably. The long-term annual average and monthly average boron concentrations, for either
 15 the 16-year period or drought period modeled, would never exceed the 2,000 µg/L human health
 16 advisory objective (i.e., for children) or the 500 µg/L agricultural objective at the majority of
 17 assessment locations, which represents no change from the Existing Conditions and No Action
 18 Alternative (ELT) (Appendix 8F, *Boron*, Table Bo-3C). A small increase in the frequency of
 19 exceedances 500 µg/L agricultural objective at the Sacramento River at Mallard Island (i.e., as much
 20 as 3% in the drought period relative to the No Action Alternative [ELT]) would not be anticipated to
 21 substantially affect agricultural diversions which occur primarily at interior Delta locations. Minor
 22 reductions in long-term average assimilative capacity of up to 8% at interior Delta locations (i.e., Old
 23 River at Rock Slough) would occur with respect to the 500 µg/L agricultural objective (Appendix 8F,
 24 *Boron*, Table Bo-29). However, because the absolute boron concentrations would still be well below
 25 the lowest 500 µg/L objective for the protection of the agricultural beneficial use under Alternative
 26 2D, the levels of boron degradation would not be of sufficient magnitude to substantially increase
 27 the risk of exceeding objectives or cause adverse effects to municipal and agricultural water supply
 28 beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, *Boron*, Figure Bo-6).

29 Effects of Alternative 2D in the Delta in the LLT, relative to Existing Conditions and the No Action
 30 Alternative (LLT), would be expected to be similar to those described above for the ELT. Boron
 31 concentrations may be higher at western Delta locations due to greater effects of climate change on
 32 sea level rise that would occur in the LLT; however, these effects are independent of the alternative.
 33 Further, boron is of concern in waters diverted for agricultural use, which primarily occurs in the
 34 interior Delta, and based on Delta source water characteristics (see Table 8-42 in Section 8.3.1.7,
 35 *Construction-Specific Considerations Used in the Assessment*), boron concentrations in the interior
 36 Delta would be expected to remain suitable for agricultural use.

37 **SWP/CVP Export Service Areas**

38 Under the Alternative 2D, long-term average boron concentrations would decrease at the Banks
 39 pumping plant (24%) and at Jones pumping plant (28%) relative to Existing Conditions, and the
 40 reductions would be similar compared to No Action Alternative (ELT) (Appendix 8F, *Boron*, Table
 41 Bo-28) as a result of export of a greater proportion of low-boron Sacramento River water.
 42 Commensurate with the decrease in exported boron concentrations, boron concentrations in the
 43 lower San Joaquin River may be reduced and would likely alleviate or lessen any expected increase
 44 in boron concentrations at Vernalis associated with flow reductions (see discussion of Upstream of

1 the Delta), as well as locations in the Delta receiving a large fraction of San Joaquin River water.
2 Reduced export boron concentrations also may contribute to reducing the existing CWA Section
3 303(d) impairment in the lower San Joaquin River and associated TMDL actions for reducing boron
4 loading. These same effects on boron at the Banks and Jones pumping plants would be expected in
5 the LLT, because the primary effect of climate change on sea level rise and boron concentrations is
6 expected in the western Delta.

7 Maintenance of SWP and CVP facilities under Alternative 2D would not be expected to create new
8 sources of boron or contribute towards a substantial change in existing sources of boron in the
9 affected environment.

10 **NEPA Effects:** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 2D
11 would result in relatively small increases in long-term average boron concentrations in the Delta,
12 not measurably increase boron levels in the lower San Joaquin River, and reduce boron levels in
13 water exported to the SWP/CVP export service areas. However, the predicted changes would not be
14 expected to cause exceedances of applicable objectives or further measurable water quality
15 degradation, and thus would not constitute an adverse effect on water quality.

16 **CEQA Conclusion:** Based on the above assessment, any modified reservoir operations and
17 subsequent changes in river flows under Alternative 2D, relative to Existing Conditions, would not
18 be expected to result in a substantial adverse change in boron levels upstream of the Delta. Small
19 increases in boron levels predicted for interior Delta locations in response to a shift in the Delta
20 source water percentages would not be expected to cause exceedances of objectives, or substantial
21 degradation of these water bodies. Alternative 2D maintenance also would not result in any
22 substantial increases in boron concentrations in the affected environment. Boron concentrations
23 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
24 reflecting a potential improvement to boron loading in the lower San Joaquin River.

25 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 2D
26 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
27 Existing Conditions, Alternative 2D would not result in substantially increased boron concentrations
28 such that frequency of exceedances of municipal and agricultural water supply objectives would
29 increase. The levels of boron degradation that may occur under Alternative 2D would not be of
30 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
31 agricultural beneficial uses within the affected environment. Long-term average boron
32 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may
33 contribute to reducing the existing CWA Section 303(d) impairment of agricultural beneficial uses in
34 the lower San Joaquin River. Based on these findings, this impact is determined to be less than
35 significant. No mitigation is required.

36 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of** 37 **Environmental Commitments 3, 4, 6–12, 15, and 16**

38 Effects on boron from implementation of Environmental Commitments under Alternative 2D would
39 be the same as those described for Alternative 4A.

40 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
41 Alternative 2D present no new direct sources of boron to the affected environment, including areas
42 upstream of the Delta, within the Delta region, and in the SWP/CVP Export Service Areas. Habitat
43 restoration activities in the Delta, while involving increased land and water interaction within these

1 habitats, would not be anticipated to contribute boron which is primarily associated with source
 2 water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and Bay source water).
 3 Moreover, some habitat restoration would occur on lands within the Delta currently used for
 4 irrigated agriculture, thus replacing agricultural land uses with restored habitats. The potential
 5 reduction in irrigated lands within the Delta may result in reduced discharges of agricultural field
 6 drainage with elevated boron concentrations, which would be considered an improvement
 7 compared to the No Action Alternative (ELT and LLT). Consequently, as they pertain to boron,
 8 implementation of the Environmental Commitments would not be expected to adversely affect any
 9 of the beneficial uses of the affected environment.

10 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
 11 Alternative 2D would not present new or substantially changed sources of boron to the affected
 12 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas. As such,
 13 their implementation would not be expected to substantially increase the frequency with which
 14 applicable Basin Plan objectives or other criteria would be exceeded in water bodies of the affected
 15 environment located upstream of the Delta, within the Delta, or in the SWP/CVP Export Service
 16 Areas or substantially degrade the quality of these water bodies, with regard to boron. Based on
 17 these findings, this impact is considered to be less than significant. No mitigation is required.

18 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and** 19 **Maintenance**

20 ***Upstream of the Delta***

21 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 2D in the ELT there would be
 22 no expected change to the sources of bromide in the Sacramento River and eastside tributary
 23 watersheds. Thus, changes in the magnitude and timing of reservoir releases north and east of the
 24 Delta would have negligible, if any, effect on the sources, and ultimately the concentration of
 25 bromide in the Sacramento River, the eastside tributaries, and the various reservoirs of the related
 26 watersheds. The modeled annual average lower San Joaquin River flow at Vernalis would decrease
 27 slightly (1%) compared to Existing Conditions and would remain virtually the same as the No Action
 28 Alternative (ELT), and thus flow changes would not result in substantial bromide increases
 29 (Appendix 8E, *Bromide*, Table 24). Moreover, there are no existing municipal intakes on the lower
 30 San Joaquin River, which is the beneficial use most sensitive to elevated bromide concentrations.
 31 Consequently, Alternative 2D in the ELT would not be expected to adversely affect the MUN
 32 beneficial use, or any other beneficial uses, of the Sacramento River, the San Joaquin River, the
 33 eastside tributaries, or their associated reservoirs upstream of the Delta due to changes in bromide
 34 concentrations.

35 Effects of Alternative 2D in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
 36 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
 37 change and sea level rise that would occur in the LLT would not affect bromide sources in these
 38 areas.

39 ***Delta***

40 Estimates of bromide concentrations at Delta assessment locations were generated using a mass
 41 balance approach, and using relationships between EC and chloride and between chloride and
 42 bromide and DSM2 EC output. See Section 8.3.1.3, *Plan Area*, for more information regarding these

1 modeling approaches. The assessment below identifies changes in bromide at Delta assessment
2 locations based on both approaches.

3 Based on the mass balance modeling approach for bromide, relative to Existing Conditions,
4 Alternative 2D long-term average bromide concentrations would increase in the S. Fork Mokelumne
5 River at Staten Island, and decrease at all other assessment locations (Appendix 8E, *Bromide*, Table
6 22). Average bromide concentrations at Staten Island would increase from 50 µg/L under Existing
7 Conditions to 55 µg/L (10% increase) for the modeled 16-year hydrologic period (1976–1991).
8 However, multiple interior and western Delta assessment locations would have an increased
9 frequency of exceedance of 50 µg/L, which is the CALFED Drinking Water Program goal for bromide
10 as a long-term average applied to drinking water intakes (Appendix 8E, Table 22). These locations
11 are the S. Fork Mokelumne River at Staten Island, Franks Tract, Old River at Rock Slough,
12 Sacramento River at Emmaton, San Joaquin River at Antioch, and Sacramento River at Mallard
13 Island. The greatest increase in frequency of exceedance of the CALFED Drinking Water Program
14 long-term goal of 50 µg/L would occur in the S. Fork Mokelumne River (12% increase) and
15 Sacramento River at Emmaton (5% increase). The increase in frequency of exceedance of the 50
16 µg/L threshold at the other locations would be 2% or less. Similarly, these locations and North Bay
17 Aqueduct at Barker Slough would have an increased frequency of exceedance of 100 µg/L, which is
18 the concentration believed to be sufficient to meet currently established drinking water criteria for
19 disinfection byproducts (Appendix 8E, Table 22). The greatest increase in frequency of exceedance
20 of 100 µg/L would occur at Franks Tract (6% increase). The increase in frequency of exceedance of
21 the 100 µg/L threshold at the other locations would be 5% or less.

22 Changes in long-term average bromide concentrations and changes in threshold exceedance
23 frequencies relative to the No Action Alternative (ELT) are generally of similar magnitude to those
24 previously described relative to Existing Conditions (Appendix 8E, *Bromide*, Table 22). However,
25 unlike the Existing Conditions comparison, relative to the No Action Alternative (ELT), long-term
26 average bromide concentrations in the San Joaquin River at Buckley Cove and the North Bay
27 Aqueduct at Barker Slough would increase under Alternative 2D, although the increases would be
28 relatively small (<2%). Further, at the North Bay Aqueduct, the frequency of exceedance of the 50
29 µg/L would increase from 35% to 40% and the frequency of exceedance of the 100 µg/L threshold
30 would increase from 0% to 1%. Also, there would not be an increased exceedance of the 100 µg/L
31 threshold at Emmaton and Rock Slough.

32 Results of the modeling approach which used relationships between EC and chloride and between
33 chloride and bromide were consistent with the discussion above, and assessment of bromide using
34 these modeling results lead to the same conclusions as are presented above for the mass balance
35 approach (Appendix 8E, *Bromide*, Table 23).

36 The magnitude of bromide concentration increases at Mallard Slough and in the San Joaquin River at
37 Antioch during their historical months of use, relative to Existing Conditions and the No Action
38 Alternative (ELT), would be generally similar to or less than those described for Alternative 4
39 (Appendix 8E, *Bromide*, Table 25), and the frequency of exceedance of bromide thresholds would be
40 similar (Appendix 8E, Table 22). As described for Alternative 4, the use of seasonal intakes at these
41 locations is largely driven by acceptable water quality, and thus has historically been opportunistic.
42 Opportunity to use these intakes would remain, and the predicted increases in bromide
43 concentrations at Antioch and Mallard Slough would not be expected to adversely affect MUN
44 beneficial uses, or any other beneficial use, at these locations.

1 The effects of Alternative 2D in the LLT in the Delta region, relative to Existing Conditions and the
 2 No Action Alternative (LLT), would be expected to be similar to that described above. There may be
 3 higher bromide concentrations in the LLT in the western Delta, but this would be associated with
 4 sea level rise, not the project alternative, because the primary source of bromide to the Delta is sea
 5 water intrusion.

6 ***SWP/CVP Export Service Areas***

7 Under Alternative 2D, long-term average bromide concentrations at the Banks and Jones pumping
 8 plants, based on the mass balance modeling approach, would decrease. Long-term average bromide
 9 concentrations for the modeled 16-year hydrologic period at the pumping plants would decrease by
 10 as much as 50% relative to Existing Conditions and 47% relative to the No Action Alternative (ELT)
 11 (Appendix 8E, *Bromide*, Table 22). As a result, less frequent exceedances of the 50 µg/L and 100
 12 µg/L assessment thresholds would occur and an overall improvement in SWP/CVP Export Service
 13 Areas water quality would occur respective to bromide. Commensurate with the decrease in
 14 exported bromide, an improvement in lower San Joaquin River bromide would also occur since
 15 bromide in the lower San Joaquin River is principally related to irrigation water deliveries from the
 16 Delta. Results of the modeling approach which used relationships between EC and chloride and
 17 between chloride and bromide are consistent with the mass balance results, and assessment of
 18 bromide using these modeling results leads to the same conclusions (Appendix 8E, Table 23).

19 The effects of Alternative 2D in the LLT in the SWP/CVP Export Service Areas, relative to Existing
 20 Conditions and the No Action Alternative (LLT), would be expected to be similar to that described
 21 above, because the sea level rise that could occur in the LLT would not be expected to result in
 22 substantial bromide contributions to the water exported at Banks and Jones pumping plants.

23 Maintenance of SWP and CVP facilities under Alternative 2D would not be expected to create new
 24 sources of bromide or contribute towards a substantial change in existing sources of bromide in the
 25 affected environment. Maintenance activities would not be expected to cause any substantial change
 26 in bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected
 27 anywhere in the affected environment.

28 ***NEPA Effects:*** In summary, the operations and maintenance activities under Alternative 2D, relative
 29 to the No Action Alternative (ELT and LLT) would result in an increased frequency of exceedance of
 30 the CALFED Drinking Water Program long-term bromide goal of 50 µg/L at the S. Fork Mokelumne
 31 River at Staten Island, Franks Tract, Sacramento River at Emmaton, San Joaquin River at Antioch,
 32 Sacramento River at Mallard Island, and North Bay Aqueduct at Barker Slough. The frequency of
 33 exceedance of the 100 µg/L threshold for protection against the formation of disinfection
 34 byproducts in treated drinking water would increase by 4% at Franks Tract, 3% at Antioch, and 1%
 35 at Staten Island, Mallard Island, and Barker Slough. However, long-term average bromide
 36 concentrations would increase only in the S. Fork Mokelumne River at Staten Island, San Joaquin
 37 River at Buckley Cove, and North Bay Aqueduct at Barker Slough; long-term average bromide
 38 concentrations at the other assessment locations will be the same or decrease. The long-term
 39 bromide concentration in the S. Fork Mokelumne River at Staten Island would be less than the
 40 concentration believed to be sufficient to meet currently established drinking water criteria for
 41 disinfection byproducts, and the increase in the San Joaquin River at Buckley Cove and North Bay
 42 Aqueduct at Barker Slough would be minimal (<2%). Thus, these increased bromide concentrations
 43 are not expected to result in adverse effects to MUN beneficial uses, or any other beneficial use, at
 44 these locations. Based on these findings, this effect is determined to not be adverse.

1 **CEQA Conclusion:** While greater water demands under Alternative 2D would alter the magnitude
 2 and timing of reservoir releases north and east of the Delta, these activities would have negligible, if
 3 any, effect on the sources of bromide, and ultimately the concentration of bromide in the
 4 Sacramento River, the San Joaquin River, the eastside tributaries, and the various reservoirs of the
 5 related watersheds, as described for Alternative 4 (see Section 8.3.3.9).

6 Under Alternative 2D there would be an increased frequency of exceedance of the 50 µg/L and 100
 7 µg/L bromide thresholds for protecting against the formation of disinfection byproducts in treated
 8 drinking water at the S. Fork Mokelumne River at Staten Island, Franks Tract, Old River at Rock
 9 Slough, Sacramento River at Emmaton, San Joaquin River at Antioch, and Sacramento River at
 10 Mallard Island. The North Bay Aqueduct at Barker Slough also would have an increased exceedance
 11 of the 100 µg/L threshold (from 0% to 1%). However, long-term average bromide concentrations
 12 would increase only in the S. Fork Mokelumne River at Staten Island and decrease at all other
 13 assessment locations. The long-term bromide concentration in the S. Fork Mokelumne River at
 14 Staten Island (55 µg/L) would be less than the 100 µg/L believed to be sufficient to meet currently
 15 established drinking water criteria for disinfection byproducts. Further, as described for Alternative
 16 4 (see Section 8.3.3.9), the use of seasonal intakes at Antioch and Mallard Island is largely driven by
 17 acceptable water quality, and thus has historically been opportunistic and opportunity to use these
 18 intakes would remain. Thus, these increased bromide concentrations would not be expected to
 19 adversely affect MUN beneficial uses, or any other beneficial use, at these locations.

20 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
 21 of changes in bromide concentrations at Banks and Jones pumping plants. Long-term average
 22 bromide concentrations at the Banks and Jones pumping plants are predicted to decrease by as
 23 much as 50% relative to Existing Conditions and there would be less frequent exceedance of
 24 bromide concentration thresholds.

25 Based on the above, Alternative 2D would not cause exceedance of applicable state or federal
 26 numeric or narrative water quality objectives/criteria because none exist for bromide. Alternative
 27 2D would not result in any substantial change in long-term average bromide concentration or
 28 exceed 50 and 100 µg/L assessment threshold concentrations by frequency, magnitude, and
 29 geographic extent that would result in adverse effects on any beneficial uses within affected water
 30 bodies. Bromide is not a bioaccumulative constituent and thus concentrations under this alternative
 31 would not result in bromide bioaccumulating in aquatic organisms. Increases in exceedances of the
 32 100 µg/L assessment threshold concentration would be 6% or less at all locations assessed, which is
 33 considered to be less than substantial long-term degradation of water quality. The levels of bromide
 34 degradation that may occur under the Alternative 2D would not be of sufficient magnitude to cause
 35 substantially increased risk for adverse effects on any beneficial uses of water bodies within the
 36 affected environment. Bromide is not CWA Section 303(d) listed and thus the minor increases in
 37 long-term average bromide concentrations would not affect existing beneficial use impairment
 38 because no such use impairment currently exists for bromide. Based on these findings, this impact is
 39 less than significant. No mitigation is required.

40 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of** 41 **Environmental Commitments 3, 4, 6–12, 15, and 16**

42 **NEPA Effects:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would present
 43 no new sources of bromide to the affected environment, including areas Upstream of the Delta,
 44 within the Plan Area, and the SWP/CVP Export Service Areas. Some habitat restoration activities

1 would occur on lands in the Delta formerly used for irrigated agriculture. Such replacement or
 2 substitution of land use activity would not be expected to result in new or increased sources of
 3 bromide to the Delta. Therefore, as they pertain to bromide, implementation of these Environmental
 4 Commitments would not be expected to adversely affect MUN beneficial use, or any other beneficial
 5 uses, of the affected environment.

6 Environmental Commitment 4 would result in some tidal habitat restoration, however, the areal
 7 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
 8 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
 9 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
 10 bromide concentration changes.

11 In summary, implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 12 Alternative 2D relative to the No Action Alternative (ELT and LLT), would have negligible, if any,
 13 effects on bromide concentrations. Therefore, the effects on bromide from implementing
 14 Environmental Commitments 3, 4, 6–12, 15, and 16 are determined to not be adverse.

15 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 16 Alternative 2D would not present new or substantially changed sources of bromide to the affected
 17 environment. Some Environmental Commitments may replace or substitute for existing irrigated
 18 agriculture in the Delta. This replacement or substitution would not be expected to substantially
 19 increase or present new sources of bromide. Thus, implementation of Environmental Commitments
 20 3, 4, 6–12, 15, and 16 would have negligible, if any, effects on bromide concentrations throughout
 21 the affected environment, would not cause exceedance of applicable state or federal numeric or
 22 narrative water quality objectives/criteria because none exist for bromide, and would not cause
 23 changes in bromide concentrations that would result in significant impacts on any beneficial uses
 24 within affected water bodies. Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16
 25 would not cause significant long-term water quality degradation such that there would be greater
 26 risk of significant impacts on beneficial uses, would not cause greater bioaccumulation of bromide,
 27 and would not further impair any beneficial uses due to bromide concentrations because no uses are
 28 currently impaired due to bromide levels. Based on these findings, this impact is considered less
 29 than significant. No mitigation is required.

30 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and** 31 **Maintenance**

32 ***Upstream of the Delta***

33 The effects of Alternative 2D on chloride concentrations in reservoirs and rivers upstream of the
 34 Delta would be the similar to those effects described for Alternative 4 (see Section 8.3.3.9). Chloride
 35 loading in these watersheds would remain unchanged and resultant changes in flows from altered
 36 system-wide operations would have negligible, if any, effects on the concentration of chloride in the
 37 rivers and reservoirs of these watersheds. There would be no expected change to the sources of
 38 chloride in the Sacramento River and eastside tributary watersheds, and changes in the magnitude
 39 and timing of reservoir releases north and east of the Delta would have negligible, if any, effect on
 40 the sources, and ultimately the concentration of chloride in the Sacramento River, the eastside
 41 tributaries, and the various reservoirs of the related watersheds. The modeled annual average lower
 42 San Joaquin River flow at Vernalis would decrease slightly (1%) compared to Existing Conditions
 43 and would remain virtually the same as the No Action Alternative (ELT), and thus flow changes

1 would not result in substantial chloride increases. Moreover, there are no existing municipal intakes
2 on the lower San Joaquin River. Consequently, Alternative 2D in the ELT would not be expected to
3 cause exceedances of chloride objectives/criteria or substantially degrade water quality with
4 respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River,
5 the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

6 Effects of Alternative 2D in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
7 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
8 change and sea level rise that would occur in the LLT would not affect chloride sources in these
9 areas.

10 ***Delta***

11 Estimates of chloride concentrations at Delta assessment locations were generated using a mass
12 balance approach and EC-chloride relationships and DSM2 EC output. See Section 8.3.1.3, *Plan Area*,
13 for more information regarding these modeling approaches. The assessment below identifies
14 changes in chloride at Delta assessment locations based on both approaches.

15 Modeling of chloride using both the mass balance approach and EC-chloride relationship predicts
16 that Alternative 2D in the ELT would result in reduced long-term average chloride concentrations,
17 relative to Existing Conditions, for the 16-year period modeled at all assessment locations except for
18 the S. Fork Mokelumne River at Staten Island. The increase in long-term average chloride
19 concentration at Staten Island would be 1 mg/L (9%) based on the mass balance modeling and 1
20 mg/L (3%) based on the EC-chloride relationship (Appendix 8G, *Chloride*, Tables Cl-73 and Cl-74).
21 These increases are extremely small in absolute terms and relative to applicable water quality
22 objectives, and are within the estimated modeling uncertainty. The results differ from Alternative 4,
23 under which there would be increased long-term average chloride concentrations also at the North
24 Bay Aqueduct at Barker Slough. The change in long-term average chloride concentrations relative to
25 the No Action Alternative (ELT) would be similar to those relative to Existing Conditions.

26 The following outlines the modeled chloride changes relative to the applicable objectives and
27 beneficial uses of Delta waters.

28 *Municipal Beneficial Uses Relative to Existing Conditions*

29 Estimates of chloride concentrations generated using EC-chloride relationships were used to
30 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses on a
31 basis of the percentage of years the chloride objective is exceeded for the modeled 16-year period.
32 The objective is exceeded if chloride concentrations exceed 150 mg/L for a specified number of days
33 in a given water year at Antioch and Contra Costa Pumping Plant #1. The modeled frequency of
34 objective exceedance would decrease at the Contra Costa Pumping Plant #1 from 7% of years under
35 Existing Conditions to 0% of years under Alternative 2D in the ELT (Appendix 8G, *Chloride*, Table Cl-
36 64).

37 Evaluation of the 250 mg/L Bay-Delta WQCP objective for chloride utilized results from both the
38 mass balance approach and EC-chloride relationship. The basis for the evaluation was the predicted
39 number of days the objective would be exceeded for the modeled 16-year period.

40 Based on the mass balance approach, there would be a decreased frequency of exceedance of the
41 250 mg/L objective under Alternative 2D, relative to Existing Conditions, at all locations except in
42 the Sacramento River at Mallard Island and the San Joaquin River at Antioch. In the Sacramento

1 River at Mallard Island, the frequency of objective exceedance would increase from 85% under
2 Existing Conditions to 86% under Alternative 2D for the entire period modeled (Appendix 8G,
3 *Chloride*, Table CI-81). In the San Joaquin River at Antioch, there would be an increase in chloride
4 objective exceedance during the drought period modeled, from 82% to 83%. These changes are
5 within the uncertainty of the modeling approach.

6 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
7 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
8 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
9 basis for the evaluation was the predicted number of days the objective was exceeded for the
10 modeled 16-year period. For Alternative 2D, the modeled frequency of objective exceedance would
11 decrease, from 6% of modeled days under Existing Conditions, to 2% of modeled days under
12 Alternative 2D (Appendix 8G, *Chloride*, Table CI-63).

13 The mass balance results also indicate reduced assimilative capacity with respect to the 250 mg/L
14 objective during certain months and at certain locations. In the San Joaquin River at Antioch, there
15 would be a reduction in assimilative capacity in March and April of up to 14% for the 16-year period
16 modeled, and 53% for the drought period modeled (Appendix 8G, *Chloride*, Table CI-75).
17 Assimilative capacity at the Contra Costa Pumping Plant #1 also would be reduced, in February
18 through April and June, by up to 5% for the entire period modeled and in June by 5% for the drought
19 period modeled. These estimates include the effect of climate change and sea level rise, as well as
20 the alternative. Comparisons to the No Action Alternative (ELT) below provide an assessment of the
21 effect of the alternative alone.

22 When utilizing the EC-chloride relationship to model chloride concentrations for the 16-year period,
23 trends in frequency of exceedance and use of assimilative capacity would be similar to those
24 discussed when utilizing the mass balance modeling approach (Appendix 8G, *Chloride*, Tables CI-76
25 and CI-82). However, the EC-chloride relationships generally predicted changes of lesser magnitude,
26 where predictions of change utilizing the mass balance approach were generally of greater
27 magnitude, and thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such
28 disagreement, the approach that yielded the more conservative predictions was used as the basis for
29 determining adverse impacts.

30 *CWA Section 303(d) Listed Water Bodies—Relative to Existing Conditions*

31 Tom Paine Slough in the southern Delta is on the state's CWA Section 303(d) list for chloride with
32 respect to the secondary MCL of 250 mg/L. Monthly average chloride concentrations at the Old
33 River at Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled
34 location to Tom Paine Slough, would be generally similar under Alternative 2D in the ELT relative to
35 Existing Conditions, and thus, would not be further degraded on a long-term basis (Appendix 8G,
36 *Chloride*, Figure CI-17).

37 Suisun Marsh also is on the state's CWA Section 303(d) list for chloride in association with the Bay-
38 Delta WQCP objectives for maximum allowable salinity during the months of October through May,
39 which establish appropriate seasonal salinity conditions for fish and wildlife beneficial uses. With
40 respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
41 modeled would generally increase by <10% under Alternative 2D in the ELT relative to Existing
42 Conditions in March and April at the Sacramento River at Mallard Island (Appendix 8G, *Chloride*,
43 Figure CI-18), at Collinsville (Appendix 8G, *Chloride*, Figure CI-19), and in Montezuma Slough at
44 Beldon's Landing (Appendix 8G, *Chloride*, Figure CI-20), and remain similar or decrease in all other

1 months. Chloride levels in Suisun Marsh are highly dynamic on a sub-daily basis as a result of tidal
2 influences. The changes identified above are small relative to normal day-to-day variability in
3 chloride in Suisun Marsh. For these reasons, any changes in chloride in Suisun Marsh are expected to
4 have no adverse effect on marsh beneficial uses. These changes reflect the effect of climate change
5 and sea level rise, as well as the alternative. Comparisons to the No Action Alternative (ELT) below
6 provide an assessment of the effect of the alternative alone.

7 *Municipal Beneficial Uses Relative to No Action Alternative (ELT)*

8 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
9 generated from EC-chloride relationships were used to evaluate the 150 mg/L Bay-Delta WQCP
10 objective for municipal and industrial beneficial uses. For Alternative 2D in the ELT, the modeled
11 frequency of objective exceedance would not change at the Contra Costa Pumping Plant #1—both
12 the No Action Alternative (ELT) and Alternative 2D in the ELT would have 0% exceedance
13 (Appendix 8G, *Chloride*, Table CI-64).

14 Based on the mass balance approach, the frequency of exceedance of the 250 mg/L objective under
15 Alternative 2D in the ELT would be the same, or would decrease, at all locations relative to the No
16 Action Alternative (ELT) (Appendix 8G, *Chloride*, Table CI-81).

17 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
18 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
19 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
20 basis for the evaluation was the predicted number of days the objective was exceeded for the
21 modeled 16-year period. For Alternative 2D, the modeled frequency of objective exceedance would
22 decrease, from 8% of modeled days under the No Action Alternative (ELT), to 2% of modeled days
23 under Alternative 2D (Appendix 8G, *Chloride*, Table CI-63).

24 Estimates of long-term use of assimilative capacity using the mass balance results indicated the
25 potential for reduced assimilative capacity with respect to the 250 mg/L objective for certain
26 months and locations. Calculations using the long-term monthly and annual average concentrations
27 showed that in the San Joaquin River at Antioch, there would be a reduction in assimilative capacity
28 in April of 15% for the drought period modeled (Appendix 8G, *Chloride*, Table CI-75). However, this
29 approach used long-term average chloride concentrations, which can be heavily influenced by
30 changes in a small number of years when chloride concentrations would already be very high.
31 Additionally, when long term averages are just below the objective, very small changes in chloride
32 that are within the modeling uncertainty can result in very high estimates of use of assimilative
33 capacity. To further investigate the potential for water quality degradation with respect to chloride,
34 the concentrations of chloride during individual water years was examined.

35 This further examination was limited to the mass balance approach, since when utilizing the EC-
36 chloride relationship to model monthly average chloride concentrations for the 16-year period,
37 trends in frequency of exceedance and use of assimilative capacity were similar to those discussed
38 for the mass balance modeling approach (Appendix 8G, *Chloride*, Tables CI-82 and CI-76). However,
39 utilizing the EC-chloride relationships generally predicted changes of lesser magnitude, where
40 predictions of change utilizing the mass balance approach were generally of greater magnitude, and
41 thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such disagreement, the
42 approach that yielded the more conservative predictions was used as the basis for determining
43 adverse impacts.

1 Figure Cl-21 in Appendix 8G, *Chloride*, shows chloride concentrations in April during the 5-year
2 drought period (1987–1991) at Antioch, where Table Cl-75 in Appendix 8G indicated 15% use of
3 assimilative capacity. The figure shows that during 3 of the 5 years, chloride concentrations
4 increased relative to the No Action Alternative (ELT) and decreased in the other 2 years. The
5 absolute differences estimated are fairly small and may be within modeling uncertainty. Figures Cl-
6 22 and Cl-23 in Appendix 8G show a box and whisker plot and exceedance plot for April at Antioch
7 for all dry and critical water years modeled (not just the 1987–1991 drought period). These graphs
8 show that while the median chloride concentration is increased relative to the No Action Alternative
9 (ELT), the maximum, 25th percentile, and 75th percentile values are all decreased. Based on this
10 analysis, long-term degradation is not expected at Antioch in April during drought years.

11 Based on the low level of water quality degradation estimated for the western Delta, and the lack of
12 exceedance of water quality objectives, Alternative 2D is not expected to have substantial adverse
13 effects on municipal and industrial beneficial uses in the western Delta.

14 *CWA Section 303(d) Listed Water Bodies—Relative to No Action Alternative (ELT)*

15 With respect to the state’s CWA Section 303(d) listing for chloride, Alternative 2D would generally
16 result in changes similar to those discussed for the comparison to Existing Conditions. Monthly
17 average chloride concentrations at Tom Paine Slough would not be further degraded on a long-term
18 basis, based on changes that would occur in Old River at Tracy Road (Appendix 8G, *Chloride*, Figure
19 Cl-17). Modeling indicated that monthly average chloride concentrations at source water channel
20 locations for the Suisun Marsh remain similar or decrease relative to the No Action Alternative
21 (ELT) (Appendix 8G, Figures Cl-18, Cl-19, and Cl-20). For these reasons, any changes in chloride in
22 Suisun Marsh are expected to have no adverse effect on marsh beneficial uses.

23 The effects of Alternative 2D in the LLT in the Delta region, relative to Existing Conditions and the
24 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
25 climate change and sea level rise, additional outflow may be required at certain times to prevent
26 increases in chloride in the west Delta. Small increases in chloride concentrations may occur in some
27 areas, but it is not expected that these increases would cause exceedance of Bay-Delta WQCP
28 objectives of cause substantial long-term degradation that would impact municipal and industrial
29 beneficial uses.

30 ***SWP/CVP Export Service Areas***

31 Under Alternative 2D in the ELT, long-term average chloride concentrations at the Banks and Jones
32 pumping plants, based on the mass balance analysis of modeling results for the 16-year period,
33 would decrease relative to Existing Conditions. Chloride concentrations would be reduced by 49%
34 at Banks pumping plant (Appendix 8G, *Chloride*, Table Cl-73). At Jones pumping plant, chloride
35 concentrations would be reduced 47% (Appendix 8G, Table Cl-73). The frequency of exceedances of
36 applicable water quality objectives would decrease relative to Existing Conditions, for both the 16-
37 year period and the drought period modeled (Appendix 8G, Table Cl-81). The chloride concentration
38 changes relative to the No Action Alternative (ELT) would be similar. Consequently, water exported
39 into the SWP/CVP Export Service Areas would generally be of similar or better quality with regard
40 to chloride relative to Existing Conditions and the No Action Alternative (ELT). Results of the
41 modeling approach which utilized a EC-chloride relationship are consistent these results, and
42 assessment of chloride using these modeling output results in the same conclusions as for the mass
43 balance approach (Appendix 8G, *Chloride*, Tables Cl-74 and Cl-82).

1 Commensurate with the reduced chloride concentrations in water exported to the SWP/CVP Export
2 Service Area, reduced chloride loading in the lower San Joaquin River would be anticipated which
3 would likely alleviate chloride concentrations at Vernalis.

4 The effects of Alternative 2D in the LLT in the SWP/CVP Export Service Areas, relative to Existing
5 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
6 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
7 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

8 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
9 contribute towards a substantial change in existing sources of chloride in the affected environment.
10 Maintenance activities would not be expected to cause any substantial change in chloride such that
11 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
12 affected anywhere in the affected environment.

13 **NEPA Effects:** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 2D
14 would not result in substantially increased chloride concentrations in the Delta on a long-term
15 average that would result in adverse effects on the municipal and industrial water supply beneficial
16 use, or any other beneficial use. Additional exceedance of the 150 mg/L and 250 mg/L objectives is
17 not expected, and substantial long-term degradation is not expected that would result in adverse
18 effects on the municipal and industrial water supply beneficial use, or any other beneficial use.
19 Based on these findings, this effect is determined to not be adverse.

20 **CEQA Conclusion:** Chloride is not a constituent of concern in the Sacramento River watershed
21 upstream of the Delta, thus river flow rate and reservoir storage reductions that would occur under
22 Alternative 2D relative to Existing Conditions, would not be expected to result in a substantial
23 adverse change in chloride levels. Additionally, relative to Existing Conditions, Alternative 2D would
24 not result in reductions in river flow rates (i.e., less dilution) or increased chloride loading such that
25 there would be any substantial increase in chloride concentrations upstream of the Delta in the San
26 Joaquin River watershed.

27 Relative to Existing Conditions, Alternative 2D would not result in substantially increased chloride
28 concentrations in the Delta on a long-term average basis that would result in adverse effects on the
29 municipal and industrial water supply beneficial use. Additional exceedance of the 150 mg/L and
30 250 mg/L objectives is not expected, and substantial long-term degradation is not expected that
31 would result in adverse effects on the municipal and industrial water supply beneficial use.

32 Chloride concentrations would be reduced under Alternative 2D in water exported from the Delta to
33 the SWP/CVP Export Service Areas thus reflecting a potential improvement to chloride loading in
34 the lower San Joaquin River.

35 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the
36 Alternative 2D would not result in substantial chloride bioaccumulation impacts on aquatic life or
37 humans. Alternative 2D maintenance would not result in any substantial changes in chloride
38 concentration upstream of the Delta or in the SWP/CVP Export Service Areas

39 Based on these findings, this impact is determined to be less than significant. No mitigation is
40 required. Despite the fact that no mitigation is required, DWR proposed to further reduce any
41 impacts by implementing Mitigation Measure WQ-7e.

1 **Mitigation Measure WQ-7e: Implement Terms of the Contra Costa Water District**
 2 **Settlement Agreement**

3 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of**
 4 **Environmental Commitments 3, 4, 6–12, 15, and 16**

5 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 6 Alternative 2D would present no new direct sources of chloride to the affected environment,
 7 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
 8 Consequently, as they pertain to chloride, implementation of these Environmental Commitments
 9 would not be expected to adversely affect any of the beneficial uses of the affected environment.
 10 Moreover, some habitat restoration activities would occur on lands within the Delta currently used
 11 for irrigated agriculture. The potential reduction in irrigated lands within the Delta may result in
 12 reduced discharges of agricultural field drainage with elevated chloride concentrations, which
 13 would be considered an improvement relative to the No Action Alternative (ELT and LLT).
 14 Therefore, the effects on chloride from implementing Environmental Commitments 3, 4, 6–12, 15,
 15 and 16 are considered to be not adverse.

16 **CEQA Conclusion:** Implementation of the Environmental Commitments 3, 4, 6–12, 15, and 16 under
 17 Alternative 2D would not present new or substantially changed sources of chloride to the affected
 18 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas.
 19 Replacement of irrigated agricultural land uses in the Delta with habitat restoration may result in
 20 some reduction in discharge of agricultural field drainage with elevated chloride concentrations,
 21 thus resulting in improved water quality conditions. Based on these findings, this impact is
 22 considered to be less than significant. No mitigation is required.

23 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
 24 **Maintenance**

25 As described in detail for Alternative 4 (see Section 8.3.3.9), DO levels are primarily affected by
 26 water temperature, flow velocity, turbulence, amounts of oxygen demanding substances present
 27 (e.g., ammonia, organics), and rates of photosynthesis (which is influenced by nutrient levels),
 28 respiration, and decomposition. Water temperature and salinity affect the maximum DO saturation
 29 level (i.e., the highest amount of oxygen the water can dissolve). Flow velocity affects the turbulence
 30 and re-aeration of the water (i.e., the rate at which oxygen from the atmosphere can be dissolved in
 31 water). High nutrient content can support aquatic plant and algae growth, which in turn generates
 32 oxygen through photosynthesis and consumes oxygen through respiration and decomposition.

33 As described for Alternative 4, amounts of oxygen demanding substances present (e.g., ammonia,
 34 organics) in the reservoirs and rivers upstream of the Delta, rates of photosynthesis (which is
 35 influenced by nutrient levels/loading), and respiration and decomposition of aquatic life is not
 36 expected to change sufficiently under Alternative 2D (ELT and LLT) to substantially alter DO levels
 37 relative to Existing Conditions or the No Action Alternative (ELT and LLT). Further, the rivers
 38 upstream of the Delta are well oxygenated and experience periods of supersaturation (i.e., when DO
 39 level exceeds the saturation concentration). Because these are large, turbulent rivers, any reduced
 40 DO saturation level that would be caused by an increase in temperature under Alternative 2D would
 41 not be expected to cause DO levels to be outside of the range seen historically. Flow changes that
 42 would occur under Alternative 2D would not be expected to have substantial effects on river DO
 43 levels; likely, the changes would be immeasurable. This is because sufficient turbulence and

1 interaction of river water with the atmosphere would continue to occur to maintain water
2 saturation levels (due to these factors) at levels similar to that of Existing Conditions and the No
3 Action Alternative (ELT and LLT).

4 Also as described for Alternative 4, salinity changes would generally have relatively minor effects on
5 Delta DO levels. Further, the relative degree of tidal exchange of flows and turbulence, which
6 contributes to exposure of Delta waters to the atmosphere for reaeration, would not be expected to
7 substantially change relative to Existing Conditions or the No Action Alternative (ELT and LLT), such
8 that these factors would reduce Delta DO levels below objectives or levels that protect beneficial
9 uses. Similarly, increased temperature under Alternative 2D (ELT and LLT), which would be due to
10 climate change, would generally have relatively minor effects on Delta DO levels, relative to Existing
11 Conditions.

12 Similar to Alternative 4, flows in the San Joaquin River at Stockton were evaluated under Alternative
13 2D and are shown in Figure 8-65b. The figure shows that while flows do would change somewhat,
14 they are would generally be within the range of flows seen under Existing Conditions and the No
15 Action Alternative. Reports indicate that the aeration facility performs adequately under the range
16 of flows from 250–1,000 cfs (ICF International 2010). Based on the above, the expected changes in
17 flows in the San Joaquin River at Stockton are not expected to substantially move the point of
18 minimum DO, and therefore the aeration facility will would likely still be located appropriately to
19 keep DO levels above Basin Plan objectives.

20 Overall, assuming continued operation of the aerators, the alternative is not expected to have a
21 substantial impact adverse effect on DO in the Deep Water Ship Channel. It is expected that DO levels
22 in the Deep Water Ship Channel, which is CWA Section 303(d) listed as impaired due to low DO,
23 would remain similar to those under Existing Conditions and the No Action Alternative (ELT and
24 LLT) or improve as TMDL-required studies are completed and actions are implemented to improve
25 DO levels. DO levels in other Clean Water Act Section 303(d)-listed waterways would not be
26 expected to change relative to Existing Conditions or the No Action Alternative (ELT and LLT), as the
27 circulation of flows, tidal flow exchange, and re-aeration would continue to occur.

28 In the SWP/CVP Export Service Areas, the primary factor that would affect DO in the conveyance
29 channels and ultimately the receiving reservoirs would be changes in the levels of nutrients and
30 oxygen-demanding substances and DO levels in the exported water. Because the biochemical oxygen
31 demand of the exported water would not be expected to substantially differ from that under Existing
32 Conditions or the No Action Alternative (ELT and LLT) due to water quality regulations, canal
33 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
34 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
35 downstream reservoirs.

36 **NEPA Effects:** Because DO levels are not expected to change substantially relative to the No Action
37 Alternative (ELT and LLT), the effects on DO from implementing Alternative 2D (ELT and LLT) are
38 determined to not be adverse.

39 **CEQA Conclusion:** The effects of Alternative 2D on DO levels in surface waters upstream of the Delta,
40 in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would be
41 similar to those described for Alternative 4 (see Section 8.3.3.9). Reservoir storage reductions that
42 would occur under Alternative 2D, relative to Existing Conditions, would not be expected to result in
43 a substantial adverse change in DO levels in the reservoirs, because oxygen sources (surface water
44 aeration, aerated inflows, vertical mixing) would remain. Similarly, river flow rate reductions would

1 not be expected to result in a substantial adverse change in DO levels in the rivers upstream of the
 2 Delta, given that mean monthly flows would remain within the ranges historically seen under
 3 Existing Conditions and the affected river are large and turbulent. Any reduced DO saturation level
 4 that may be caused by increased water temperature would not be expected to cause DO levels to be
 5 outside of the range seen historically. Finally, amounts of oxygen demanding substances and salinity
 6 would not be expected to change sufficiently to affect DO levels.

7 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
 8 Delta source water percentages under this alternative or substantial degradation of these water
 9 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state regulates
 10 the discharges of, and this loading would not be expected to lower DO levels relative to Existing
 11 Conditions based on historical DO levels. Further, the anticipated changes in salinity would have
 12 relatively minor effects on DO levels, and tidal exchange, which contribute to the reaeration of Delta
 13 waters would not be expected to change substantially.

14 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
 15 Export Service Areas waters, relative to Existing Conditions. Because the biochemical oxygen
 16 demand of the exported water would not be expected to substantially differ from that under Existing
 17 Conditions (due to water quality regulations), canal turbulence and exposure of the water to the
 18 atmosphere and the algal communities that exist within the canals would establish an equilibrium
 19 for DO levels within the canals. The same would occur in downstream reservoirs.

20 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
 21 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
 22 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
 23 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
 24 uses would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for
 25 low DO, but because no substantial decreases in DO levels would be expected, greater degradation
 26 and DO-related impairment of these areas would not be expected. Based on these findings, this
 27 impact would be less than significant. No mitigation is required.

28 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of Environmental** 29 **Commitments 3, 4, 6-12, 15, and 16**

30 **NEPA Effects:** Environmental Commitments 3, 4, and 6-11 would involve habitat restoration
 31 actions. The increased habitat provided by these Environmental Commitments could contribute to
 32 an increased biochemical or sediment demand, through contribution of organic carbon and plants
 33 decaying. However, the areal extent of new habitat would be small relative to existing and No Action
 34 Alternative habitat areas, and similar habitat existing in the Delta is not identified as contributing to
 35 adverse DO conditions. The remaining Environmental Commitments would not be expected to affect
 36 DO levels because they are actions that do not affect the presence of oxygen-demanding substances.
 37 Therefore, the effects on DO from implementing Environmental Commitments 3, 4, 6-12, 15, and 16
 38 are determined to not be adverse.

39 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
 40 or in the SWP/CVP Export Service Areas following implementation of Environmental Commitments
 41 3, 4, 6-12, 15, and 16 under Alternative 2D would not be substantially different from existing DO
 42 conditions, because these would contribute to a minimal, localized change in oxygen-demanding
 43 substances associated with habitat restoration, if at all. Therefore, these Environmental
 44 Commitments are not expected to cause additional exceedance of applicable water quality objectives

1 by frequency, magnitude, and geographic extent that would result in significant impacts on any
2 beneficial uses within affected water bodies. Because no substantial changes in DO levels would be
3 expected, long-term water quality degradation would not be expected, and, thus, beneficial uses
4 would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for low
5 DO, but because no substantial decreases in DO levels would be expected, greater degradation and
6 impairment of these areas would not be expected. Based on these findings, this impact would be less
7 than significant. No mitigation is required.

8 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities** 9 **Operations and Maintenance**

10 ***Upstream of the Delta***

11 The effects of Alternative 2D on EC levels in reservoirs and rivers upstream of the Delta would be
12 similar to those effects described for Alternative 4 (see Section 8.3.3.9). The extent of new urban
13 growth would be less in the ELT, thus discharges of EC-elevating parameters in runoff and
14 wastewater discharges to water bodies upstream of the Delta would be expected to be less than in
15 the LLT. However, the state is regulating point source discharges of EC-related parameters and
16 implementing a program to further decrease loading of EC-related parameters to tributaries. Based
17 on these considerations, and those described in Section 8.3.3.9, EC levels (highs, lows, typical
18 conditions) in the Sacramento River and its tributaries, the eastside tributaries, or their associated
19 reservoirs upstream of the Delta would not be expected to be outside the ranges occurring under
20 Existing Conditions.

21 For the San Joaquin River, increases in EC levels under Alternative 2D could occur, but would be
22 slightly less than those described for Alternative 4 (see Section 8.3.3.9). This is because the effects of
23 climate change on flows, which could affect dilution of high EC discharges, would be less in the ELT.
24 The implementation of the adopted TMDL for the San Joaquin River at Vernalis and the ongoing
25 development of the TMDL for the San Joaquin River upstream of Vernalis are expected to contribute
26 to improved EC levels. Based on these considerations, substantial changes in EC levels in the San
27 Joaquin River relative to Existing Conditions would not be expected to be of sufficient magnitude
28 and geographic extent that would result in adverse effects on any beneficial uses, or substantially
29 degrade the quality of these water bodies, with regard to EC.

30 ***Delta***

31 Initial review of modeling results indicated that Alternative 2D would potentially result in an
32 increase in the number of days the Bay-Delta WQCP EC objectives would be exceeded in the
33 Sacramento River at Emmaton, relative to Existing Conditions, and San Joaquin River at San Andreas
34 Landing and Prisoners Point, relative to both Existing Conditions and No Action Alternative (ELT)
35 (Appendix 8H, *Electrical Conductivity*, Table EC-26). To understand and interpret these results,
36 considerations must be made regarding uncertainty in the modeling and results from sensitivity
37 analyses. In addition, modeling results indicate there would be small increases in long-term monthly
38 average EC at modeled Suisun Marsh locations relative to Existing Conditions. These locations are
39 addressed in detail below. At all other locations, the level of exceedance and modeled average EC
40 levels under the alternative was approximately equivalent or lower than under Existing Conditions
41 and the No Action Alternative (ELT).

1 *Sacramento River at Emmaton*

2 Modeling results indicated that the Emmaton EC objective would be exceeded more often under
3 Alternative 2D than under Existing Conditions, but less often relative to the No Action Alternative
4 (ELT). The modeling results also indicated that increases in EC could cause substantial water quality
5 degradation in summer months of below normal, dry and critical water years. However, these
6 increases in exceedance of the objective and degradation are expected to be addressed via real-time
7 operations, including real time management of the north Delta and south Delta intakes, as well as
8 Delta Cross Channel operation. Further discussion is provided below.

9 Modeling results indicated that the percentage of days the Emmaton EC objective would be
10 exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing
11 Conditions to 7%; there would be a 5% decrease relative to the No Action Alternative (ELT), from
12 12% to 7% (Appendix 8H, *Electrical Conductivity*, Table EC-26). The percentage of days out of
13 compliance would increase from 11% under Existing Conditions to 15%; there would be a 6%
14 decrease relative to the No Action Alternative (ELT), from 21% to 15% (Appendix 8H, Table EC-26).
15 The comparison of the alternative to Existing Conditions reflects changes due both to operation of
16 the alternative as well as effects of sea level rise due to climate change. The comparison of the
17 alternative to the No Action Alternative (ELT) reflects changes in EC due solely to operations of the
18 alternative. Based on the comparison to the No Action Alternative (ELT), the alternative would not
19 contribute to additional exceedance of the EC objective at Emmaton.

20 The results of the EC modeling indicate there would be months with substantial degradation relative
21 to the No Action Alternative (ELT), particularly during the drought period modeled. Long-term
22 average EC levels at Emmaton would increase in the months of July through September by 3–7% for
23 the entire period modeled (1976–1991), and in the months of July and August by 4–29% during the
24 drought period modeled (1987–1991), relative to the No Action Alternative (ELT) (Appendix 8H,
25 *Electrical Conductivity*, Table EC-30). The largest increases in EC would occur in below normal, dry
26 and critical water year types. These periods of degradation are expected to be addressed via real-
27 time operations. The level to which modeling output depicts degradation of water quality with
28 respect to EC is primarily a function of the modeling not being able to fully capture how the system
29 would be operated in real-time to minimize or avoid such degradation

30 Discussions with SWP operators indicated that real-time operations would ensure that the Bay-
31 Delta WQCP EC objectives at Emmaton, applicable from April 1 through August 15, would be met. In
32 latter August and September, the Threemile Slough standard in the North Delta Water Agency
33 Agreement and the Bay-Delta WQCP municipal and industrial objective at Rock Slough are in effect.
34 During this period of the year, the coordinated operations of the SWP/CVP system strives to meet
35 both standards in the most water-efficient method available to the CVP and SWP. Real-time
36 operation would result in less EC degradation than depicted by modeling output because in order to
37 comply with Bay-Delta WQCP objectives and the the North Delta Water Agency Agreement during
38 the summer period, operators could, for example, increase upstream reservoir releases for
39 necessary periods of time, reduce North Delta diversions, and/or close (short-term) the Delta Cross
40 Channel. These options as well as real-time and forecasted tides, winds and barometric pressure are
41 considered when the projects schedule daily operations, which the modeling does not fully capture.

42 Alternative 2D does not change the Bay-Delta WQCP objectives or the the North Delta Water Agency
43 Agreement which are primary drivers of operations and resulting water quality in the Sacramento
44 River at at Emmaton during late August and September. Therefore, the EC degradation at Emmaton
45 that would occur upon implementation of Alternative 2D would be lesser than that shown by the

1 modeling and would not be expected to differ substantially from that which would occur under the
2 No Project Alternative because the compliance targets are not changing due to Alternative 2D during
3 these months and real-time operations would achieve the compliance targets.

4 The modeling results also show that in the remaining months there would be decreases in EC
5 relative to the No Action Alternative (ELT) of 2–27% for the entire period modeled and 2–32% for
6 the drought period modeled. These decreases would contribute to the long-term average EC levels
7 decreasing by 10% for the entire period modeled and 9% for the drought period modeled (Appendix
8 8H, Table EC-30).

9 *San Joaquin River at San Andreas Landing*

10 Alternative 2D is not expected to have adverse effects on EC in the San Joaquin River at San Andreas
11 Landing, relative to Existing Conditions and the No Action Alternative (ELT). Modeling results
12 estimated that the percentage of days the San Andreas Landing EC objective would be exceeded
13 would increase by <1% relative to Existing Conditions, and the percentage of days out of compliance
14 would increase from 1% under Existing Conditions to 2% (Appendix 8H, *Electrical Conductivity*,
15 Table EC-26). San Andreas Landing average EC would decrease 15% for the entire period modeled
16 and 12% during the drought period modeled, relative to Existing Conditions (Appendix 8H, Table
17 EC-30). Results relative to the No Action Alternative (ELT) were similar (Appendix 8H, Table EC-
18 30). Sensitivity analyses performed for Alternative 4 Scenario H3 at the LLT indicate that many of
19 these exceedances are likely modeling artifacts, and the small number of remaining exceedances
20 would be small in magnitude, lasting only a few days, and could be addressed with real time
21 operations of the SWP and CVP (see Section 8.3.1.1, *Models Used and Their Linkages*, for a
22 description of real time operations of the SWP and CVP). These sensitivity analyses were only run at
23 the LLT, but it is expected that the findings can generally be extended to the ELT, because the factors
24 affecting salinity findings in the sensitivity analysis (e.g., modeling assumptions, physical
25 hydrodynamic mechanisms) are similar between the ELT and LLT (see Appendix 8H, Attachment 1).

26 *San Joaquin River at Prisoners Point*

27 Modeling results indicated that the EC objective that applies to the San Joaquin River between Jersey
28 Point and Prisoners Point would be exceeded at Prisoners Point more often under Alternative 2D
29 than under Existing Conditions and the No Action Alternative (ELT). However, these exceedances
30 are expected to be able to be addressed via real-time operations, including real time management of
31 the north Delta and south Delta intakes, as well as Head of Old River Barrier management. Further
32 discussion is provided below.

33 Modeling results estimated that the percentage of days the Prisoners Point EC objective would be
34 exceeded would increase from 6% under Existing Conditions, or 2% under the No Action Alternative
35 (ELT), to 12%, and the percentage of days out of compliance with the EC objective would increase
36 from 10% under Existing Conditions, or 2% under the No Action Alternative (ELT), to 13%
37 (Appendix 8H, *Electrical Conductivity*, Table EC-26). The magnitude of the exceedances is estimated
38 to be very small—the objective is 440 $\mu\text{mhos/cm}$, and the EC during times of exceedance was
39 generally between 440 and 600 $\mu\text{mhos/cm}$ —and the exceedances generally occurred in drier water
40 years (4 of the 5 years in which there were exceedances were dry water year type), when flows
41 would be lower (Appendix 8H, Figures EC-1 through EC-5). During these times, the EC in the San
42 Joaquin River at Vernalis is greater than in the Sacramento River entering the Delta, and is high
43 enough on its own to cause an exceedance of the Prisoners Point EC objective.

1 There are two main drivers of the increase in exceedances under the alternative: an increase in San
 2 Joaquin River flow at Prisoners Point during April and May under the alternative, relative to Existing
 3 Conditions and the No Action Alternative (ELT), and a reduction in the amount of Sacramento River
 4 water moving past Prisoners Point under the alternative. The result is increased San Joaquin River
 5 water at Prisoners Point, and a reduction in the dilution that the Sacramento River provides the
 6 higher EC San Joaquin River. The increase in San Joaquin River flow at Prisoners Point is due to a
 7 reduction in pumping from the south Delta under the alternative, as well as due to the presence of
 8 the Head of Old River Barrier, which increases flow in the San Joaquin River downstream of Old
 9 River by preventing flow from entering Old River. The reduction in Sacramento River water
 10 influence is due to less pumping at the south Delta pumping plants (i.e., greater pumping draws
 11 more Sacramento River water through the Delta).

12 Sensitivity analyses conducted for Alternative 4 Scenario H3 at the LLT indicated that if the Head of
 13 Old River Barrier was open in April and May, exceedances would be reduced by about 5 percentage
 14 points. These sensitivity analyses were only run at the LLT, but it is expected that the findings can
 15 generally be extended to the ELT. Results of the sensitivity analyses indicate that the exceedances
 16 are partly due also to operations of the alternative itself, perhaps due to Head of Old River Barrier
 17 assumptions and south Delta export differences (see Appendix 8H, Attachment 1, for more
 18 discussion of these sensitivity analyses). Appendix 8H, Attachment 2, contains a more detailed
 19 assessment of the likelihood of these exceedances estimated via modeling adversely affecting
 20 aquatic life beneficial uses. Specifically, Appendix 8H, Attachment 2, discusses whether these
 21 exceedances might have indirect effects on striped bass spawning in the Delta, and concludes that
 22 the high level of uncertainty precludes making a definitive determination for those alternatives.
 23 Additionally, by adaptively managing the Head of Old River Barrier and the fraction of south Delta
 24 versus north Delta diversions, EC levels at Prisoners Point would likely be decreased to a level that
 25 would not adversely affect aquatic life beneficial uses.

26 *Suisun Marsh*

27 For Suisun Marsh October–May is the period when Bay-Delta WQCP EC objectives for protection of
 28 fish and wildlife apply. Modeling results indicate that average EC for the entire period modeled
 29 would increase in the Sacramento River at Collinsville during the months of March and April relative
 30 to Existing Conditions, by 0.1 mS/cm (Appendix 8H, *Electrical Conductivity*, Table EC-32). In
 31 Montezuma Slough at National Steel, average EC levels would increase in March through May by
 32 0.1 mS/cm (Appendix 8H, Table EC-33). There would be similarly small increases in long-term
 33 average EC in the months of March through May in Montezuma Slough near Beldon’s Landing,
 34 Chadbourne Slough near Sunrise Duck Club, and Suisun Slough near Volanti Slough, ranging 0.1–0.3
 35 mS/cm depending on month and location (Appendix 8H, Tables EC-34 through EC-36). Relative to
 36 the No Action Alternative (ELT), the modeled long-term average EC under the alternative would be
 37 similar or lower from October through May for these locations (Appendix 8H, Tables EC-32 through
 38 EC-36).

39 The Suisun Marsh EC objectives are expressed as a monthly average of daily high tide EC, which
 40 does not have to be met if it can be demonstrated “equivalent or better protection will be provided
 41 at the location” (State Water Resources Control Board 2006:14). Long-term average EC increases
 42 relative to Existing Conditions may, or may not, contribute to adverse effects on beneficial uses,
 43 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
 44 water is managed, and future actions taken with respect to the Marsh. Given the Bay-Delta WQCP
 45 narrative objective regarding “equivalent or better protection” in lieu of meeting specific numeric

1 objectives, the small increases in EC under Alternative 2D, relative to Existing Conditions, would not
 2 be expected to adversely affect beneficial uses of Suisun Marsh. While Suisun Marsh is CWA Section
 3 303(d) listed as impaired because of elevated EC, the potential increases in long-term average EC
 4 concentrations, relative to Existing Conditions, would not be expected to contribute to additional
 5 impairment, because the increase would be so small (<1 mS/cm) relative to the daily fluctuations in
 6 EC levels as to not be measurable and beneficial uses would not be adversely affected.

7 Further, the EC changes in Suisun Marsh relative to Existing Conditions reflect the influence of both
 8 operations of the alternative and sea level rise due to climate change, whereas the changes relative
 9 to the No Action Alternative (ELT) are due solely to operations of the alternative. As described
 10 above, there would be no increase in the long-term average EC at modeled Suisun Marsh locations,
 11 and for some locations long-term average EC would decrease. Therefore, it is expected that this
 12 alternative would not contribute to exceedances of EC objectives or additional impairment of
 13 beneficial uses, as affected by EC or other salinity-related parameters.

14 The effects of Alternative 2D in the LLT in the Delta region, relative to Existing Conditions and the
 15 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
 16 climate change and sea level rise, additional outflow may be required at certain times to prevent
 17 increases in EC in the west Delta, but this requirement would not be due to the alternative.

18 ***SWP/CVP Export Service Areas***

19 Under Alternative 2D, at the Banks and Jones pumping plants, there would be no exceedance of the
 20 Bay-Delta WQCP's 1,000 µmhos/cm EC objective for the entire period modeled (Appendix 8H,
 21 *Electrical Conductivity*, Table EC-27). Relative to Existing Conditions, average EC levels under
 22 Alternative 2D would decrease 28–29% for the entire period modeled and 27% during the drought
 23 period modeled (Appendix 8H, Table EC-30). Relative to the No Action Alternative (ELT), average EC
 24 levels would similarly decrease, by 25–26% for the entire period modeled and 25% during the
 25 drought period modeled (Appendix 8H, Table EC-30). Based on the decreases in long-term average
 26 EC levels that would occur at the Banks and Jones pumping plants, Alternative 2D would not cause
 27 degradation of water quality with respect to EC in the SWP/CVP Export Service Areas. Rather,
 28 Alternative 2D would improve long-term average EC conditions in the SWP/CVP Export Service
 29 Areas.

30 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 31 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
 32 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
 33 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-
 34 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
 35 increase in EC at Vernalis related to decreased annual average San Joaquin River flows.

36 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
 37 elevated EC. Alternative 2D would result in lower average EC levels relative to Existing Conditions
 38 and the No Action Alternative (ELT) and, thus, would not contribute to additional beneficial use
 39 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

40 The effects of Alternative 2D in the LLT in the SWP/CVP Export Service Areas, relative to Existing
 41 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
 42 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
 43 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

1 **NEPA Effects:** In summary, based on the results of the modeling and sensitivity analyses conducted,
2 it is unlikely that there would be increased frequency of exceedance of agricultural EC objectives in
3 the western, interior, or southern Delta. However, modeling results indicate that there could be
4 increased long-term and drought period average EC levels during the summer months that would
5 occur in the western Delta (i.e., in the Sacramento River at Emmaton) under Alternative 2D relative
6 to the No Action Alternative (ELT), that could contribute to adverse effects on the agricultural
7 beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin River at
8 Prisoners Point EC objective could contribute to adverse effects on fish and wildlife beneficial uses
9 (specifically, indirect adverse effects on striped bass spawning), though there is a high degree of
10 uncertainty associated with this impact. Suisun Marsh is CWA Section 303(d) listed as impaired due
11 to elevated EC, but EC levels are not expected to increase under Alternative 2D, relative to the No
12 Action Alternative (ELT), and thus it is not expected to contribute to additional beneficial use
13 impairment. The increases in EC in the Sacramento River at Emmaton, particularly during summer
14 months of below normal, dry and critical water years, and the additional exceedances of water
15 quality objectives in the San Joaquin River at Prisoners Point constitute an adverse effect on water
16 quality. Mitigation Measure WQ-11 would be available to reduce these effects.

17 **CEQA Conclusion:** River flow rate and reservoir storage reductions that would occur under
18 Alternative 2D, relative to Existing Conditions, would not be expected to result in a substantial
19 adverse change in EC levels in the reservoirs and rivers upstream of the Delta, given that: changes in
20 the quality of watershed runoff and reservoir inflows would not be expected to occur in the future;
21 the state's regulation of point-source discharge effects on Delta salinity-elevating parameters and
22 the expected further regulation as salt management plans are developed; the salt-related TMDLs
23 adopted and being developed for the San Joaquin River; and the expected improvement in lower San
24 Joaquin River average EC levels commensurate with the lower EC of the irrigation water deliveries
25 from the Delta.

26 Relative to Existing Conditions, Alternative 2D would not result in any substantial increases in long-
27 term average EC levels in the SWP/CVP Export Service Areas, and there would be no exceedance of
28 the Bay-Delta WQCP EC objective for this area of the Delta. Average EC levels for the entire period
29 modeled would decrease at both the Banks and Jones pumping plants and, thus, this alternative
30 would not contribute to additional beneficial use impairment related to elevated EC in the SWP/CVP
31 Export Service Areas waters. Rather, this alternative would improve long-term EC levels in the
32 SWP/CVP Export Service Areas, relative to Existing Conditions.

33 Further, relative to Existing Conditions, Alternative 2D would not result in substantial increases in
34 long-term average EC in Suisun Marsh. Thus, EC levels in Suisun Marsh are not expected to further
35 degrade existing EC levels and thus would not contribute additionally to adverse effects on the fish
36 and wildlife beneficial uses. Because EC is not bioaccumulative, any changes in long-term average EC
37 levels would not directly cause bioaccumulative problems in fish and wildlife. Suisun Marsh is CWA
38 Section 303(d) listed as impaired due to elevated EC, but EC levels are not expected to change
39 substantially under Alternative 2D, relative to Existing Conditions, and thus it is not expected that
40 they would contribute to additional beneficial use impairment.

41 In the Plan Area, Alternative 2D is not expected to result in an increase in the frequency with which
42 Bay-Delta WQCP EC objectives are exceeded, except for at the San Joaquin River at Prisoners Point
43 (fish and wildlife objective; 6% increase). The increased frequency of exceedance of the fish and
44 wildlife objective at Prisoners Point could contribute to adverse effects on aquatic life (specifically,
45 indirect adverse effects on striped bass spawning), though there is a high degree of uncertainty

1 associated with this impact. However, by adaptively managing the Head of Old River Barrier and the
 2 fraction of south Delta versus north Delta diversions, EC levels at Prisoners Point would likely be
 3 decreased to a level that would not adversely affect aquatic life beneficial uses.

4 In the Sacramento River at Emmaton, large monthly average increases in EC were modeled to occur
 5 during the summer months of the drought period, and more generally in below normal, dry and
 6 critical water year types. The increases in drought period average EC levels modeled could cause
 7 substantial water quality degradation that would potentially contribute to adverse effects on the
 8 agricultural beneficial uses in the western Delta. The comparison to Existing Conditions reflects
 9 changes in EC due to both Alternative 2D operations and climate change/sea level rise. The adverse
 10 effects expected to occur at Emmaton would be due in part to the effects of climate change/sea level
 11 rise, and in part due to Alternative 2D operations. This is evidenced by the significant effects
 12 expected in the No Action Alternative (ELT) at Emmaton relative to Existing Conditions, as well as
 13 the fact that a lesser level of adverse effects is expected at Emmaton under Alternative 2D relative to
 14 the No Action Alternative (ELT). During summer of below normal, dry and critical water years,
 15 additional flow in the Sacramento River at Emmaton would reduce or eliminate increases in EC. It is
 16 expected that for July–August of below normal, dry and critical water years, real-time operations
 17 that would include more precise management of upstream reservoir releases on a daily basis and
 18 less pumping from the north Delta intakes and greater reliance on south Delta intakes than that
 19 modeled would allow for enough flow in the Sacramento River at Emmaton to reduce water quality
 20 degradation to levels closer to the No Action Alternative that would not be expected to adversely
 21 affect beneficial uses. Because EC is not bioaccumulative, the increases in long-term average EC
 22 levels would not directly cause bioaccumulative problems in aquatic life or humans. The western
 23 Delta is CWA Section 303(d) listed for elevated EC and the increased EC degradation that was
 24 modeled in the western Delta could make beneficial use impairment measurably worse. Based on
 25 these findings, this impact in the Plan Area is considered to be significant. Implementation of
 26 Mitigation Measure WQ-11 would be expected to reduce these effects to a less-than-significant level.

27 **Mitigation Measure WQ-11: Avoid or Minimize Reduced Water Quality Conditions**

28 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 4A.

29 **Mitigation Measure WQ-11e: Adaptively Manage Diversions at the North and South Delta**
 30 **Intakes to Reduce or Eliminate Water Quality Degradation in Western Delta**

31 Please see Mitigation Measure WQ-11e under Impact WQ-11 in the discussion of Alternative 4A.

32 **Mitigation Measure WQ-11f: Adaptively Manage Head of Old River Barrier and Diversions**
 33 **at the North and South Delta Intakes to Reduce or Eliminate Exceedances of the Bay-Delta**
 34 **WQCP Objective at Prisoners Point**

35 Please see Mitigation Measure WQ-11f under Impact WQ-11 in the discussion of Alternative 4A.

36 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of**
 37 **Environmental Commitments 3, 4, 6–12, 15 and 16**

38 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would
 39 present no new direct sources of EC to the affected environment, including areas upstream of the
 40 Delta, within the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC,
 41 implementation of these Environmental Commitments would not be expected to adversely affect

1 any of the beneficial uses of the affected environment. Moreover, some habitat restoration activities
 2 would occur on lands within the Delta currently used for irrigated agriculture. Such replacement or
 3 substitution of land use activity is not expected to result in new or increased sources of EC to the
 4 Delta and, in fact, could decrease EC through elimination of high EC agricultural runoff.

5 Environmental Commitment 4 would result in some tidal habitat restoration, however, the areal
 6 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
 7 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
 8 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
 9 EC changes.

10 In summary, implementation of the Environmental Commitments would not be expected to
 11 adversely affect EC levels in the affected environment and thus would not adversely affect beneficial
 12 uses or substantially degrade water quality with regard to EC within the affected environment.
 13 Therefore, the effects on EC from implementing Environmental Commitments 3, 4, 6–12, 15, and 16
 14 are determined to not be adverse.

15 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 16 Alternative 2D would not present new or substantially changed sources of EC to the affected
 17 environment. Thus, implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would
 18 have negligible, if any, adverse effects on EC levels throughout the affected environment and would
 19 not cause exceedance of applicable state or federal numeric or narrative water quality
 20 objectives/criteria that would result in adverse effects on any beneficial uses within affected water
 21 bodies. Further, implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would not
 22 cause significant long-term water quality degradation such that there would be greater risk of
 23 adverse effects on beneficial uses. Based on these findings, this impact is considered to be less than
 24 significant. No mitigation is required.

25 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 26 **Maintenance**

27 ***Upstream of the Delta***

28 The effects of the Alternative 2D on mercury levels in surface waters upstream of the Delta relative
 29 to Existing Conditions and the No Action Alternative (ELT and LLT) would be similar to those
 30 described for Alternative 4 (see Section 8.3.3.9). This is because factors that affect mercury
 31 concentrations in surface waters upstream of the Delta are similar under Alternatives 4 and 2D. The
 32 changes in flow in the Sacramento River under Alternative 2D relative to Existing Conditions and the
 33 No Action Alternative (ELT) would not be of the magnitude of storm flows, in which substantial
 34 sediment-associated mercury is mobilized. Therefore, mercury loading should not be substantially
 35 different due to changes in flow. In addition, even though they may be flow-affected, total mercury
 36 concentrations remain well below criteria at upstream locations. Any negligible changes in mercury
 37 concentrations that may occur in the water bodies of the affected environment located upstream of
 38 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
 39 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
 40 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
 41 are expected to remain above guidance levels at upstream of Delta locations, but would not change
 42 substantially because the anticipated changes in flow are not expected to substantially change
 43 mercury loading relative to Existing Conditions or the No Action Alternative (ELT).

1 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
2 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
3 Mercury Control Program. These projects will target specific sources of mercury and methylation
4 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
5 The implementation of these projects could help to ensure that upstream of Delta environments will
6 not be substantially degraded for water quality with respect to mercury or methylmercury.

7 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
8 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
9 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
10 effects on mercury in the LLT are expected to be similar to those described above.

11 **Delta**

12 The effects of Alternative 2D on waterborne concentrations of mercury (Appendix 8I, *Mercury*, Table
13 I-17) and methylmercury (Appendix 8I, Table I-18), and fish tissue mercury concentrations for
14 largemouth bass fillet (Appendix 8I, Tables I-21a and I-21b) were evaluated for nine Delta locations.

15 Increases in long-term average mercury concentrations relative to Existing Conditions and the No
16 Action Alternative (ELT) would be very small, 0.3 ng/L or less. Also, use of assimilative capacity for
17 mercury relative to the 25 ng/L ecological threshold under Alternative 2D, relative to Existing
18 Conditions and the No Action Alternative (ELT), would be very low, approximately 2% or less, as a
19 long-term average, for all Delta locations (Appendix 8I, *Mercury*, Table I-24). These concentration
20 changes and small changes in assimilative capacity for mercury are not expected to result in adverse
21 (or positive) effects to beneficial uses.

22 Changes in methylmercury concentrations in water also are expected to be very small. The greatest
23 annual average methylmercury concentration under Alternative 2D would be 0.166 ng/L for the San
24 Joaquin River at Buckley Cove, for the drought period modeled, which would be slightly higher than
25 Existing Conditions (0.161 ng/L) and slightly lower than the No Action Alternative (ELT) (0.168
26 ng/L) (Appendix 8I, *Mercury*, Table I-18). All methylmercury concentrations in water were
27 estimated to exceed the TMDL guidance objective of 0.06 ng/L under Existing Conditions and,
28 therefore, no assimilative capacity exists.

29 Fish tissue estimates for largemouth bass fillet show small or no increases in mercury
30 concentrations relative to Existing Conditions and the No Action Alternative (ELT) based on long-
31 term annual average concentrations for mercury at the Delta locations (Appendix 8I, *Mercury*,
32 Tables I-21a and I-21b). Concentrations expected for Alternative 2D, with Equation 1, show
33 increases of 7% or less, relative to Existing Conditions and the No Action Alternative (ELT), in all
34 years (Appendix 8I, Table I-21a). Concentrations expected with Equation 2 show increases of 10%
35 or less relative to Existing Conditions and the No Action Alternative (ELT) in all years (Appendix 8I,
36 Table I-21b).

37 Because the increases are relatively small, and it is not evident that substantive increases are
38 expected at numerous locations throughout the Delta, these changes are expected to be within the
39 uncertainty inherent in the modeling approach, and would likely not be measurable in the
40 environment. See Appendix 8I, *Mercury*, for a complete discussion of the uncertainty associated with
41 the fish tissue estimates. Briefly, the bioaccumulation models contain multiple sources of
42 uncertainty associated with their development. These are related to: analytical variability; temporal
43 and/or seasonal variability in Delta source water concentrations of methylmercury;

1 interconversion of mercury species (i.e., the non-conservative nature of methylmercury as a
2 modeled constituent); and limited sample size (both in number of fish and time span over which the
3 measurements were made), among others. Although there is considerable uncertainty in the models
4 used, the results serve as a reasonable approximations of a very complex process. Considering the
5 uncertainty, small (i.e., <20–25%) increases or decreases in modeled fish tissue mercury
6 concentrations at a low number of Delta locations (i.e., 2–3) should be interpreted to be within the
7 uncertainty of the overall approach, and not predictive of actual adverse effects. Larger increases, or
8 increases evident throughout the Delta, can be interpreted as more reliable indicators of potential
9 adverse effects.

10 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
11 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
12 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
13 effects on mercury in the LLT are expected to be similar to those described above.

14 ***SWP/CVP Export Service Areas***

15 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
16 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
17 methylmercury concentrations for Alternative 2D at the Jones and Banks pumping plants would be
18 lower than Existing Conditions and the No Action Alternative (ELT) (Appendix 8I, *Mercury*, Tables I-
19 17 and I-18). Therefore, there would be increased assimilative capacity for mercury at these
20 locations (Appendix 8I, Table I-24).

21 The largest improvements in largemouth bass tissue mercury concentrations and Exceedance
22 Quotients ([EQs]; modeled tissue divided by TMDL guidance concentration) for Alternative 2D,
23 relative to Existing Conditions and the No Action Alternative (ELT) at any location within the Delta
24 are expected for the Banks and Jones pumping plants export pump locations. Concentrations
25 expected for Alternative 2D at the export pump locations with Equation 1 in all years show
26 decreases relative to Existing Conditions (10% to 12%) and relative to the No Action Alternative
27 (ELT) (11% to 13%) (Appendix 8I, *Mercury*, Table I-21a). Concentrations expected for Alternative
28 2D at the export pump locations with Equation 2 in all years show decreases relative to Existing
29 Conditions (14% to 17%) and relative to the No Action Alternative (ELT) (15% to 18%) (Appendix
30 8I, Table I-21b).

31 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
32 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
33 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
34 effects on mercury in the LLT are expected to be similar to those described above.

35 ***NEPA Effects:*** Based on the above discussion, Alternative 2D would not cause concentrations of
36 mercury and methylmercury in water and fish tissue in the affected environment to be substantially
37 different from the No Action Alternative (ELT and LLT) and, thus, would not cause additional
38 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
39 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
40 Because mercury concentrations are not expected to increase substantially, no long-term water
41 quality degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
42 Because any increases in mercury or methylmercury concentrations are not likely to be measurable,
43 changes in mercury concentrations or fish tissue mercury concentrations would not make any
44 existing mercury-related impairment measurably worse. In comparison to the No Action Alternative

1 (ELT and LLT), Alternative 2D would not be expected to increase levels of mercury by frequency,
 2 magnitude, and geographic extent such that the affected environment would be expected to have
 3 measurably higher body burdens of mercury in aquatic organisms, thereby substantially increasing
 4 the health risks to wildlife (including fish) or humans consuming those organisms. Based on these
 5 findings, the effects of Alternative 2D on mercury in the affected environment are considered to be
 6 not adverse.

7 **CEQA Conclusion:** Under Alternative 2D, greater water demands and climate change would alter the
 8 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
 9 River watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury
 10 and methylmercury upstream of the Delta would not be substantially different relative to Existing
 11 Conditions due to the lack of important relationships between mercury/methylmercury
 12 concentrations and flow for the major rivers.

13 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
 14 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
 15 over the period of record under Alternative 2D would be very similar to Existing Conditions.
 16 Similarly, estimates of fish tissue mercury concentrations show small differences would occur
 17 among sites for Alternative 2D as compared to Existing Conditions for Delta sites.

18 Assessment of effects of mercury in the SWP/CVP Export Service Areas were based on effects on
 19 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
 20 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
 21 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 2D, as
 22 compared to Existing Conditions.

23 As such, Alternative 2D is expected to cause additional exceedance of applicable water quality
 24 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects
 25 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
 26 not expected to increase substantially, no long-term water quality degradation is expected to occur
 27 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
 28 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
 29 or fish tissue mercury concentrations would not make any existing mercury-related impairment
 30 measurably worse. In comparison to Existing Conditions, Alternative 2D would not increase levels of
 31 mercury by frequency, magnitude, and geographic extent such that the affected environment would
 32 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
 33 substantially increasing the health risks to wildlife (including fish) or humans consuming those
 34 organisms. Based on these findings, this impact is considered to be less than significant. No
 35 mitigation is required.

36 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of**
 37 **Environmental Commitments 3, 4, 6-12, 15, and 16**

38 **NEPA Effects:** The potential types of effects on mercury resulting from implementation of the
 39 Environmental Commitments under Alternative 2D would be generally similar to those described
 40 under Alternative 4 (see Section 8.3.3.9). However, the magnitude of effects on mercury and
 41 methylmercury at locations upstream of the Delta, in the Delta, and the SWP/CVP Export Service
 42 Areas related to habitat restoration would be considerably lower than described for Alternative 4.
 43 This is because the amount of habitat restoration to be implemented under Alternative 2D would be
 44 very low compared to the total proposed restoration area that would be implemented under

1 Alternative 4. The small amount of habitat restoration to be implemented under Alternative 2D may
 2 occur on lands in the Delta formerly used for irrigated agriculture. Habitat restoration proposed
 3 under Alternative 2D has the potential to increase water residence times and increase accumulation
 4 of organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
 5 vicinity of the restored habitat areas. Design of restoration sites would be guided by Environmental
 6 Commitment 12, which requires development of site-specific mercury management plans as
 7 restoration actions are implemented. The effectiveness of minimization and mitigation actions
 8 implemented according to the mercury management plans is not known at this time, although the
 9 potential to reduce methylmercury concentrations exists based on current research. Although
 10 Environmental Commitment 12 would be implemented with the goal to reduce this potential effect,
 11 there remain uncertainties related to site-specific restoration conditions and the potential for
 12 increases in methylmercury concentrations in the Delta in the vicinity of the restored areas.
 13 Therefore, the effect of Environmental Commitments 3, 4, 6–12, 15, and 16 on mercury and
 14 methylmercury is considered to be adverse.

15 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
 16 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
 17 the SWP/CVP Export Service Areas due to implementation of Environmental Commitments 3, 4, 6–
 18 12, 15, and 16 relative to Existing Conditions. However, in the Delta, due to the small amount of tidal
 19 restoration areas proposed, relative to Existing Conditions, uptake of mercury from water and/or
 20 methylation of inorganic mercury may increase in localized areas as part of the creation of new,
 21 marshy, shallow, or organic-rich restoration areas. Although not quantifiable, on a local level,
 22 increases in methylmercury concentrations may be measurable. Methylmercury is CWA Section
 23 303(d)-listed within the affected environment, and therefore any potential measurable increase in
 24 methylmercury concentrations would make existing mercury-related impairment measurably
 25 worse. Because mercury is bioaccumulative, increases in water-borne mercury or methylmercury
 26 that could occur in some areas could bioaccumulate to somewhat greater levels in aquatic organisms
 27 and would, in turn, pose health risks to fish, wildlife, or humans. Design of restoration sites would be
 28 guided by Environmental Commitment 12, which requires development of site-specific mercury
 29 management plans as restoration actions are implemented. The effectiveness of minimization and
 30 mitigation actions implemented according to the mercury management plans is not known at this
 31 time, although the potential to reduce methylmercury concentrations exists based on current
 32 research. Although Environmental Commitment 12 would be implemented with the goal to reduce
 33 this potential effect, the uncertainties related to site specific restoration conditions and the potential
 34 for increases in methylmercury concentrations in the Delta result in this potential impact being
 35 considered significant. No mitigation measures would be available until specific restoration actions
 36 are proposed. Therefore, this impact is considered significant and unavoidable.

37 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 38 **Maintenance**

39 ***Upstream of the Delta***

40 As described for Alternative 4 (in Section 8.3.3.9), nitrate levels in the major rivers (Sacramento,
 41 Feather, American) are low, generally due to ample dilution available in the reservoirs and rivers
 42 relative to the magnitude of the point and non-point source discharges, and there is no correlation
 43 between historical water year average nitrate concentrations and water year average flow in the
 44 Sacramento River at Freeport. Consequently, any modified reservoir operations and subsequent
 45 changes in river flows under Alternative 2D, relative to Existing Conditions or the No Action

1 Alternative (ELT), are expected to have negligible, if any, effects on average reservoir and river
2 nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

3 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento River
4 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
5 between historical water year average nitrate concentrations and water year average flow in the San
6 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
7 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
8 regression $r^2=0.49$; Figure 2 in Appendix 8J, *Nitrate*). Under Alternative 2D, long-term average flows
9 at Vernalis would decrease an estimated 1% relative to Existing Conditions and would remain
10 virtually the same relative to the No Action Alternative (ELT). Given the relatively small decreases in
11 flows and the weak correlation between nitrate and flows in the San Joaquin River, it is expected
12 that nitrate concentrations in the San Joaquin River would be minimally affected, if at all, by
13 anticipated changes in flow rates under the No Action Alternative (ELT).

14 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
15 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
16 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
17 effects on nitrate in the LLT are expected to be similar to those described above.

18 Any negligible changes in nitrate concentrations that may occur under Alternative 2D in the water
19 bodies of the affected environment located upstream of the Delta would not be of frequency,
20 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
21 degrade the quality of these water bodies, with regard to nitrate.

22 **Delta**

23 Mass balance calculations indicate that under Alternative 2D, relative to Existing Conditions and the
24 No Action Alternative (ELT), nitrate concentrations throughout the Delta are anticipated to remain
25 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Table 34). Although changes
26 at specific Delta locations and for specific months may be substantial on a relative basis (Appendix
27 8J, Table 39), the absolute concentration of nitrate in Delta waters would remain low (<1.4 mg/L-N)
28 in relation to the drinking water MCL of 10 mg/L-N, as well as all other thresholds (see *Nitrate*
29 under Section 8.3.1.7, *Constituent-Specific Considerations Used in the Assessment*). Long-term average
30 nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 Delta assessment
31 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
32 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
33 concentrations would be somewhat reduced under Alternative 2D relative to Existing Conditions,
34 and slightly increased relative to the No Action Alternative (ELT). No additional exceedances of the
35 MCL are anticipated at any location under Alternative 2D (Appendix 8J, Table 34).

36 Use of assimilative capacity relative to the drinking water MCL of 10 mg/L-N under Alternative 2D
37 would be low or negligible (i.e., $\leq 4\%$) in comparison to both Existing Conditions and the No Action
38 Alternative (ELT), for all locations and months, for all modeled years (1976–1991), and for the
39 drought period (1987–1991) (Appendix 8J, *Nitrate*, Table 40).

40 As described for Alternative 4 (see Section 8.3.3.9), actual nitrate concentrations would likely be
41 higher than the modeling results indicate in certain locations under Alternative 2D. This is the mass
42 balance modeling does not account for contributions from the SRWTP, which would be
43 implementing nitrification/partial denitrification, or Delta wastewater treatment plant dischargers

1 that practice nitrification, but not denitrification. However, for the reasons described for Alternative
 2 4, any increases in nitrate concentrations that may occur at certain locations within the Delta under
 3 Alternative 2D would not be of frequency, magnitude and geographic extent that would adversely
 4 affect any beneficial uses or substantially degrade the water quality at these locations, with regard
 5 to nitrate.

6 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 7 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 8 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 9 effects on nitrate in the LLT are expected to be similar to those described above.

10 ***SWP/CVP Export Service Areas***

11 Assessment of effects of Alternative 2D on nitrate in the SWP/CVP Export Service Areas is based on
 12 effects on nitrate at the Banks and Jones pumping plants. Results of the mass balance calculations
 13 indicate that relative to Existing Conditions and the No Action Alternative (ELT), nitrate
 14 concentrations at Banks and Jones pumping plants under Alternative 2D are anticipated to decrease
 15 on a long-term average annual basis by 34% at the Banks pumping plant and 36% at the Jones
 16 pumping plant (Appendix 8J, *Nitrate*, Table 39). During the late summer, particularly in the drought
 17 period assessed, concentrations are expected to increase, but the absolute value of these changes
 18 (i.e., in mg/L-N) would be small. Additionally, given the many factors that contribute to potential
 19 algal blooms in the SWP and CVP canals within the Export Service Areas, and the lack of studies that
 20 have shown a direct relationship between nutrient concentrations in the canals and reservoirs and
 21 problematic algal blooms in these water bodies, there is no basis to conclude that these small (i.e.,
 22 generally <0.2 mg/L-N), seasonal increases in nitrate concentrations would increase the potential
 23 for problem algal blooms in the SWP/CVP Export Service Areas. No additional exceedances of the
 24 MCL are anticipated under Alternative 2D relative to Existing Conditions and the No Action
 25 Alternative (ELT) (Appendix 8J, Table 34). On a monthly average basis and on a long-term annual
 26 average basis, for all modeled years and for the drought period only, use of assimilative capacity
 27 available under Existing Conditions and the No Action Alternative (ELT), relative to the 10 mg/L-N
 28 MCL, would be negligible ($\leq 2\%$) for both Banks and Jones pumping plants (Appendix 8J, Table 38).

29 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 30 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 31 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 32 effects on nitrate in the LLT are expected to be similar to those described above.

33 Any increases in nitrate concentrations that may occur in water exported via Banks and Jones
 34 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
 35 degrade the quality of exported water, with regard to nitrate.

36 ***NEPA Effects:*** Modified reservoir operations and subsequent changes in river flows under
 37 Alternative 2D, relative to the No Action Alternative (ELT and LLT), are expected to have negligible,
 38 if any, effects on reservoir and river nitrate concentrations upstream of Freeport in the Sacramento
 39 River watershed and upstream of the Delta in the San Joaquin River watershed. In the Delta, nitrate
 40 concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to
 41 adopted objectives. No additional exceedances of the 10 mg/L-N MCL are anticipated at any Delta
 42 location, and use of assimilative capacity available under the No Action Alternative, relative to the
 43 drinking water MCL of 10 mg/L-N, would be low. Long-term average nitrate concentrations at Banks
 44 and Jones pumping plants are anticipated to differ negligibly relative to the No Action Alternative

1 (ELT and LLT) and no additional exceedances of the 10 mg/L-N MCL are anticipated. Therefore, the
2 effects on nitrate from implementing water conveyance facilities are considered to be not adverse.

3 **CEQA Conclusion:** Nitrate concentrations are generally low in the reservoirs and rivers of the
4 watersheds, owing to substantial dilution available for point sources and the lack of substantial
5 nonpoint sources of nitrate upstream of the SRWTP in the Sacramento River watershed, and in the
6 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although
7 higher in the San Joaquin River watershed, nitrate concentrations are not well-correlated with flow
8 rates. Consequently, any modified reservoir operations and subsequent changes in river flows under
9 Alternative 2D, relative to Existing Conditions, are expected to have negligible, if any, effects on
10 reservoir and river nitrate concentrations upstream of Freeport in the Sacramento River watershed
11 and upstream of the Delta in the San Joaquin River watershed.

12 In the Delta, results of the mass balance calculations indicate that under Alternative 2D, relative to
13 Existing Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4
14 mg/L-N) relative to adopted objectives. No additional exceedances of the 10 mg/L-N MCL are
15 anticipated at any location, and use of assimilative capacity available under Existing Conditions,
16 relative to the drinking water MCL of 10 mg/L-N, would be low or negligible (i.e., ≤4%) for virtually
17 all locations and months.

18 Assessment of effects of nitrate in the SWP/CVP Export Service Areas is based on effects on nitrate
19 concentrations at the Banks and Jones pumping plants. Results of the mass balance calculations
20 indicate that under Alternative 2D, relative to Existing Conditions, long-term average nitrate
21 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No
22 additional exceedances of the 10 mg/L-N MCL are anticipated, and use of assimilative capacity
23 available under Existing Conditions, relative to the MCL would be negligible (i.e., ≤2%) for both
24 Banks and Jones pumping plants for all months.

25 Based on the above, there would be no substantial, long-term increase in nitrate concentrations in
26 the rivers and reservoirs upstream of the Delta, in the Plan Area, or the SWP/CVP Export Service
27 Areas under Alternative 2D relative to Existing Conditions. As such, this alternative is not expected
28 to cause additional exceedance of applicable water quality objectives/criteria by frequency,
29 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
30 in the affected environment. Because nitrate concentrations are not expected to increase
31 substantially, no long-term water quality degradation is expected to occur and, thus, no adverse
32 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
33 environment and thus any increases that may occur in some areas and months would not make any
34 existing nitrate-related impairment measurably worse because no such impairments currently exist.
35 Because nitrate is not bioaccumulative, increases that may occur in some areas and months would
36 not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
37 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
38 significant. No mitigation is required.

39 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of**
40 **Environmental Commitments 3, 4, 6-12, 15, and 16**

41 **NEPA Effects:** Some habitat restoration activities included in Environmental Commitments 3, 4, and
42 6-11 would occur on lands within the Delta formerly used for agriculture. As discussed for Impact
43 WQ-2, increased biota that may result in those areas may increase ammonia, which in turn may be
44 converted to nitrate by established microbial communities. However, the areal extent of the new

1 habitat implemented for the Environmental Commitments would be less than the existing and No
2 Action Alternative habitat areas, and similar habitat exists currently in the Delta and is not identified
3 as contributing to adverse nitrate conditions. Thus, these land use changes would not be expected to
4 substantially increase nitrate concentrations in the Delta. Implementation of Environmental
5 Commitments 12, 15, and 16 do not include actions that would affect nitrate sources or loading.
6 Based on these findings, the effects on nitrate from implementing Environmental Commitments 3, 4,
7 6–12, 15, and 16 are considered to be not adverse.

8 **CEQA Conclusion:** Land use changes that would occur from the Environmental Commitments are
9 not expected to substantially increase nitrate concentrations, because the amount of area to be
10 converted would be small relative to existing habitat, and existing habitats are not known for
11 contributing to adverse nitrate conditions. Thus, it is expected that implementation of
12 Environmental Commitments 3, 4, 6–12, 15, and 16 would not cause additional exceedance of
13 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
14 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
15 nitrate concentrations are not expected to increase substantially due to these Environmental
16 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
17 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
18 environment and thus any minor increases that may occur in some areas would not make any
19 existing nitrate-related impairment measurably worse because no such impairments currently exist.
20 Because nitrate is not bioaccumulative, minor increases that may occur in some areas would not
21 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
22 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
23 significant. No mitigation is required.

24 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 25 **Operations and Maintenance**

26 ***Upstream of the Delta***

27 The effects of Alternative 2D on DOC concentrations in reservoirs and rivers upstream of the Delta
28 would be similar to those effects described for Alternative 4 because factors affecting DOC
29 concentrations in these water bodies would be similar. Moreover, long-term average flow and DOC
30 levels in the Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus
31 changes in system operations and resulting reservoir storage levels and river flows under
32 Alternative 2D would not be expected to cause substantial long-term changes in DOC concentrations
33 in the water bodies upstream of the Delta. Any changes in DOC levels in water bodies upstream of
34 the Delta under Alternative 2D, relative to Existing Conditions and the No Action Alternative (ELT
35 and LLT), would not be of sufficient frequency, magnitude and geographic extent that would
36 adversely affect any beneficial uses or substantially degrade the quality of these water bodies.

37 ***Delta***

38 Under Alternative 2D, the geographic extent of effects pertaining to long-term average DOC
39 concentrations in the Delta would be less extensive, and the magnitude of predicted long-term
40 change and relative frequency of concentration threshold exceedances would be similar to, or lower
41 than, the changes described for Alternative 4. The effects of Alternative 2D relative to Existing
42 Conditions and the No Action Alternative (ELT) are discussed together because the direction and
43 magnitude of predicted change are similar. Relative to the Existing Conditions and No Action

1 Alternative (ELT), Alternative 2D would result in small increases in long-term average DOC
 2 concentrations for both the modeled 16-year period (1976–1991) and drought period (1987–1991)
 3 at several interior Delta locations (increases up to 0.3 mg/L at the S. Fork Mokelumne River at
 4 Staten Island, Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant #1)
 5 (Appendix 8K, *Organic Carbon*, Table DOC-12). The increases in average DOC concentrations would
 6 correspond to more frequent concentration threshold exceedances, with the greatest change
 7 occurring at the Contra Costa Pumping Plant #1 associated with the 3 mg/L threshold (i.e., increase
 8 from 52% under Existing Conditions to 68% under Alternative 2D for the modeled 16-year period).
 9 The change in frequency of threshold concentration exceedances at other assessment locations
 10 would be similar or lower.

11 While Alternative 2D would lead to slightly higher long-term average DOC concentrations at some
 12 municipal water intakes and Delta interior locations, the predicted change would not be expected to
 13 adversely affect MUN beneficial uses, or any other beneficial use. As discussed for Alternative 4,
 14 substantial changes in ambient DOC concentrations would need to occur before significant changes
 15 in drinking water treatment plant design or operations are triggered. The increases in long-term
 16 average DOC concentrations estimated to occur at various Delta locations under Alternative 2D are
 17 of sufficiently small magnitude that they would not require existing drinking water treatment plants
 18 to substantially upgrade treatment for DOC removal above levels currently employed.

19 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 20 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 21 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 22 effects on DOC in the LLT are expected to be similar to those described above.

23 Relative to Existing Conditions and the No Action Alternative (ELT and LLT), Alternative 2D would
 24 lead to predicted improvements in long-term average DOC concentrations at Barker Slough, as well
 25 as Banks and Jones pumping plants (discussed below).

26 ***SWP/CVP Export Service Areas***

27 Under the Alternative 2D, long-term average DOC concentrations would decrease at Barker Slough
 28 by 0.1 mg/L, and at both the Banks and Jones pumping plants by 0.5 mg/L, relative to Existing
 29 Conditions, and the reductions would be similar compared to No Action Alternative (ELT) (Appendix
 30 8K, *Organic Carbon*, Table DOC-12). Decreases in long-term average DOC would result in generally
 31 lower exceedance frequencies for concentration thresholds, although the frequency of exceedances
 32 of the 3 mg/L threshold during the modeled drought period would increase at the Banks and Jones
 33 pumping plants. Relative to Existing Conditions, exceedance of the 3 mg/L threshold would increase
 34 from 57% to 73% at Banks pumping plant and from 72% to 88% at Jones pumping plant. There
 35 would be little to no increase in exceedance of the 3 mg/L threshold relative to the No Action
 36 Alternative (ELT).

37 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 38 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 39 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 40 effects on DOC in the LLT are expected to be similar to those described above.

41 Maintenance of SWP and CVP facilities under Alternative 2D would not be expected to create new
 42 sources of DOC or contribute towards a substantial change in existing sources of DOC in the affected
 43 area.

1 **NEPA Effects:** In summary, the operations and maintenance activities under Alternative 2D, relative
2 to the No Action Alternative (ELT and LLT), would not cause a substantial long-term change in DOC
3 concentrations in the water bodies upstream of the Delta, in the Delta, or in the SWP/CVP Export
4 Service Areas. The long-term average DOC concentrations at Banks and Jones pumping plants are
5 predicted to decrease by 0.5 mg/L, while long-term average DOC concentrations for some Delta
6 interior locations are predicted to increase by as much as 0.3 mg/L. However, the increase in long-
7 term average DOC concentration that could occur within the Delta interior would not be of sufficient
8 magnitude to adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters.
9 Based on these findings, the effect of operations and maintenance activities on DOC under
10 Alternative 2D is determined to be not adverse.

11 **CEQA Conclusion:** For the same reasons described for Alternative 4, the operations and
12 maintenance activities under Alternative 2D, relative to the Existing Conditions, would not cause a
13 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta, in
14 the Delta, or in the SWP/CVP Export Service Areas. Any modified reservoir operations and
15 subsequent changes in river flows under Alternative 2D, relative to Existing Conditions, would not
16 be expected to result in a substantial adverse change in DOC levels upstream of the Delta. Moreover,
17 long-term average flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are
18 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
19 long-term change in DOC concentrations upstream of the Delta.

20 Relative to Existing Conditions, Alternative 2D would result in relatively small increases (i.e., ≤ 0.3
21 mg/L) in long-term average DOC concentrations at some interior Delta locations. The predicted
22 increases would not substantially increase the frequency with which long-term average DOC
23 concentrations exceeds 2, 3, or 4 mg/L. Because this alternative would lead to only slightly higher
24 long-term average DOC concentrations at the interior Delta locations and some municipal water
25 intakes, the predicted changes would not be expected to adversely affect MUN beneficial uses, or any
26 other beneficial use.

27 Relative to Existing Conditions, Alternative 2D would result in reduced long-term average DOC
28 concentrations at the Banks and Jones pumping plants and Barker Slough. However, Alternative 2D
29 would result in slightly greater frequency of exceedance of the 3 mg/L DOC concentration threshold
30 during the modeled drought period. Nevertheless, an overall improvement in DOC-related water
31 quality would be predicted in the SWP/CVP Export Service Areas.

32 Based on the above, the operations and maintenance activities of Alternative 2D would not result in
33 any substantial change in long-term average DOC concentration. The increases in long-term average
34 DOC concentration that could occur within the Delta would not be of sufficient magnitude to
35 adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters or waters of the
36 SWP/CVP Service Area. Because DOC is not bioaccumulative, the increases in long-term average
37 DOC concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
38 Finally, DOC is not causing beneficial use impairments and thus is not CWA Section 303(d) listed for
39 any water body within the affected environment. Because long-term average DOC concentrations
40 are not expected to increase substantially, no long-term water quality degradation with respect to
41 DOC is expected to occur and, thus, no adverse effects on beneficial uses would occur. Based on
42 these findings, this impact is considered to be less than significant. No mitigation is required.

1 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
2 **Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16**

3 **NEPA Effects:** Relative to existing habitat and that to be developed under the No Action Alternative
4 (ELT and LLT), the area of new habitat restoration implemented for the Environmental
5 Commitments would be very small. Implementation of non-habitat restoration Environmental
6 Commitments would not be expected to have substantial, if even measurable, effect on DOC
7 concentrations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas,
8 because they would present no major sources of DOC to the affected environment. Consequently,
9 any increases in average DOC levels in the affected environment are not expected to be of sufficient
10 frequency, magnitude and geographic extent that would adversely affect the MUN beneficial use, or
11 any other beneficial uses, of the affected environment, nor would potential increases substantially
12 degrade water quality with regard to DOC. Based on these findings, the effect of the Environmental
13 Commitments on DOC is determined to be not adverse.

14 **CEQA Conclusion:** Implementation of habitat restoration (i.e., Environmental Commitments 4, 6, 7,
15 and 10), relative to the Existing Conditions, is not expected to cause a substantial long-term change
16 in DOC concentrations in the water bodies upstream of the Delta, in the Delta, or in the SWP/CVP
17 Export Service Areas, because the land area proposed for restoration would be relatively small
18 compared to existing land area and sources of DOC. Implementation of other Environmental
19 Commitments also would not be expected to have substantial, if even measurable, effect on DOC
20 concentrations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas,
21 because they would present no major sources of DOC to the affected environment. Consequently,
22 increases in average DOC levels in the affected environment are not expected to be of sufficient
23 frequency, magnitude and geographic extent that would adversely affect the MUN beneficial use, or
24 any other beneficial uses, of the affected environment, nor would potential increases substantially
25 degrade water quality with regard to DOC. Furthermore, DOC is not bioaccumulative, therefore
26 changes in DOC concentrations would not cause bioaccumulative problems in aquatic life or
27 humans. Finally, DOC is not causing beneficial use impairments and thus is not CWA Section 303(d)
28 listed for any water body within the affected environment. Because long-term average DOC
29 concentrations are not expected to increase substantially, no long-term water quality degradation
30 with respect to DOC is expected to occur and, thus, no adverse effects on beneficial uses would
31 occur. Based on these findings, this impact is considered to be less than significant. No mitigation is
32 required.

33 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

34 The effects of operation of the water conveyance facilities under Alternative 2D on pathogen levels
35 in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas
36 relative to Existing Conditions would be similar to those effects described for Alternative 4 (see
37 Section 8.3.3.9). As described for Alternative 4, pathogen concentrations in the Sacramento and San
38 Joaquin Rivers have a minimal relationship to flow rate in these rivers. Further, urban runoff
39 contributions during the dry season would be expected to be a relatively small fraction of the rivers'
40 total flow rates. During wet weather events, when urban runoff contributions would be higher, the
41 flows in the rivers also would be higher. Given the small magnitude of urban runoff contributions
42 relative to the magnitude of river flows and that pathogen concentrations in the rivers have a
43 minimal relationship to river flow rate, river flow rate and reservoir storage reductions that would
44 occur under Alternative 2D, relative to Existing Conditions and the No Action Alternative (ELT and

1 LLT), would not be expected to result in a substantial adverse change in pathogen concentrations in
2 the reservoirs and rivers upstream of the Delta.

3 The effects of Alternative 2D relative to Existing Conditions and the No Action Alternative (ELT and
4 LLT) would be changes in the relative percentage of water throughout the Delta being comprised of
5 various source waters (i.e., water from the Sacramento River, San Joaquin River, Bay water, eastside
6 tributaries, and agricultural return flow), due to potential changes in inflows particularly from the
7 Sacramento River watershed. However, as described for Alternative 4, it is expected there would be
8 no substantial change in Delta pathogen concentrations in response to a shift in the Delta source
9 water percentages under this alternative or substantial degradation of these water bodies, with
10 regard to pathogens, because it is expected that pathogen sources in close proximity to Delta sites
11 would have a greater influence on pathogen levels at the site, rather than the primary source(s) of
12 water to the site. In-Delta potential pathogen sources, including water-based recreation, tidal
13 habitat, wildlife, and livestock-related uses, would continue under this alternative. As such, there is
14 not expected to be substantial, if even measurable, changes in pathogen concentrations in the
15 SWP/CVP Export Service Area waters.

16 As such, Alternative 2D would not be expected to substantially increase the frequency with which
17 applicable Basin Plan objectives or U.S. EPA-recommended pathogen criteria would be exceeded in
18 water bodies of the affected environment located upstream of the Delta or substantially degrade the
19 quality of these water bodies, with regard to pathogens.

20 **NEPA Effects:** Because pathogen levels are expected to be minimally affected relative to the No
21 Action Alternative (ELT and LLT), the effects on pathogens from implementing Alternative 2D are
22 determined to be not adverse.

23 **CEQA Conclusion:** The effects of Alternative 2D on pathogen levels in surface waters upstream of the
24 Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would
25 be similar to those described for Alternative 4 (see Section 8.3.3.9). This is because the factors that
26 would affect pathogen levels in the surface waters of these areas would be similar. Therefore, this
27 alternative is not expected to cause additional exceedance of applicable water quality objectives by
28 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
29 of waters in the affected environment. Because pathogen concentrations are not expected to
30 increase substantially, no long-term water quality degradation for pathogens is expected to occur
31 and, thus, no adverse effects on beneficial uses would occur. The San Joaquin River in the Stockton
32 Deep Water Ship Channel is CWA Section 303(d) listed for pathogens. Because no measurable
33 increase in Deep Water Ship Channel pathogen concentrations are expected to occur on a long-term
34 basis, further degradation and impairment of this area is not expected to occur. Finally, pathogens
35 are not bioaccumulative constituents. Based on these findings, this impact is considered to be less
36 than significant. No mitigation is required.

37 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of Environmental** 38 **Commitments 3, 4, 6-12, 15, and 16**

39 **NEPA Effects:** Environmental Commitments 3, 4, and 6-11 would involve habitat restoration
40 actions. This could result in localized increases in wildlife-related coliforms relative to the No Action
41 Alternative (ELT and LLT). The Delta currently supports similar habitat types and, with the
42 exception of the CWA Section 303(d) listing for the Stockton Deep Water Ship Channel, is not
43 recognized as exhibiting pathogen concentrations that rise to the level of adversely affecting
44 beneficial uses. As such, the potential increase in wildlife-related coliform concentrations due to

1 tidal habitat creation is not expected to adversely affect beneficial uses. The remaining
 2 Environmental Commitments would not be expected to affect pathogen levels, because they are
 3 actions that do not affect the presence of pathogen sources. Based on these findings, the effects on
 4 pathogens from implementing Environmental Commitments 3, 4, 6–12, 15, and 16 are determined
 5 to not be adverse.

6 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, and 6–11 could result in
 7 localized increases in wildlife-related coliforms relative to Existing Conditions. The Delta currently
 8 supports similar habitat types and, with the exception of the CWA Section 303(d) listing for the
 9 Stockton Deep Water Ship Channel, is not recognized as exhibiting pathogen concentrations that rise
 10 to the level of adversely affecting beneficial uses. As such, the potential increase in wildlife-related
 11 coliform concentrations due to tidal habitat creation is not expected to adversely affect beneficial
 12 uses. Therefore, the Environmental Commitments are not expected to cause additional exceedance
 13 of applicable water quality objectives by frequency, magnitude, and geographic extent that would
 14 cause adverse effects on any beneficial uses of waters in the affected environment. Because
 15 pathogen concentrations are not expected to increase substantially, no long-term water quality
 16 degradation for pathogens is expected to occur and, thus, no adverse effects on beneficial uses
 17 would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is CWA Section 303(d)
 18 listed for pathogens. Because no measurable increase in Deep Water Ship Channel pathogen
 19 concentrations are expected to occur on a long-term basis, further degradation and impairment of
 20 this area is not expected to occur. Finally, pathogens are not bioaccumulative constituents. Based on
 21 these findings, this impact is considered to be less than significant. No mitigation is required.

22 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and** 23 **Maintenance**

24 The effects of Alternative 2D operations and maintenance on pesticide levels in surface waters
 25 upstream of the Delta, relative to Existing Conditions and the No Action Alternative (ELT), would be
 26 similar to those expected to occur under Alternative 4 (see Section 8.3.3.9). This is because under
 27 Alternative 2D, the primary factor that would influence pesticide concentrations in surface waters
 28 upstream of the Delta—the effect of timing and magnitude of reservoir releases on dilution
 29 capacity—is expected to change by a similar degree. Changes in average winter and summer flow
 30 rates, relative to Existing Conditions and the No Action Alternative (ELT), are expected to be similar
 31 to or less than changes in flow rates expected under Alternative 4 in the Sacramento River at
 32 Freeport, American River at Nimbus, Feather River at Thermalito and the San Joaquin River at
 33 Vernalis (Appendix 8L, *Pesticides*, Tables 1 through 4). Similarly, the primary factor that would
 34 influence pesticide concentrations in surface waters of the Delta and in the SWP/CVP Export Service
 35 Areas (i.e., changes in San Joaquin River, Sacramento River and Delta Agriculture source water
 36 fractions at various Delta locations, including Banks and Jones pumping plants) is expected to
 37 change by a similar degree. The percentage change in monthly average source water fractions would
 38 be similar to changes expected under Alternative 4 (Appendix 8D, *Source Water Fingerprinting*
 39 *Results*).

40 It was concluded for Alternative 4, and thus for Alternative 2D based on similar flow changes, that
 41 the potential average summer flow reductions would not be of sufficient magnitude to substantially
 42 increase in-river pesticide concentrations or alter the long-term risk of pesticide-related effects on
 43 aquatic life beneficial uses upstream of the Delta. Greater long-term average flow reductions, and
 44 corresponding reductions in dilution/assimilative capacity, would be necessary before long-term
 45 risk of pesticide related effects on aquatic life beneficial uses would be adversely altered. Similarly,

1 the modeled changes in the source water fractions of Sacramento River, San Joaquin River, and Delta
2 agriculture water under Alternative 2D would not be of sufficient magnitude to substantially alter
3 the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial
4 uses of the Delta. Based on the general observation that San Joaquin River, in comparison to the
5 Sacramento River, is a greater contributor of organophosphate insecticides in terms of greater
6 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
7 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
8 improvement in export water quality respective to pesticides.

9 The flow changes in the LLT would be expected in the ranges of that described above for Alternative
10 2D, relative to Existing Conditions and the No Action Alternative (ELT), and that described for
11 Alternative 4 relative to the No Action Alternative (LLT) in Section 8.3.3.9. Thus, similar to above
12 and Alternative 4, the flow changes that would occur in the LLT under Alternative 2D, relative to
13 Existing Conditions and the No Action Alternative (LLT), would not be expected to result in changes
14 in dilution of pesticides of sufficient magnitude to substantially alter the long-term risk of pesticide-
15 related toxicity to aquatic life, nor adversely affect other beneficial uses upstream of the Delta, in the
16 Delta, or the SWP/CVP Export Service Areas.

17 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
18 American, and San Joaquin Rivers under Alternative 2D relative to the No Action Alternative (ELT
19 and LLT) would be of insufficient magnitude to substantially increase the long-term risk of
20 pesticide-related water quality degradation and related toxicity to aquatic life in these water bodies
21 upstream of the Delta. Similarly, changes in source water fractions to the Delta would be of
22 insufficient magnitude to substantially alter the long-term risk of pesticide-related water quality
23 degradation and related toxicity to aquatic life in the Delta or CVP/SWP Export Service Areas.
24 Therefore, the effects on pesticides from the water conveyance facilities are determined not to be
25 adverse.

26 **CEQA Conclusion:** Based on the discussion above, the effects of Alternative 2D on pesticide levels in
27 surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative
28 to Existing Conditions would be similar to or slightly less than those described for the Alternative 4.
29 Alternative 2D would not result in any substantial change in long-term average pesticide
30 concentration or result in substantial increase in the anticipated frequency with which long-term
31 average pesticide concentrations would exceed aquatic life toxicity thresholds or other beneficial
32 use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for the Delta, or
33 the SWP/CVP service area. Numerous pesticides are currently used throughout the affected
34 environment, and while some of these pesticides may be bioaccumulative, those present-use
35 pesticides for which there is sufficient evidence for their presence in waters affected by SWP and
36 CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
37 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
38 problems in aquatic life or humans. Furthermore, while there are numerous CWA Section 303(d)
39 listings throughout the affected environment that name pesticides as the cause for beneficial use
40 impairment, the modeled changes in upstream river flows and Delta source water fractions under
41 Alternative 2D would not be expected to make any of these beneficial use impairments measurably
42 worse. Because long-term average pesticide concentrations are not expected to increase
43 substantially, no long-term water quality degradation with respect to pesticides is expected to occur
44 and, thus, no adverse effects on beneficial uses would occur. Based on these findings, this impact is
45 considered to be less than significant. No mitigation is required.

1 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of**
 2 **Environmental Commitments 3, 4, 6–12, 15, and 16**

3 **NEPA Effects:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that would
 4 contribute long-term additional loading of pesticides, and the potential short-term loading from
 5 former agricultural lands would be expected to degrade and dissipate rapidly. Therefore, relative to
 6 the No Action Alternative (ELT), the effects on pesticides from implementing Environmental
 7 Commitments 3, 4, 6–12, 15, and 16 are determined to be not adverse.

8 **CEQA Conclusion:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that
 9 would contribute long-term additional loading of pesticides, and the potential short-term loading
 10 from former agricultural lands would be expected to degrade and dissipate rapidly, such that
 11 pesticide levels would differ little from Existing Conditions. Therefore, implementation of
 12 Environmental Commitments 3, 4, 6–12, 15, and 16 would not cause substantial long-term increase
 13 in pesticide concentrations in the rivers and reservoirs upstream of the Delta, in the Delta Region, or
 14 the SWP/CVP Export Service Areas. As such, these Environmental Commitments are not expected to
 15 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
 16 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
 17 environment. Because pesticide concentrations are not expected to increase substantially, no long-
 18 term water quality degradation for pesticides is expected to occur and, thus, no adverse effects to
 19 beneficial uses would occur. Furthermore, any negligible changes in long-term pesticide
 20 concentrations that may occur throughout the affected environment would not be expected to make
 21 any existing beneficial use impairments measurably worse. Environmental Commitments 3, 4, 6–12,
 22 15, 16 do not include the use of pesticides known to be bioaccumulative in animals or humans, nor
 23 do the Environmental Commitments propose the use of any pesticide currently named in a CWA
 24 Section 303(d) listing of the affected environment. Based on these findings, this impact is considered
 25 to be less than significant. No mitigation is required.

26 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
 27 **and Maintenance**

28 The effects of Alternative 2D on phosphorus concentrations in surface waters upstream of the Delta,
 29 in the Delta, and in the SWP/CVP Export Service Areas would be similar to those described for
 30 Alternative 4 (see Section 8.3.3.9). This is because factors which affect phosphorus concentrations in
 31 surface waters of these areas are the same under Alternative 4 and Alternative 2D. As described for
 32 Alternative 4, phosphorus loading to waters upstream of the Delta is not anticipated to change, and
 33 because changes in flows do not necessarily result in changes in concentrations or loading of
 34 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
 35 anticipated under Alternative 2D, relative to Existing Conditions or the No Action Alternative (ELT),
 36 upstream of the Delta. Phosphorus concentrations may increase during January through March at
 37 locations in the Delta where the source fraction of San Joaquin River water increases, due to the
 38 higher concentration of phosphorus in the San Joaquin River during these months compared to
 39 Sacramento River water or San Francisco Bay water. However, based on the DSM2 fingerprinting
 40 results (Figures 331 through 352 in Appendix 8D, *Source Water Fingerprinting Results*), together
 41 with source water concentrations (in Figure 8-56), the magnitude of increases during these months
 42 is expected to be negligible to low (i.e., <0.02 mg/L) at all Delta locations relative to Existing
 43 Conditions and the No Action Alternative (ELT and LLT). Thus, phosphorus concentrations in the
 44 Delta and waters exported from Banks and Jones pumping plants to the SWP/CVP Export Service
 45 Areas are expected to be similar to Existing Conditions and the No Action Alternative (ELT and LLT).

1 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 2 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 3 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 4 effects on phosphorus in the LLT are expected to be similar to those described above.

5 **NEPA Effects:** In summary, operation of the water conveyance facilities would have little to no effect
 6 on phosphorus concentrations in water bodies upstream of the Delta, in the Plan Area, and the
 7 waters exported to the SWP/CVP Export Service Areas, relative to the No Action Alternative (ELT
 8 and LLT). Thus, effects of the water conveyance facilities on phosphorus are considered to be not
 9 adverse.

10 **CEQA Conclusion:** The effects of Alternative 2D on phosphorus levels in surface waters upstream of
 11 the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions
 12 would be similar to those described for the Alternative 4. There would be no substantial, long-term
 13 increase in phosphorus concentrations in the rivers and reservoirs upstream of the Delta, in the Plan
 14 Area, or the waters exported to the CVP and SWP service areas under Alternative 2D relative to
 15 Existing Conditions. As such, this alternative is not expected to cause additional exceedance of
 16 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 17 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
 18 phosphorus concentrations are not expected to increase substantially, no long-term water quality
 19 degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
 20 Phosphorus is not CWA Section 303(d) listed within the affected environment and thus any minor
 21 increases that may occur in some areas would not make any existing phosphorus-related
 22 impairment measurably worse because no such impairments currently exist. Because phosphorus is
 23 not bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to
 24 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,
 25 or humans. Based on these findings, this impact is considered to be less than significant. No
 26 mitigation is required.

27 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
 28 **Environmental Commitments 3, 4, 6-12, 15, and 16**

29 **NEPA Effects:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that would
 30 contribute long-term additional loading of phosphorus. Therefore, relative to the No Action
 31 Alternative (ELT and LLT), the effects on phosphorus from implementing Environmental
 32 Commitments 3, 4, 6-12, 15, and 16 are considered to be not adverse.

33 **CEQA Conclusion:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that
 34 would contribute long-term additional loading of phosphorus. Therefore, there would be no
 35 substantial, long-term increase in phosphorus concentrations in the rivers and reservoirs upstream
 36 of the Delta, in the Delta Region, or the waters exported to the SWP/CVP Export Service Areas due to
 37 implementation of these Environmental Commitments relative to Existing Conditions. Because
 38 phosphorus concentrations are not expected to increase substantially due to these Environmental
 39 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
 40 effects to beneficial uses would occur. Phosphorus is not CWA Section 303(d) listed within the
 41 affected environment and, thus, the Environmental Commitments would not make any existing
 42 phosphorus-related impairment measurably worse because no such impairments currently exist.
 43 Because phosphorus is not bioaccumulative, any increases that may occur in some areas would not
 44 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health

1 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
2 significant. No mitigation is required.

3 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and** 4 **Maintenance**

5 ***Upstream of the Delta***

6 The effects of Alternative 2D on selenium concentrations in reservoirs and rivers upstream of the
7 Delta would be similar to those effects described for Alternative 4 (see Section 8.3.3.9), because
8 factors affecting selenium concentrations in these water bodies would be similar. Substantial point
9 sources of selenium do not exist upstream in the Sacramento River watershed, in the watersheds of
10 the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or upstream of the Delta in
11 the San Joaquin River watershed. Nonpoint sources of selenium within the watersheds of the
12 Sacramento River and the eastern tributaries also are relatively low, resulting in generally low
13 selenium concentrations in the reservoirs and rivers of those watersheds. Consequently, any
14 modified reservoir operations and subsequent changes in river flows under Alternative 2D, relative
15 to Existing Conditions or the No Action Alternative (ELT and LLT), are expected to have negligible, if
16 any, effects on reservoir and river selenium concentrations upstream of Freeport in the Sacramento
17 River watershed or in the eastern tributaries upstream of the Delta. Similarly, it is expected that
18 selenium concentrations in the San Joaquin River would be minimally affected, if at all, by
19 anticipated changes in flow rates under Alternative 2D, given the relatively small decreases in flows
20 and the considerable variability in the relationship between selenium concentrations and flows in
21 the San Joaquin River. Any negligible changes in selenium concentrations that may occur in the
22 water bodies of the affected environment located upstream of the Delta would not be of frequency,
23 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
24 degrade the quality of these water bodies as related to selenium.

25 ***Delta***

26 Alternative 2D would result in small changes in average selenium concentrations in water relative to
27 Existing Conditions and No Action Alternative (ELT) at all modeled Delta assessment locations
28 (Appendix 8M, *Selenium*, Table M-33). Long-term average concentrations at some interior and
29 western Delta locations would increase by 0.01–0.04 µg/L for the entire period modeled (1976–
30 1991). These small increases in selenium concentrations in water would result in small reductions
31 (4% or less) in available assimilative capacity for selenium, relative to USEPA's draft water quality
32 criterion of 1.3 µg/L (Appendix 8M, Table M-45). The long-term average selenium concentrations in
33 water under Alternative 2D (range 0.09–0.40 µg/L) would be similar to Existing Conditions (range
34 0.09–0.41 µg/L) and the No Action Alternative (ELT) (range 0.09–0.39 µg/L), and would be below
35 the draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

36 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 2D would result in
37 small changes (about 1% or less) in estimated selenium concentrations in most biota (whole-body
38 fish, bird eggs [invertebrate diet or fish diet], and fish fillets) throughout the Delta, with little
39 difference among locations (Appendix 8M, *Selenium*, Tables M-35 and M-39). Level of Concern
40 Exceedance Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for selenium
41 concentrations in those biota for all years and for drought years are less than 1.0, indicating low
42 probability of adverse effects. Similarly, Advisory Tissue Level Exceedance Quotients for selenium
43 concentrations in fish fillets for all years and drought years are less than 1.0. Estimated selenium

1 concentrations in sturgeon for the San Joaquin River at Antioch are predicted to increase by about
2 19% relative to Existing Conditions in all years (from about 4.7 to about 5.6 mg/kg dry weight) and
3 by about 16% relative to the No Action Alternative (ELT) in all years (from 4.8 to about 5.6 mg/kg
4 dry weight). For sturgeon in the Sacramento River at Mallard Island concentrations are predicted to
5 increase by about 14% relative to Existing Conditions in all years (from about 4.4 to 5.0 mg/kg dry
6 weight) and by about 11% relative to the No Action Alternative in all years (from about 4.5 to 5.0
7 mg/kg dry weight) (Appendix 8M, Tables M-41 and M-42). Selenium concentrations in sturgeon
8 during drought years are expected to increase by about 2–7% at those locations (from about 6.8 to
9 7.3 mg/kg dry weight) (Appendix 8M, Tables M-41 and M-42). Detection of small changes in whole-
10 body sturgeon such as those estimated for the western Delta would require very large sample sizes
11 because of the inherent variability in fish tissue selenium concentrations. Low Toxicity Threshold
12 Exceedance Quotients for selenium concentrations in sturgeon in the western Delta would exceed
13 1.0 for drought years at both locations (as they do for Existing Conditions and the No Action
14 Alternative (ELT)) and for all years in the San Joaquin River at Antioch (where quotient increases
15 from 0.94 to 1.0) (Appendix 8M, Table M-43). The High Toxicity Threshold Quotient would be less
16 than 1.0 at both locations for all years and drought years (Appendix 8M, Table M-43).

17 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
18 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
19 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
20 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
21 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
22 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
23 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at
24 the two western Delta locations and used literature-derived uptake factors and trophic transfer
25 factors for the estuary from Presser and Luoma (2013). As noted in Appendix 8M, there was a
26 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
27 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
28 concentrations. There was no difference in bass selenium concentrations in the Sacramento River at
29 Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
30 despite a nearly 10-fold difference in waterborne selenium. Thus, there is more confidence in the
31 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
32 estimates for sturgeon based on “fixed” K_d s for all years and for drought years without regard to
33 waterborne selenium concentration at the two locations in different time periods.

34 Residence time of water in the Delta is expected to increase relative to Existing Conditions primarily
35 as a result of habitat restoration (8,000 acres of tidal habitat restoration and enhancements to the
36 Yolo Bypass) that is assumed to occur under the No Action Alternative (ELT) separate from
37 Alternative 2D. Although estimates of the residence time increases are not available for Alternative
38 2D, estimates for Alternative 2 at the LLT (presented in Table 8-60a in Section 8.3.1.7 in the
39 *Microcystis* subsection) which contained 65,000 acres of tidal restoration are available, and is
40 expected that residence time increases under Alternative 2D would be substantially less than
41 identified for Alternative 2 in the table.

42 If increases in fish tissue or bird egg selenium were to occur as a result of increased residence time,
43 the increases would likely be of concern only where fish tissues or bird eggs are already elevated in
44 selenium to near or above thresholds of concern. That is, where biota concentrations are currently
45 low and not approaching thresholds of concern (which, as discussed above, is the case throughout
46 the Delta, except for sturgeon in the western Delta), changes in residence time alone would not be

1 expected to cause them to then approach or exceed thresholds of concern. Thus, the most likely area
2 in which biota tissues would be at levels high enough that additional bioaccumulation due to
3 increased residence time would be a concern is the western Delta and Suisun Bay for sturgeon.
4 Based on the expected minor increases in residence time in the western Delta, any increases are not
5 expected to be of sufficient magnitude to substantially affect selenium bioaccumulation.

6 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 2D would result in
7 essentially no change in selenium concentrations throughout the Delta for most biota (less than
8 1%), although larger increases in selenium concentrations are predicted for sturgeon in the western
9 Delta. Concentrations of selenium in sturgeon would exceed only the lower benchmark, indicating a
10 low potential for effects. The modeling of bioaccumulation for sturgeon is less calibrated to site-
11 specific conditions than that for other biota, which was calibrated on a robust dataset for modeling
12 of bioaccumulation in largemouth bass as a representative species for the Delta. Overall, Alternative
13 2D would not be expected to substantially increase the frequency with which the applicable water
14 quality criterion or toxicity and level of concern benchmarks would be exceeded in the Delta (there
15 being only a small increase for sturgeon relative to the low benchmark and no exceedance of the
16 high benchmark) or to substantially degrade the quality of water in the Delta, with regard to
17 selenium.

18 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
19 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
20 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
21 effects on selenium in the LLT are expected to be similar to those described above.

22 ***SWP/CVP Export Service Areas***

23 Alternative 2D would result in small (0.01–0.10 µg/L) decreases in long-term average selenium
24 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
25 the No Action Alternative (ELT), for the entire period modeled (Appendix 8M, *Selenium*, Table M-
26 33). These decreases in long-term average selenium concentrations in water would result in
27 increases in available assimilative capacity for selenium at these pumping plants, relative to the
28 USEPA's draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-45). The long-term average
29 selenium concentrations in water for Alternative 2D (range 0.14–0.20 µg/L) would be well below
30 the draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

31 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 2D would result in
32 small changes (about 1% or less) in estimated selenium concentrations in biota (whole-body fish,
33 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, *Selenium*, Table M-
34 39). Concentrations in biota would not exceed any selenium toxicity or level of concern benchmarks
35 for Alternative 2D (Appendix 8M, Table M-39).

36 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
37 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
38 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
39 effects on selenium in the LLT are expected to be similar to those described above.

40 ***NEPA Effects:*** Relative to the No Action Alternative (ELT and LLT), Alternative 2D would result in
41 essentially negligible changes in selenium concentrations in water upstream of the Delta. Similarly,
42 there would be negligible changes in selenium water and most biota concentrations in the Delta,
43 with no exceedances of benchmarks for biological effects. For sturgeon in the Delta, there would be

1 only a small increase of threshold exceedance relative to the low benchmark for sturgeon and no
2 exceedance of the high benchmark. At the Banks and Jones pumping plants, Alternative 2D would
3 cause no increases in the frequency with which applicable benchmarks would be exceeded and
4 would slightly improve the quality of water in selenium concentrations. Therefore, the effects on
5 selenium (both as waterborne and as bioaccumulated in biota) from Alternative 2D are considered
6 to be not adverse.

7 **CEQA Conclusion:** There are no substantial point sources of selenium in watersheds upstream of the
8 Delta, and no substantial nonpoint sources of selenium in the watersheds of the Sacramento River
9 and the eastern tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to
10 the Delta will be controlled through a TMDL developed by the Central Valley Water Board (2001) for
11 the lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
12 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources
13 Control Board 2010b, 2010c) that are expected to result in decreasing discharges of selenium from
14 the San Joaquin River to the Delta. Consequently, any modified reservoir operations and subsequent
15 changes in river flows under Alternative 2, relative to Existing Conditions, are expected to cause
16 negligible changes in selenium concentrations in water. Any negligible changes in selenium
17 concentrations that may occur in the water bodies of the affected environment located upstream of
18 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
19 any beneficial uses or substantially degrade the quality of these water bodies as related to selenium.

20 Relative to Existing Conditions, modeling estimates indicate Alternative 2D would result in
21 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
22 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance
23 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
24 would increase slightly, from 0.94 for Existing Conditions to 1.0 for Alternative 2D. Concentrations
25 of selenium in sturgeon would exceed only the lower benchmark, indicating a low potential for
26 effects. Overall, Alternative 2D would not be expected to substantially increase the frequency with
27 which applicable benchmarks would be exceeded in the Delta (there being only a small increase for
28 sturgeon exceedance relative to the low benchmark for sturgeon and no exceedance of the high
29 benchmark) or substantially degrade the quality of water in the Delta, with regard to selenium.

30 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
31 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
32 Alternative 2D would cause no increases in the frequency with which applicable benchmarks would
33 be exceeded, and would slightly improve the quality of water in selenium concentrations at the
34 Banks and Jones pumping plants.

35 Based on the above, selenium concentrations that would occur in water under Alternative 2D would
36 not cause additional exceedances of applicable state or federal numeric or narrative water quality
37 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment,
38 by frequency, magnitude, and geographic extent that would result in adverse effects to one or more
39 beneficial uses within affected water bodies. In comparison to Existing Conditions, water quality
40 conditions under Alternative 2D would not increase levels of selenium by frequency, magnitude, and
41 geographic extent such that the affected environment would be expected to have measurably higher
42 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
43 wildlife (including fish) or humans consuming those organisms. Water quality conditions under this
44 alternative with respect to selenium would not cause long-term degradation of water quality in the
45 affected environment, and therefore would not result in use of available assimilative capacity such

1 that exceedances of water quality objectives/criteria would be likely and would result in
2 substantially increased risk for adverse effects to one or more beneficial uses. This alternative would
3 not further degrade water quality by measurable levels, on a long-term basis, for selenium and, thus,
4 cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly worse.
5 Based on these findings, this impact is considered to be less than significant. No mitigation is
6 required.

7 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of**
8 **Environmental Commitments 3, 4, 6-12, 15, and 16**

9 **NEPA Effects:** Environmental Commitments 3, 4, 6-12, 15, and 16 would not increase selenium
10 loading, and the amount of restoration that would occur would be minimal relative to the area of the
11 Delta and implemented such that any localized changes in residence time are unlikely to measurably
12 change selenium concentrations in water or biota relative to the No Action Alternative (ELT and
13 LLT). Therefore, the effects on selenium from implementing Environmental Commitments 3, 4, 6-
14 12, 15, and 16 are determined to be not adverse.

15 CEQA Conclusion: Environmental Commitments 3, 4, 6-12, 15, and 16 would not increase selenium
16 loading, and the amount of restoration that would occur would be minimal relative to the area of the
17 Delta and implemented such that any localized changes in residence time are unlikely to measurably
18 change selenium concentrations in water or biota relative to Existing Conditions. Therefore, it is
19 expected that with implementation of these Environmental Commitments there would be no
20 substantial, long-term increase in selenium concentrations in water in the rivers and reservoirs
21 upstream of the Delta, water in the Delta, or the waters exported to the SWP/CVP Export Service
22 Areas, relative to Existing Conditions. As such, these Environmental Commitments would not
23 contribute to additional exceedances of applicable water quality objectives/criteria. Given the
24 factors discussed in the assessment above and for Alternative 4 (see Section 8.3.3.9), any increases
25 in bioaccumulation rates from waterborne selenium that could occur in some areas as a result of
26 increased water residence times would not be of sufficient magnitude and geographic extent that
27 any portion of the Delta would be expected to have measurably higher body burdens of selenium in
28 aquatic organisms, and therefore would not substantially increase risk for adverse effects to
29 beneficial uses. Environmental Commitments 3, 4, 6-12, 15, and 16 would not cause long-term
30 degradation of water quality resulting in sufficient use of available assimilative capacity such that
31 occasionally exceeding water quality objectives/criteria would be likely. Also, these Environmental
32 Commitments would not result in substantially increased risk for adverse effects to any beneficial
33 uses. Furthermore, although the Delta is a CWA Section 303(d)-listed water body for selenium, given
34 the discussion in the assessment above, it is unlikely that restoration areas would result in
35 measurable increases in selenium in fish tissues or bird eggs such that the beneficial use impairment
36 would be made discernibly worse.

37 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
38 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
39 and minimization measures that are designed to further minimize and evaluate the risk of such
40 increases (see BDCP Appendix 3.C, *Avoidance and Minimization Measures*, for more detail on
41 AMM27) as well as the Selenium Management environmental commitment (see Appendix 3B,
42 *Environmental Commitments, AMMs, and CMs*), this impact is considered less than significant. No
43 mitigation is required.

1 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations**
2 **and Maintenance**

3 The effects of operation of the water conveyance facilities under Alternative 2D on trace metal
4 concentrations in surface waters upstream of the Delta, relative to Existing Conditions and the No
5 Action Alternative (ELT and LLT) would be similar to those effects described for Alternative 4 (see
6 Section 8.3.3.9).

7 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
8 reservoir storage reductions that would occur under Alternative 2D, relative to Existing Conditions
9 and the No Action Alternative (ELT and LLT), would not be expected to result in a substantial
10 adverse change in trace metal concentrations in the reservoirs and rivers upstream of the Delta.

11 In the Delta, for metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel,
12 silver, and zinc), average and 95th percentile trace metal concentrations of the primary source
13 waters to the Delta are very similar, and very large changes in source water fraction would be
14 necessary to effect a relatively small change in trace metal concentration at a particular Delta
15 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
16 waters are all below their respective water quality criteria, including those that are hardness-based
17 (see Tables 8-51 and 8-52 in Section 8.3.1.7, *Construction-Specific Considerations Used in the*
18 *Assessment*). No mixing of these three source waters could result in a metal concentration greater
19 than the highest source water concentration, and given that the average and 95th percentile source
20 water concentrations for copper, cadmium, chromium, lead, nickel, silver, and zinc do not exceed
21 their respective criteria, more frequent exceedances of criteria in the Delta would not occur. For
22 metals of primarily human health and drinking water concern (arsenic, iron, manganese), average
23 and 95th percentile concentrations are also very similar (see Tables 8–10 in Appendix 8N, *Trace*
24 *Metals*) and average concentrations are below human health criteria. No mixing of these three
25 source waters could result in a metal concentration greater than the highest source water
26 concentration, and given that the average water concentrations for arsenic, iron, and manganese do
27 not exceed water quality criteria, more frequent exceedances of drinking water criteria in the Delta
28 would not be expected to occur.

29 Because Alternative 2D would not result in substantial increases in trace metal concentrations in the
30 water exported from the Delta or diverted from the Sacramento River through the proposed
31 conveyance facilities, there is not expected to be substantial changes in trace metal concentrations
32 in the SWP/CVP Export Service Areas, relative to Existing Conditions or the No Action Alternative
33 (ELT and LLT).

34 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
35 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
36 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
37 effects on trace metals in the LLT are expected to be similar to those described above.

38 As such, Alternative 2D would not be expected to substantially increase the frequency with which
39 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
40 affected environment or substantially degrade the quality of these water bodies, with regard to trace
41 metals.

42 **NEPA Effects:** Alternative 2D would not be expected to substantially increase the frequency with
43 which applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the

1 affected environment or substantially degrade the quality of these water bodies, with regard to trace
 2 metals, relative to the No Action Alternative (ELT and LLT). Therefore, the effects on trace metals
 3 from implementing Alternative 2D are determined to not be adverse.

4 **CEQA Conclusion:** While Alternative 2D would alter the magnitude and timing of reservoir releases
 5 north, south and east of the Delta, this would have no substantial effect on the various watershed
 6 sources of trace metals. Moreover, long-term average flow and trace metals at Sacramento River at
 7 Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows
 8 would not be expected to cause a substantial long-term change in trace metal concentrations
 9 upstream of the Delta.

10 Average and 95th percentile trace metal concentrations are very similar across the primary source
 11 waters to the Delta. Given this similarity, very large changes in source water fraction would be
 12 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 13 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 14 waters are all below their respective water quality criteria. No mixing of these three source waters
 15 could result in a metal concentration greater than the highest source water concentration, and given
 16 that trace metals do not already exceed water quality criteria, more frequent exceedances of criteria
 17 in the Delta would not be expected to occur under Alternative 2D.

18 Because Alternative 2D is not expected to result in substantial changes in trace metal concentrations
 19 in Delta waters, which includes Banks and Jones pumping plants, effects on trace metal
 20 concentrations in the SWP/CVP Export Service Area are expected to be negligible.

21 As such, this alternative is not expected to cause additional exceedance of applicable water quality
 22 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
 23 beneficial uses of waters in the affected environment. Because trace metal concentrations are not
 24 expected to increase substantially, no long-term water quality degradation for trace metals is
 25 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore, any
 26 negligible changes in long-term trace metal concentrations that may occur in water bodies of the
 27 affected environment would not be expected to make any existing beneficial use impairments
 28 measurably worse. The trace metals discussed in this assessment are not considered
 29 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
 30 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
 31 is required.

32 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of** 33 **Environmental Commitments 3, 4, 6-12, 15, and 16**

34 **NEPA Effects:** Because Environmental Commitments 3, 4, 6-12, 15, and 16 present no new sources
 35 of trace metals to the affected environment, the effects on trace metal concentrations from
 36 implementing these Environmental Commitments are determined to be not adverse.

37 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 would not
 38 cause substantial long-term increase in trace metal concentrations in the rivers and reservoirs
 39 upstream of the Delta, in the Delta Region, or the SWP/CVP Export Service Areas, because they
 40 present no new sources of trace metals to the affected environment. As such, this alternative is not
 41 expected to cause additional exceedance of applicable water quality objectives by frequency,
 42 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
 43 in the affected environment. Because trace metal concentrations are not expected to increase

1 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
2 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
3 trace metal concentrations that may occur throughout the affected environment would not be
4 expected to make any existing beneficial use impairments measurably worse. The trace metals
5 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
6 bioaccumulative problems in aquatic life or humans. Based on these findings, this impact is
7 considered to be less than significant. No mitigation is required.

8 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and** 9 **Maintenance**

10 As described for Alternative 4 (see Section 8.3.3.9), the operation of the water conveyance facilities
11 under Alternative 2D is expected to have a minimal effect on TSS and turbidity levels in surface
12 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
13 Existing Conditions and the No Action Alternative (ELT and LLT). This is because the factors that
14 would affect TSS and turbidity levels in the surface waters of these areas would be the same. TSS
15 concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1) TSS
16 concentrations and turbidity levels of the water released from the upstream reservoirs, 2) erosion
17 occurring within the river channel beds, which is affected by river flow velocity and bank protection,
18 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and nonpoint
19 runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and other
20 biological material in the water. Within the Delta, TSS concentrations and turbidity levels in Delta
21 waters are affected by TSS concentrations and turbidity levels of inflows (and associated sediment
22 load), as well as fluctuation in flows within the channels due to the tides, with sediments depositing
23 as flow velocities and turbulence are low at periods of slack tide, and sediments becoming
24 suspended when flow velocities and turbulence increase when tides are near the maximum. TSS and
25 turbidity variations can also be attributed to phytoplankton, zooplankton and other biological
26 material in the water. These factors would be similar under Alternative 2D and Alternative 4, are
27 expected to be minimally different from Existing Conditions and the No Action Alternative (ELT and
28 LLT). Because Alternative 2D is expected to have minimal effect on TSS concentrations and turbidity
29 levels in Delta waters, including water exported at the south Delta pumps, relative to Existing
30 Conditions or the No Action Alternative (ELT and LLT), Alternative 2D also is expected to have
31 minimal effect on TSS concentrations and turbidity levels in the SWP/CVP Export Service Areas
32 waters.

33 **NEPA Effects:** Because TSS concentrations and turbidity levels are expected to be minimally affected
34 relative to the No Action Alternative (ELT and LLT), the effects on TSS and turbidity from
35 implementing Alternative 2D are determined to not be adverse.

36 **CEQA Conclusion:** As described for Alternative 4 (see Section 8.3.3.9) changes in river flow rate and
37 reservoir storage that would occur under Alternative 2D, relative to Existing Conditions, would not
38 be expected to result in a substantial adverse change in TSS concentrations and turbidity levels in
39 the reservoirs and rivers upstream of the Delta, given that suspended sediment concentrations are
40 more affected by season than flow. Within the Delta, geomorphic changes associated with sediment
41 transport and deposition are usually gradual, occurring over years, and high storm event inflows
42 would not be substantially affected. Thus, it is expected that the TSS concentrations and turbidity
43 levels in the affected channels would not be substantially different from the levels under Existing
44 Conditions. There is not expected to be substantial, if even measurable, changes in TSS
45 concentrations and turbidity levels in the SWP/CVP Export Service Areas waters under Alternative

1 2D, relative to Existing Conditions, because this alternative is not expected to result in substantial
 2 changes in TSS concentrations and turbidity levels at the south Delta export pumps, relative to
 3 Existing Conditions. Therefore, this alternative is not expected to cause additional exceedance of
 4 applicable water quality objectives where such objectives are not exceeded under Existing
 5 Conditions. Because TSS concentrations and turbidity levels are not expected to be substantially
 6 different, long-term water quality degradation is not expected, and, thus, beneficial uses are not
 7 expected to be adversely affected. Finally, TSS and turbidity are neither bioaccumulative nor CWA
 8 Section 303(d) listed constituents. Based on these findings, this impact is considered to be less than
 9 significant. No mitigation is required.

10 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of**
 11 **Environmental Commitments 3, 4, 6-12, 15, and 16**

12 **NEPA Effects:** Localized, temporary changes in TSS and turbidity could occur associated with the
 13 restoration actions of Environmental Commitments 3, 4, 6-12, 15, and 16. However, these changes
 14 would be gradual and not expected to substantially differ from No Action Alternative (ELT and LLT)
 15 conditions. Therefore, the effects on TSS and turbidity from implementing these Environmental
 16 Commitments are determined to be not adverse.

17 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
 18 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of
 19 Environmental Commitments 3, 4, 6-12, 15, and 16 would not be substantially different relative to
 20 Existing Conditions, except within localized areas of the Delta modified through creation of habitat
 21 and open water. Therefore, this alternative is not expected to cause additional exceedance of
 22 applicable water quality objectives where such objectives are not exceeded under Existing
 23 Conditions. Because TSS concentrations and turbidity levels Upstream of the Delta, in the greater
 24 Plan Area, and in the SWP/CVP Export Service Areas are not expected to be substantially different,
 25 long-term water quality degradation is not expected relative to TSS and turbidity, and, thus,
 26 beneficial uses are not expected to be adversely affected. Finally, TSS and turbidity are neither
 27 bioaccumulative nor CWA Section 303(d) listed constituents. Based on these findings, this impact is
 28 considered to be less than significant. No mitigation is required.

29 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities for the**
 30 **Water Conveyance Facilities and Environmental Commitments**

31 The potential construction-related water quality effects that would occur under Alternative 2D
 32 would be similar to the effects described for Alternative 4A (see Section 8.3.4.2). This is because the
 33 type, size and number of construction activities for water conveyance facilities and Environmental
 34 Commitments that would occur under Alternative 2D would be similar to Alternative 4A. The
 35 construction-related activities for the water conveyance facilities under Alternative 2D would be
 36 similar to those described for Alternative 4A. However, there would be more construction activity
 37 associated with two additional intakes and the area of in-water habitat restoration activities
 38 implemented under Alternative 2D would be greater.

39 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
 40 associated with implementation of Alternative 2D would be very similar to the effects discussed for
 41 Alternative 4A. Nevertheless, the construction of water conveyance facilities and Environmental
 42 Commitments, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
 43 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements, would result

1 in the potential water quality effects being largely avoided and minimized. The specific
 2 Environmental Commitments that would be implemented under Alternative 2D would be similar to
 3 those described for Alternative 4A. Consequently, relative to the No Action Alternative (ELT),
 4 Alternative 2D would not be expected to cause exceedance of applicable water quality
 5 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
 6 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
 7 SWP/CVP Export Service Areas. Therefore, with implementation of environmental commitments
 8 presented in Appendix 3B, the potential construction-related water quality effects are considered to
 9 be not adverse.

10 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
 11 2D for construction-related activities along with agency-issued permits that also contain
 12 construction requirements to protect water quality, the construction-related effects, relative to
 13 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
 14 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
 15 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
 16 degrade water quality with respect to the constituents of concern on a long-term average basis, and
 17 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
 18 Delta, or in the SWP/CVP Export Service Areas. Moreover, because the construction-related
 19 activities would be temporary and intermittent in nature, the construction would involve negligible
 20 discharges, if any, of bioaccumulative or CWA Section 303(d) listed constituents to water bodies of
 21 the affected environment. As such, construction activities would not contribute measurably to
 22 bioaccumulation of contaminants in organisms or humans or cause CWA Section 303(d)
 23 impairments to be discernibly worse. Based on these findings, this impact is determined to be less
 24 than significant. No mitigation is required.

25 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 26 **and Maintenance**

27 ***Upstream of the Delta***

28 Adverse effects from *Microcystis* upstream of the Delta have only been documented in lakes such as
 29 Clear Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over
 30 other phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
 31 characterized by low nutrient concentrations, where other phytoplankton outcompete
 32 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
 33 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
 34 Joaquin River upstream of the Delta under Existing Conditions, bloom development is limited by
 35 high water velocity and low residence times. These conditions are not expected to change under
 36 Alternative 2D or the No Action Alternative (ELT and LLT). Consequently, any modified reservoir
 37 operations under Alternative 2D are not expected to promote *Microcystis* production upstream of
 38 the Delta, relative to Existing Conditions and the No Action Alternative (ELT and LLT).

39 ***Delta***

40 During the June through October period when *Microcystis* blooms occur in the Delta, it is a
 41 combination of flows, associated residence time, and water temperatures that are believed to most
 42 influence *Microcystis* bloom formation.

1 Under Alternative 2D, a portion of the Sacramento River water which is conveyed through the Delta
2 to the south Delta intakes under Existing Conditions would be replaced at various locations
3 throughout the Delta by other source water due to diversion of Sacramento River water at the north
4 Delta intakes. The changes in flow paths of water through the Delta and change in operation of the
5 south Delta pumps that would occur due to facilities operations and maintenance of Alternative 2D
6 could result in localized increases in residence time in various Delta sub-regions and decreases in
7 residence time in other areas. Because there is no published analysis of the relationship between
8 *Microcystis* occurrence and residence time, there is uncertainty on how increased residence times
9 may affect *Microcystis* occurrences (ICF International 2016). Further, there is substantial
10 uncertainty regarding the extent that facilities operations and maintenance of Alternative 2D would
11 result in a net increase in water residence times at various locations throughout the Delta, relative
12 to Existing Conditions. In addition to the effects of operations and maintenance of Alternative 2D,
13 increases in water residence times are expected occur due to separate factors and actions
14 concurrent with the alternative, including habitat restoration (8,000 acres of tidal habitat and
15 enhancements in the Yolo Bypass) and sea level rise due to climate change.

16 To ensure project operations do not create increased *Microcystis* blooms in the Delta, water flow
17 through Delta channels can be managed through real-time operations, particularly the balancing of
18 the north and south Delta diversions. By operating the south Delta pumps more frequently during
19 periods conducive to increased *Microcystis* blooms, residence times can be managed to decrease the
20 potential for blooms to develop, and thus decrease potential microcystin increases due to project
21 operations. As such, effects of Alternative 2D on *Microcystis* levels, and thus microcystin
22 concentrations in the Delta, would not be made more adverse relative to Existing Conditions and the
23 No Action Alternative (ELT and LLT).

24 Water temperature is also a critical parameter that has been related to *Microcystis* blooms in the
25 Delta. Since Delta water temperatures are largely driven by air temperature, climate change that
26 increases air temperatures relative to Existing Conditions would be expected to increase ambient
27 water temperatures in the Delta by 1.3–2.5°F. These climate changes in the ELT are expected to
28 occur in the Delta under the No Action Alternative, relative to Existing Conditions. Alternative 2D
29 operations and maintenance is not expected to cause increased Delta water temperatures, relative
30 to Existing Conditions or the No Action Alternative.

31 In summary, increased frequency and magnitude of *Microcystis* blooms may occur in the Delta in the
32 future, relative to Existing Conditions, due to factors unrelated to the project alternative, including:
33 1) increased residence times resulting from restoration activities and climate change-related sea
34 level rise and 2) climate change-related increased Delta water temperatures. If *Microcystis*
35 occurrences did increase in certain sub-regions of the Delta in the future, there would also be the
36 potential for increased microcystin presence in the Delta, relative to Existing Conditions. To ensure
37 project operations under Alternative 2D do not create significant increases in *Microcystis* blooms in
38 the Delta, that may be associated with increased residence times, water flow through Delta channels
39 would be managed through real-time operations.

40 ***SWP/CVP Export Service Area***

41 As described above for the Delta, source waters to the south Delta intakes could be adversely
42 affected, relative to Existing Conditions by *Microcystis* both from an increase in Delta water
43 temperatures associated with climate change and from an increase in water residence times. The
44 impacts from increased Delta water residence times would be primarily related to habitat

1 restoration (8,000 acres of tidal habitat restoration and enhancements in the Yolo Bypass) that is
2 assumed to occur separate from Alternative 2D. The combined effect of these factors on the
3 potential for *Microcystis* blooms in source waters to the south Delta intakes is expected to be much
4 greater than the influence of operations and maintenance of Alternative 2D, the effects of which will
5 be mitigated through real time operations. Increases in ambient air temperatures due to climate
6 change relative to Existing Conditions are expected under this alternative. Increases in ambient air
7 temperatures are expected to result in warmer ambient water temperatures, and thus conditions
8 more suitable to *Microcystis* growth, in the water bodies of the SWP/CVP Export Service Areas. The
9 incremental increase in long-term average air temperatures would be less at the ELT (2.0°F),
10 compared to the LLT (4.0°F).

11 As discussed in the Delta section above, Alternative 2D is not expected to substantially adversely
12 affect *Microcystis* blooms, relative to Existing Conditions and the No Action Alternative (ELT and
13 LLT). Additionally, residence time and water temperature conditions in the SWP/CVP Export Service
14 Areas are not expected to become more conducive to *Microcystis* bloom formation due to the
15 operations and maintenance of Alternative 2D, relative to Existing Conditions and the No Action
16 Alternative (ELT and LLT), because water residence times are not projected to increase in the
17 SWP/CVP Export Service Areas and any temperature increases there would be due to climate
18 change not due to Alternative 2D.

19 **NEPA Effects:** Modified reservoir operations under Alternative 2D are not expected to promote
20 *Microcystis* production upstream of the Delta, relative to the No Action Alternative (ELT and LLT).
21 Similarly, operations and maintenance of Alternative 2D is not expected to substantially increase
22 water residence times or ambient water temperatures in the Delta, including at the Banks and Jones
23 pumping plants, and thus is not expected to result in adverse effects on *Microcystis* in the Delta,
24 relative to No Action Alternative (ELT and LLT). Lack of adverse effects on *Microcystis* in the Delta
25 would mean that Delta waters diverted into the SWP/CVP Export Service Areas would not be
26 adversely affected. Finally, the potential for *Microcystis* bloom formation within the SWP/CVP
27 Export Service Area water bodies and canals would not be expected to change substantially, if at all,
28 because water residence times are not projected to increase in the SWP/CVP Export Service Areas
29 and any temperature increases there would be due to climate change and not due to Alternative 2D.
30 Thus, the effects on *Microcystis* in surface waters upstream of the Delta, in the Delta, and in the
31 SWP/CVP Export Service Areas from implementing Alternative 2D are determined to be not
32 adverse.

33 **CEQA Conclusion:** Modified reservoir operations under Alternative 2D are not expected to promote
34 *Microcystis* production upstream of the Delta, relative to the Existing Conditions. Increased
35 frequency and magnitude of *Microcystis* blooms may occur in the Delta in the future, relative to
36 Existing Conditions, due to increased residence times resulting from restoration activities unrelated
37 to the project alternative, as well as climate change and sea level rise that are expected to increase
38 Delta water temperatures. Such increases in residence time and water temperatures would not be
39 caused by implementation of Alternative 2D. Operations and maintenance of Alternative 2D,
40 including the use of real-time operations, are not expected to result in flow and temperature
41 conditions in the Delta, including at the Banks and Jones pumping plants, that would cause
42 substantial increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms. As
43 such, this alternative would not be expected to cause additional exceedance of applicable water
44 quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
45 significant impacts on any beneficial uses of waters in the affected environment. *Microcystis* and
46 microcystins are not CWA Section 303(d) listed within the affected environment and thus any

1 increases that could occur in some areas of the Delta would not make any existing *Microcystis*
 2 impairment measurably worse because no such impairments currently exist. Microcystin, the toxin
 3 produced by *Microcystis*, is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential
 4 increases in *Microcystis* occurrences due to climate change and sea level rise may lead to increased
 5 microcystin presence in the Delta, relative to Existing Conditions. This has potential to cause
 6 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 7 risks to fish, wildlife or humans. While long-term water quality degradation related to microcystin
 8 levels may occur and, thus, impacts on beneficial uses could occur, these impacts are not related to
 9 implementation of Alternative 2D. Although there is uncertainty regarding this impact, the effects on
 10 *Microcystis* from implementing water conveyance facilities are determined to be less than
 11 significant. No mitigation is required.

12 **Impact WQ-33: Effects on *Microcystis* Bloom Formation Resulting from Environmental** 13 **Commitments**

14 Effects on *Microcystis* from implementation of Environmental Commitments under Alternative 2D
 15 would be the same as those described for Alternative 4A.

16 **NEPA Effects:** Based on the discussion for Impact WQ-33 in Section 8.3.4.2, the effects on *Microcystis*
 17 from implementing Environmental Commitments 3, 4, 6–12, 15, and 16 are determined to be not
 18 adverse.

19 **CEQA Conclusions:** Based on the discussion for Impact WQ-33 in Section 8.3.4.2, Environmental
 20 Commitments 3, 4, 6–12, 15, and 16 would not be expected to cause additional exceedance of
 21 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 22 would cause significant impacts on any beneficial uses of waters in the affected environment.
 23 *Microcystis* and microcystins are not CWA Section 303(d) listed within the affected environment and
 24 thus any increases that could occur in some areas would not make any existing *Microcystis*
 25 impairment measurably worse because no such impairments currently exist. However, it is possible
 26 that increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta
 27 would occur at the early long-term for reasons unassociated with implementation of the
 28 Environmental Commitments, including tidal habitat restoration. Further, microcystin is
 29 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 30 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 31 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 32 would, in turn, pose health risks to fish, wildlife or humans. While long-term water quality
 33 degradation related to microcystins levels may occur and, thus, significant impacts on beneficial
 34 uses could occur, these impacts are not related to implementation of the Environmental
 35 Commitments. Therefore, the effects on *Microcystis* from implementing the Environmental
 36 Commitments are determined to be less than significant. No mitigation is required.

37 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities** 38 **Operations and Maintenance and Environmental Commitments**

39 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 40 that Alternative 2D would have a less-than-significant impact/no adverse effect on the following
 41 constituents in the Delta:

- 42 • Boron

- 1 • Bromide
- 2 • Chloride
- 3 • DOC
- 4 • DO
- 5 • Pathogens
- 6 • Pesticides
- 7 • Trace metals
- 8 • Turbidity and TSS
- 9 • *Microcystis*

10 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 11 Chloride, DOC, and bromide concentrations also are of concern in drinking water supplies. However,
 12 waters in the San Francisco Bay are not designated to support MUN and AGR beneficial uses.
 13 Changes in Delta DO, pathogens, pesticides, trace metals, and turbidity and TSS are not anticipated
 14 to be of a frequency, magnitude and geographic extent that would adversely affect any beneficial
 15 uses or substantially degrade the quality of the Delta. Changes in *Microcystis* would be primarily due
 16 to factors unassociated with the project alternative. Thus, changes in boron, bromide, chloride, DOC,
 17 DO, pathogens, pesticides, trace metals, turbidity and TSS, and *Microcystis* in Delta outflow
 18 associated with implementation of Alternative 2D, relative to Existing Conditions and the No Action
 19 Alternative (ELT and LLT) are not anticipated to be of a frequency, magnitude and geographic extent
 20 that would adversely affect any beneficial uses or substantially degrade the quality of the of San
 21 Francisco Bay, as described for Alternative 4 (see Section 8.3.3.9).

22 Elevated EC is of concern for its effects on the AGR beneficial use and fish and wildlife beneficial
 23 uses. San Francisco Bay does not have an AGR beneficial use designation. As described for
 24 Alternative 4, salinity throughout San Francisco Bay is largely a function of the tides, as well as to
 25 some extent the freshwater inflow from upstream. However, the changes in Delta outflow due to
 26 Alternative 2D, relative to Existing Conditions and the No Action Alternative (ELT and LLT), would
 27 be minor compared to tidal flows, and thus no substantial adverse effects on salinity, or fish and
 28 wildlife beneficial uses, downstream of the Delta are expected.

29 Also, as described for Alternative 4, changes in nutrient loading would not be expected to contribute
 30 to adverse effects to beneficial uses. Changes in nitrogen (ammonia and nitrate) loading to Suisun
 31 and San Pablo Bays under Alternative 2D, relative to Existing Conditions and the No Action
 32 Alternative (ELT and LLT), would not adversely impact primary productivity in these embayments
 33 because light limitation and grazing currently limit algal production in these embayments. Nutrient
 34 levels and ratios are not considered a direct driver of *Microcystis* and cyanobacteria levels in the
 35 North Bay. The only postulated effect of changes in phosphorus loads to Suisun and San Pablo Bays
 36 is related to the influence of nutrient stoichiometry on primary productivity. However, there is
 37 uncertainty regarding the impact of nutrient ratios on phytoplankton community composition and
 38 abundance. As described for Alternative 4, any effect on phytoplankton community composition
 39 would likely be small compared to the effects of grazing from introduced clams and zooplankton in
 40 the estuary. Therefore, changes in total nitrogen and phosphorus loading that would occur in Delta
 41 outflow to San Francisco Bay, relative to Existing Conditions and the No Action Alternative (ELT and
 42 LLT), shown in Appendix 80, *San Francisco Bay Analysis*, Table 80-1, are not expected to result in

1 degradation of water quality with regard to nutrients that would result in adverse effects to
2 beneficial uses.

3 Similar to Alternative 4, loads of mercury and methylmercury from the Delta to San Francisco Bay
4 are estimated to change relatively little due to changes in source water fractions and net Delta
5 outflow that would occur under Alternative 2D, relative to Existing Conditions and the No Action
6 Alternative (ELT and LLT) (Appendix 80, *San Francisco Bay Analysis*, Table 80-2). Also, the
7 incremental increase in dissolved selenium concentrations in the North Bay, relative to Existing
8 Conditions, would be negligible (0.01 µg/L) under this alternative (Appendix 80, Table 80-3).

9 **NEPA Effects:** Based on the discussion above, Alternative 2D, relative to the No Action Alternative
10 (ELT and LLT), would not cause further degradation to water quality with respect to boron,
11 bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia,
12 nitrate, phosphorus), trace metals, turbidity and TSS, or *Microcystis* in the San Francisco Bay.
13 Further, changes in these constituent concentrations in Delta outflow would not be expected to
14 cause changes in Bay concentrations of frequency, magnitude, and geographic extent that would
15 adversely affect any beneficial uses. In summary, effects on the San Francisco Bay from
16 implementation of water conveyance facilities and Environmental Commitments 3, 4, 6–12, 15, and
17 16 are considered to be not adverse.

18 **CEQA Conclusion:** As with Alternative 4, Alternative 2D would not be expected to cause long-term
19 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
20 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
21 would result in substantially increased risk for adverse effects to one or more beneficial uses.
22 Further, this alternative would not be expected to cause additional exceedance of applicable water
23 quality objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent
24 that would cause significant impacts on any beneficial uses of waters in the affected environment.
25 Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay would not adversely
26 affect beneficial uses, because the uses most affected by changes in these parameters, MUN and AGR,
27 are not beneficial uses of the Bay. Further, no substantial changes in DO, pathogens, pesticides, trace
28 metals, turbidity or TSS, and *Microcystis* are anticipated in the Delta due to the implementation of
29 Alternative 2D, relative to Existing Conditions, therefore, no substantial changes to these
30 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
31 measurable changes in Bay salinity, as the change in Delta outflow would be two to three orders of
32 magnitude lower than (and thus minimal compared to) the Bay's tidal flow and thus, have minimal
33 influence on salinity changes. Changes in nutrient load, relative to Existing Conditions, are expected
34 to have minimal effect on water quality degradation, primary productivity, or phytoplankton
35 community composition. As with Alternative 4, the change in mercury and methylmercury load
36 (which is based on source water and Delta outflow), relative to Existing Conditions, would be within
37 the level of uncertainty in the mass load estimate and not expected to contribute to water quality
38 degradation, make the CWA Section 303(d) mercury impairment measurably worse or cause
39 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
40 turn, pose substantial health risks to fish, wildlife, or humans. Similarly, based on Alternative 4
41 estimates, the increase in selenium load would be minimal, and total and dissolved selenium
42 concentrations would be expected to be the same as Existing Conditions, and less than the target
43 associated with white sturgeon whole-body fish tissue levels for the North Bay. Thus, the change in
44 selenium load is not expected to contribute to water quality degradation, or make the CWA Section
45 303(d) selenium impairment measurably worse or cause selenium to bioaccumulate to greater
46 levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or

1 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
2 is required.

3 **8.3.4.4 Alternative 5A—Dual Conveyance with Modified** 4 **Pipeline/Tunnel and Intake 2 (3,000 cfs; Operational Scenario C)**

5 Discussion of water quality impacts of Alternative 5A was first provided in the RDEIR/SDEIS. The
6 water quality assessments in the RDEIR/SDEIS for boron, bromide, chloride, DOC, EC, mercury,
7 nitrate, and selenium in the Delta and SWP/CVP Export Services Areas utilized results from water
8 quality modeling performed for Alternative 5 in the ELT, which included Yolo Bypass improvements,
9 25,000 acres of tidal habitat restoration, and the EC compliance location at Emmaton relocated to
10 Threemile Slough. The analysis of effects of Alternative 5A, presented herein, on boron, bromide,
11 chloride, DOC, EC, mercury, nitrate, and selenium in the Delta and SWP/CVP Export Service Areas is
12 based on revised modeling, which assumed implementation of Yolo Bypass improvements, the EC
13 compliance location remaining at Emmaton, and no tidal habitat restoration. Because the modeling
14 of Alternative 5A and the No Action Alternative (ELT) included Yolo Bypass Improvements, but no
15 tidal habitat restoration, comparison of modeling results for Alternative 5A to No Action Alternative
16 (ELT) results in the impact discussions below allows for isolating and identifying effects solely due
17 to implementation of Alternative 5A in the ELT.

18 As described in Chapter 3, *Description of Alternatives*, actions associated with Alternative 4 that are
19 not proposed to be implemented under Alternative 5A would continue to be pursued as part of
20 existing, but separate, projects and programs associated with the 2008 USFWS and 2009 NMFS
21 BiOps, California EcoRestore, and the 2014 California Water Action Plan. Due to the reduced suite of
22 Environmental Commitments in Alternative 5A compared to Alternative 4 (in particular,
23 significantly less tidal habitat restoration), the impacts to water quality due to Alternative 5A are
24 substantially less compared to Alternative 4, particularly in the Delta.

25 The water quality impact conclusions for Alternative 5A remain the same as those presented in the
26 RDEIR/SDEIS. The revisions to the assessment are in the presentation of modeled changes in
27 concentrations, water quality criteria/objective exceedances, and use of assimilative capacity, and
28 refinements to mitigation measures for EC.

29 **Impact WQ-1: Effects on Ammonia Concentrations Resulting from Facilities Operations and** 30 **Maintenance**

31 ***Upstream of the Delta***

32 As described for Alternative 4 (see Section 8.3.3.9), substantial point and non-point sources of
33 ammonia-N do not exist upstream of the SRWTP at Freeport in the Sacramento River watershed, in
34 the watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or
35 upstream of the Delta in the San Joaquin River watershed. Thus, like Alternative 4, operation of the
36 water conveyance facilities under Alternative 5A would have negligible, if any, effect on ammonia
37 concentrations in the rivers and reservoirs upstream of the Delta relative to Existing Conditions and
38 the No Action Alternative (ELT and LLT). Any negligible increases in ammonia-N concentrations that
39 could occur in the water bodies of the affected environment located upstream of the Delta would not
40 be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or
41 substantially degrade the quality of these water bodies, with regard to ammonia.

Delta

As described for Alternative 4 (see Section 8.3.3.9), a substantial decrease in Sacramento River ammonia concentrations is expected under Alternative 5A relative to Existing Conditions, due to planned lowering of ammonia in the SRWTP effluent discharge, and this is expected to decrease ammonia concentrations for all areas of the Delta that are influenced by Sacramento River water. Concentrations of ammonia at locations not influenced notably by Sacramento River water would change little relative to Existing Conditions, due to the similarity in San Joaquin River and San Francisco Bay concentrations and the lack of expected changes in either of these concentrations. Thus, Alternative 5A would not result in substantial increases in ammonia concentrations in the project area, relative to Existing Conditions.

Relative to the No Action Alternative (ELT and LLT), the primary mechanism that could potentially alter ammonia concentrations under Alternative 5A is decreased flows in the Sacramento River, which would lower dilution available to the SRWTP discharge. This flow change would be attributable only to operations of the water conveyance facilities, since the same assumptions regarding SRWTP discharge ammonia concentrations, water demands, climate change, and sea level rise apply to both Alternative 5A and the No Action Alternative (ELT and LLT). A simple mass balance calculation was performed to calculate ammonia concentrations downstream of the SRWTP discharge (i.e., downstream of Freeport) under Alternative 5A and the No Action Alternative (ELT) to assess the effects of the flow changes. Monthly average CALSIM II flows at Freeport and the upstream ammonia concentration (0.04 mg/L-N; Central Valley Water Board 2010a:5) were used, together with the SRWTP permitted average dry weather flow (181 mgd) and seasonal ammonia limitations (1.5 mg/L-N in Apr–Oct, 2.4 mg/L-N in Nov–Mar), to estimate the average change in ammonia concentrations downstream of the SRWTP. Table 8-75 shows monthly average and long-term annual average predicted concentrations under Alternative 5A. As Table 8-75 shows, average monthly ammonia concentrations in the Sacramento River downstream of Freeport (upon full mixing of the SRWTP discharge with river water) under Alternative 5A and the No Action Alternative (ELT) are expected to be similar. In comparison to the No Action Alternative (ELT), minor increases in monthly average ammonia concentrations would occur during August, September, and November under Alternative 5A. Minor decreases in ammonia concentrations are expected for Alternative 5A in January through April, June and December. The annual average concentration under Alternative 5A would be the same as that under the No Action Alternative (ELT). Relative to the No Action Alternative (LLT), Alternative 5A (LLT) is expected to result in similar minor increases in Sacramento River ammonia concentration, because the increased water demands, climate change, and sea level rise in the LLT would occur under both alternatives, and neither would affect ammonia sources or loading. The estimated ammonia concentrations in the Sacramento River downstream of Freeport under Alternative 5A would be similar to existing source water concentrations for the San Francisco Bay and San Joaquin River. Consequently, changes in source water fraction anticipated under Alternative 5A, relative to the No Action Alternative (ELT and LLT), are not expected to substantially increase ammonia concentrations at any Delta locations.

Ammonia concentrations downstream of Freeport on the Sacramento River under Alternative 5A would be similar to those under Alternative 4 (see Table 8-67 in Section 8.3.3.9). As stated for Alternative 4, any negligible increases in ammonia concentrations that could occur at certain locations in the Delta under Alternative 5A would not be of frequency, magnitude and geographic extent that would adversely affect any beneficial uses or substantially degrade the water quality at these locations, with regard to ammonia.

1 **Table 8-75. Estimated Ammonia (mg/L as N) Concentrations in the Sacramento River Downstream of**
 2 **the Sacramento Regional Wastewater Treatment Plant for the No Action Alternative Early Long-Term**
 3 **Timeframe (ELT) and Alternative 5A**

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual Average
No Action Alternative (ELT)	0.076	0.082	0.069	0.062	0.059	0.062	0.059	0.062	0.067	0.060	0.067	0.064	0.066
Alternative 5A	0.076	0.085	0.068	0.061	0.058	0.061	0.058	0.062	0.064	0.060	0.068	0.068	0.066

4

5 ***SWP CVP Export Service Areas***

6 As discussed above, for areas of the Delta that are influenced by Sacramento River water, including
 7 Banks and Jones pumping plants, ammonia-N concentrations are expected to decrease under
 8 Alternative 5A, relative to Existing Conditions (in association with less diversion of water influenced
 9 by the SRWTP). Like Alternative 4, this decrease in ammonia-N concentrations for water exported
 10 via the south Delta pumps is not expected to result in an adverse effect on beneficial uses or
 11 substantially degrade water quality of exported water, with regard to ammonia. Furthermore, as
 12 discussed above, for all areas of the Delta, including Banks and Jones pumping plants, ammonia
 13 concentrations are not expected to be substantially different under Alternative 5A (LLT) relative to
 14 the No Action Alternative (ELT), and Alternative 5A (LLT) relative to the No Action Alternative
 15 (LLT). Thus, any negligible increases in ammonia concentrations that could occur at Banks and Jones
 16 pumping plants would not be of frequency, magnitude and geographic extent that would adversely
 17 affect any beneficial uses or substantially degrade water quality at these locations, with regard to
 18 ammonia.

19 ***NEPA Effects:*** In summary, ammonia concentrations in water bodies upstream of the Delta, in the
 20 Plan Area, and the waters exported to the SWP/CVP Export Service Areas are not expected to be
 21 substantially different under Alternative 5A relative to the No Action Alternative (ELT and LLT).
 22 Thus, effects of the water conveyance facilities on ammonia are considered to be not adverse.

23 ***CEQA Conclusion:*** The magnitude and direction of changes in ammonia concentrations in water
 24 bodies upstream of the Delta, in the Plan Area, or the waters exported to the SWP/CVP Export
 25 Service Areas would be approximately the same as expected under Alternative 4, relative to Existing
 26 Conditions. There would be no substantial, long-term increase in ammonia concentrations in the
 27 rivers and reservoirs upstream of the Delta, in the Plan Area, or the waters exported to the CVP and
 28 SWP service areas under Alternative 5A relative to Existing Conditions. As such, Alternative 5A is
 29 not expected to cause additional exceedance of applicable water quality objectives/criteria by
 30 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
 31 of waters in the affected environment. Because ammonia concentrations are not expected to
 32 increase substantially, no long-term water quality degradation is expected to occur and, thus, no
 33 adverse effects on beneficial uses would occur. Ammonia is not CWA Section 303(d) listed within
 34 the affected environment and thus any minor increases that could occur in some areas would not
 35 make any existing ammonia-related impairment measurably worse because no such impairments
 36 currently exist. Because ammonia is not bioaccumulative, minor increases that could occur in some
 37 areas would not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose

1 substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
2 considered to be less than significant. No mitigation is required.

3 **Impact WQ-2: Effects on Ammonia Concentrations Resulting from Implementation of** 4 **Environmental Commitments 3, 4, 6–12, 15, and 16**

5 **NEPA Effects:** Some habitat restoration activities would occur on lands in the Delta formerly used
6 for irrigated agriculture. Although this may decrease ammonia loading to the Delta from agriculture,
7 increased biota in those areas as a result of restored habitat may increase ammonia loading
8 originating from flora and fauna. Ammonia loaded from organisms is expected to be converted
9 rapidly to nitrate by established microbial communities. Thus, these land use changes would not be
10 expected to substantially increase ammonia concentrations in the Delta. Implementation of
11 Environmental Commitments 12, 15, and 16 do not include actions that would affect ammonia
12 sources or loading. Based on these findings, the effects on ammonia from the implementation
13 of Environmental Commitments 3, 4, 6–12, 15, and 16 under Alternative 5A are determined to not be
14 adverse.

15 **CEQA Conclusion:** Land use changes that would occur from the Environmental Commitments are
16 not expected to contribute substantially increase ammonia concentrations, because the amount of
17 area to be converted would be small relative to existing habitat, and any resulting ammonia would
18 likely be rapidly converted to nitrate. Thus, there would be no substantial, long-term increase in
19 ammonia concentrations in the rivers and reservoirs upstream of the Delta, in the Plan Area, or the
20 waters exported to the SWP/CVP Export Service Areas due to implementation of Environmental
21 Commitments 3, 4, 6–12, 15, and 16 relative to Existing Conditions. As such, implementation of these
22 Environmental Commitments would not be expected to cause additional exceedance of applicable
23 water quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
24 significant impacts on any beneficial uses of waters in the affected environment. Because ammonia
25 concentrations would not be expected to increase substantially from implementation of these
26 Environmental Commitments, no long-term water quality degradation would be expected to occur
27 and, thus, no significant impact on beneficial uses would occur. Ammonia is not CWA Section 303(d)
28 listed within the affected environment and thus any minor increases that could occur in some areas
29 would not make any existing ammonia-related impairment measurably worse because no such
30 impairments currently exist. Because ammonia is not bioaccumulative, minor increases that could
31 occur in some areas would not bioaccumulate to greater levels in aquatic organisms that would, in
32 turn, pose substantial health risks to fish, wildlife, or humans. Based on these findings, this impact is
33 considered less than significant. No mitigation is required.

34 **Impact WQ-3: Effects on Boron Concentrations Resulting from Facilities Operations and** 35 **Maintenance**

36 ***Upstream of the Delta***

37 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 5A there would be no
38 expected change to the sources of boron in the Sacramento River and eastside tributary watersheds
39 and, thus, resultant changes in flows from altered system-wide operations would have negligible, if
40 any, effects on the concentration of boron in the rivers and reservoirs of these watersheds. The
41 modeled annual average lower San Joaquin River flow at Vernalis would decrease by 1%, relative to
42 Existing Conditions (in association with the different operational components of Alternative 5A in
43 the ELT, climate change, and increased water demands) (Appendix 8F, *Boron*, Table Bo-32). The

1 reduced flow relative to Existing Conditions would result in possible increases in long-term average
 2 boron concentrations of up to about 0.5% relative to the Existing Conditions. Flows would remain
 3 virtually the same as the No Action Alternative (ELT), and thus flow changes would not result in
 4 substantial boron increases relative to the No Action Alternative (ELT). The increased boron
 5 concentrations, relative to Existing Conditions, under Alternative 5A in the ELT would not increase
 6 the frequency of exceedances of any applicable objectives or criteria and would not be expected to
 7 cause further degradation at measurable levels in the lower San Joaquin River, and thus would not
 8 cause the existing impairment there to be discernibly worse. Consequently, Alternative 5A in the
 9 ELT would not be expected to cause exceedance of boron objectives/criteria or substantially
 10 degrade water quality with respect to boron, and thus would not adversely affect any beneficial uses
 11 of the Sacramento River, the eastside tributaries, associated reservoirs upstream of the Delta, or the
 12 San Joaquin River.

13 Effects of Alternative 5A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
 14 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
 15 change and sea level rise that would occur in the LLT would not affect boron sources in these areas.

16 **Delta**

17 Effects of water conveyance facilities on boron under Alternative 5A in the Delta would be similar to
 18 the effects discussed for Alternative 4.

19 The effects of Alternative 5A relative to Existing Conditions and the No Action Alternative (ELT) are
 20 discussed together because the direction and magnitude of predicted change are similar. Relative to
 21 the Existing Conditions and No Action Alternative (ELT), Alternative 5A would result in increased
 22 long-term average boron concentrations for the 16-year period modeled at most of the interior
 23 Delta locations (increases up to 1% at the S. Fork Mokelumne River at Staten Island, 3% at Franks
 24 Tract, and 4% at Old River at Rock Slough) (Appendix 8F, *Boron*, Table Bo-30). The long-term
 25 average boron concentrations at most of the western Delta assessment locations would not change
 26 measurably. The long-term annual average and monthly average boron concentrations, for either
 27 the 16-year period or drought period modeled, would never exceed the 2,000 µg/L human health
 28 advisory objective (i.e., for children) or the 500 µg/L agricultural objective at the majority of
 29 assessment locations, which represents no change from the Existing Conditions and No Action
 30 Alternative (ELT) (Appendix 8F, *Boron*, Table Bo-3C). A small increase in the frequency of
 31 exceedances 500 µg/L agricultural objective at the Sacramento River at Mallard Island (i.e., as much
 32 as 5% in the drought period relative to the No Action Alternative [ELT]) would not be anticipated to
 33 substantially affect agricultural diversions which occur primarily at interior Delta locations. Minor
 34 reductions in long-term average assimilative capacity of up to 2% at interior Delta locations (i.e., Old
 35 River at Rock Slough) would occur with respect to the 500 µg/L agricultural objective (Appendix 8F,
 36 Table Bo-31). However, because the absolute boron concentrations would still be well below the
 37 lowest 500 µg/L objective for the protection of the agricultural beneficial use under Alternative 5A,
 38 the levels of boron degradation would not be of sufficient magnitude to substantially increase the
 39 risk of exceeding objectives or cause adverse effects to municipal and agricultural water supply
 40 beneficial uses, or any other beneficial uses, in the Delta (Appendix 8F, *Boron*, Figure Bo-6).

41 Effects of Alternative 5A in the Delta in the LLT, relative to Existing Conditions and the No Action
 42 Alternative (LLT), would be expected to be similar to those described above for the ELT. Boron
 43 concentrations may be higher at western Delta locations due to greater effects of climate change on
 44 sea level rise that would occur in the LLT; however, these effects are independent of the alternative.

1 Further, boron is of concern in waters diverted for agricultural use, which primarily occurs in the
 2 interior Delta, and based on Delta source water characteristics (see Table 8-42 in Section 8.3.1.7,
 3 *Construction-Specific Considerations Used in the Assessment*), boron concentrations in the interior
 4 Delta would be expected to remain suitable for agricultural use.

5 **SWP/CVP Export Service Areas**

6 Under the Alternative 5A, long-term average boron concentrations would decrease at Banks
 7 pumping plant (13%) and Jones pumping plant (11%) relative to Existing Conditions, and the
 8 reductions would be similar compared to No Action Alternative (ELT) (Appendix 8F, *Boron*, Table
 9 Bo-30) as a result of export of a greater proportion of low-boron Sacramento River water.
 10 Commensurate with the decrease in exported boron concentrations, boron concentrations in the
 11 lower San Joaquin River may be reduced and would likely alleviate or lessen any expected increase
 12 in boron concentrations at Vernalis associated with flow reductions (see discussion of Upstream of
 13 the Delta), as well as locations in the Delta receiving a large fraction of San Joaquin River water.
 14 Reduced export boron concentrations also may contribute to reducing the existing CWA Section
 15 303(d) impairment in the lower San Joaquin River and associated TMDL actions for reducing boron
 16 loading. These same effects on boron at the Banks and Jones pumping plants would be expected in
 17 the LLT, because the primary effect of climate change on sea level rise and boron concentrations is
 18 expected in the western Delta.

19 Maintenance of SWP and CVP facilities under Alternative 5A would not be expected to create new
 20 sources of boron or contribute towards a substantial change in existing sources of boron in the
 21 affected environment.

22 **NEPA Effects:** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 5A
 23 would result in relatively small increases in long-term average boron concentrations in the Delta,
 24 not measurably increase boron levels in the lower San Joaquin River, and reduce boron levels in
 25 water exported to the SWP/CVP export service areas. However, the predicted changes would not be
 26 expected to cause exceedances of applicable objectives or further measurable water quality
 27 degradation, and thus would not constitute an adverse effect on water quality.

28 **CEQA Conclusion:** Based on the above assessment, any modified reservoir operations and
 29 subsequent changes in river flows under Alternative 5A, relative to Existing Conditions, would not
 30 be expected to result in a substantial adverse change in boron levels upstream of the Delta. Small
 31 increases in boron levels predicted for interior Delta locations in response to a shift in the Delta
 32 source water percentages would not be expected to cause exceedances of objectives, or substantial
 33 degradation of these water bodies. Alternative 5A maintenance also would not result in any
 34 substantial increases in boron concentrations in the affected environment. Boron concentrations
 35 would be reduced in water exported from the Delta to the CVP/SWP Export Service Areas, thus
 36 reflecting a potential improvement to boron loading in the lower San Joaquin River.

37 Boron is not a bioaccumulative constituent, thus any increased concentrations under Alternative 5A
 38 would not result in adverse boron bioaccumulation effects to aquatic life or humans. Relative to
 39 Existing Conditions, Alternative 5A would not result in substantially increased boron concentrations
 40 such that frequency of exceedances of municipal and agricultural water supply objectives would
 41 increase. The levels of boron degradation that may occur under Alternative 5A would not be of
 42 sufficient magnitude to cause substantially increased risk for adverse effects to municipal or
 43 agricultural beneficial uses within the affected environment. Long-term average boron
 44 concentrations would decrease in Delta water exports to the SWP and CVP service area, which may

1 contribute to reducing the existing CWA Section 303(d) impairment of agricultural beneficial uses in
 2 the lower San Joaquin River. Based on these findings, this impact is determined to be less than
 3 significant. No mitigation is required.

4 **Impact WQ-4: Effects on Boron Concentrations Resulting from Implementation of**
 5 **Environmental Commitments 3, 4, 6–12, 15, and 16**

6 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
 7 Alternative 5A present no new direct sources of boron to the affected environment, including areas
 8 upstream of the Delta, within the Delta region, and in the SWP/CVP Export Service Areas. Habitat
 9 restoration activities in the Delta, while involving increased land and water interaction within these
 10 habitats, would not be anticipated to contribute boron which is primarily associated with source
 11 water inflows to the Delta (i.e., San Joaquin River, agricultural drainage, and Bay source water).
 12 Moreover, some habitat restoration would occur on lands within the Delta currently used for
 13 irrigated agriculture, thus replacing agricultural land uses with restored habitats. The potential
 14 reduction in irrigated lands within the Delta may result in reduced discharges of agricultural field
 15 drainage with elevated boron concentrations, which would be considered an improvement
 16 compared to the No Action Alternative (ELT and LLT). Consequently, as they pertain to boron,
 17 implementation of the Environmental Commitments would not be expected to adversely affect any
 18 of the beneficial uses of the affected environment.

19 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 for
 20 Alternative 5A would not present new or substantially changed sources of boron to the affected
 21 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas. As such,
 22 their implementation would not be expected to substantially increase the frequency with which
 23 applicable Basin Plan objectives or other criteria would be exceeded in water bodies of the affected
 24 environment located upstream of the Delta, within the Delta, or in the SWP/CVP Export Service
 25 Areas or substantially degrade the quality of these water bodies, with regard to boron. Based on
 26 these findings, this impact is considered to be less than significant. No mitigation is required.

27 **Impact WQ-5: Effects on Bromide Concentrations Resulting from Facilities Operations and**
 28 **Maintenance**

29 ***Upstream of the Delta***

30 As described for Alternative 4 (see Section 8.3.3.9), under Alternative 5A in the ELT there would be
 31 no expected change to the sources of bromide in the Sacramento River and eastside tributary
 32 watersheds. Thus, changes in the magnitude and timing of reservoir releases north and east of the
 33 Delta would have negligible, if any, effect on the sources, and ultimately the concentration of
 34 bromide in the Sacramento River, the eastside tributaries, and the various reservoirs of the related
 35 watersheds. The modeled annual average lower San Joaquin River flow at Vernalis would decrease
 36 slightly (1%) compared to Existing Conditions and would remain virtually the same as the No Action
 37 Alternative (ELT), and thus flow changes would not result in substantial bromide increases
 38 (Appendix 8E, *Bromide*, Table 24). Moreover, there are no existing municipal intakes on the lower
 39 San Joaquin River, which is the beneficial use most sensitive to elevated bromide concentrations.
 40 Consequently, Alternative 5A in the ELT would not be expected to adversely affect the MUN
 41 beneficial use, or any other beneficial uses, of the Sacramento River, the San Joaquin River, the
 42 eastside tributaries, or their associated reservoirs upstream of the Delta due to changes in bromide
 43 concentrations.

1 Effects of Alternative 5A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
2 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
3 change and sea level rise that would occur in the LLT would not affect bromide sources in these
4 areas.

5 ***Delta***

6 Estimates of bromide concentrations at Delta assessment locations were generated using a mass
7 balance approach, and using relationships between EC and chloride and between chloride and
8 bromide and DSM2 EC output. See Section 8.3.1.3, *Plan Area*, for more information regarding these
9 modeling approaches. The assessment below identifies changes in bromide at Delta assessment
10 locations based on both approaches.

11 Based on the mass balance modeling approach for bromide, relative to Existing Conditions,
12 Alternative 5A long-term average bromide concentrations would increase in the S. Fork Mokelumne
13 River at Staten Island and Sacramento River at Emmaton, and decrease at all other assessment
14 locations (Appendix 8E, *Bromide*, Table 22). Average bromide concentrations at Staten Island would
15 increase from 50 µg/L under Existing Conditions to 52 µg/L (4% increase), and at Sacramento River
16 at Emmaton from 1,284 µg/L to 1,286 µg/L (<1% increase) for the modeled 16-year hydrologic
17 period (1976–1991). However, multiple interior and western Delta assessment locations would
18 have an increased frequency of exceedance of 50 µg/L, which is the CALFED Drinking Water
19 Program goal for bromide as a long-term average applied to drinking water intakes (Appendix 8E,
20 Table 22). These locations are the S. Fork Mokelumne River at Staten Island, Old River at Rock
21 Slough, Sacramento River at Emmaton, San Joaquin River at Antioch, and Sacramento River at
22 Mallard Island. The greatest increase in frequency of exceedance of the CALFED Drinking Water
23 Program long-term goal of 50 µg/L would occur in the S. Fork Mokelumne River (7% increase) and
24 Sacramento River at Emmaton (3% increase). The increase in frequency of exceedance of the 50
25 µg/L threshold at the other locations would be 3% or less. Also, these locations (with the exception
26 of the S. Fork Mokelumne River) and the Franks Tract and Contra Costa Pumping Plant #1 locations
27 would have an increased frequency of exceedance of 100 µg/L, which is the concentration believed
28 to be sufficient to meet currently established drinking water criteria for disinfection byproducts
29 (Appendix 8E, Table 22). The greatest increase in frequency of exceedance of 100 µg/L would occur
30 at Sacramento River at Emmaton (4% increase). The increase in frequency of exceedance of the 100
31 µg/L threshold at the other locations would be 3% or less.

32 Changes in long-term average bromide concentrations and changes in threshold exceedance
33 frequencies relative to the No Action Alternative (ELT) are generally of similar magnitude to those
34 previously described relative to Existing Conditions (Appendix 8E, *Bromide*, Table 22). However,
35 there would not be an increased frequency of exceedance of the 50 µg/L threshold in Old River at
36 Rock Slough, but in Barker Slough there would be a 1% increase relative to the No Action
37 Alternative (ELT). There would not be an increased frequency of exceedance of the 100 µg/L
38 threshold at the Sacramento River at Emmaton and Mallard Island. The frequency of exceedance of
39 the 100 µg/L threshold would increase by 2% at Contra Costa Pumping Plant #1 and 1% at Franks
40 Tract, Old River at Rock Slough, and the San Joaquin River at Antioch.

41 Results of the modeling approach which used relationships between EC and chloride and between
42 chloride and bromide were consistent with the discussion above, and assessment of bromide using
43 these modeling results lead to the same conclusions as are presented above for the mass balance
44 approach (Appendix 8E, Table 23).

1 Unlike Alternative 4, there would be no increased bromide concentration in Barker Slough at the
 2 North Bay Aqueduct under Alternative 5A relative to Existing Conditions and the No Action
 3 Alternative (ELT). Also, the magnitude of bromide concentration changes at Mallard Slough and in
 4 the San Joaquin River at Antioch during their historical months of use, relative to Existing Conditions
 5 and the No Action Alternative (ELT), would be generally similar to those described for Alternative 4
 6 (Appendix 8E, *Bromide*, Table 25), and the frequency of exceedance of bromide thresholds would be
 7 similar (Appendix 8E, Table 22). As described for Alternative 4, the use of seasonal intakes at these
 8 locations is largely driven by acceptable water quality, and thus has historically been opportunistic.
 9 Opportunity to use these intakes would remain, and the predicted increases in bromide
 10 concentrations at Antioch and Mallard Slough would not be expected to adversely affect MUN
 11 beneficial uses, or any other beneficial use, at these locations.

12 The effects of Alternative 5A in the LLT in the Delta region, relative to Existing Conditions and the
 13 No Action Alternative (LLT), would be expected to be similar to that described above. There may be
 14 higher bromide concentrations in the LLT in the western Delta, but this would be associated with
 15 sea level rise, not the project alternative, because the primary source of bromide to the Delta is sea
 16 water intrusion.

17 ***SWP/CVP Export Service Areas***

18 Under Alternative 5A, long-term average bromide concentrations at the Banks and Jones pumping
 19 plants, based on the mass balance modeling approach, would decrease. Long-term average bromide
 20 concentrations for the modeled 16-year hydrologic period at the pumping plants would decrease by
 21 as much as 30% relative to Existing Conditions and 21% relative to the No Action Alternative (ELT)
 22 (Appendix 8E, *Bromide*, Table 22). As a result, less frequent exceedances of the 50 µg/L and 100
 23 µg/L assessment thresholds would occur and an overall improvement in SWP/CVP Export Service
 24 Areas water quality would occur respective to bromide. Commensurate with the decrease in
 25 exported bromide, an improvement in lower San Joaquin River bromide would also occur since
 26 bromide in the lower San Joaquin River is principally related to irrigation water deliveries from the
 27 Delta. Results of the modeling approach which used relationships between EC and chloride and
 28 between chloride and bromide are consistent with the mass balance results, and assessment of
 29 bromide using these modeling results leads to the same conclusions (Appendix 8E, Table 23).

30 The effects of Alternative 5A in the LLT in the SWP/CVP Export Service Areas, relative to Existing
 31 Conditions and the No Action Alternative (LLT), would be expected to be similar to that described
 32 above, because the sea level rise that could occur in the LLT would not result in substantial bromide
 33 contributions to the water exported at Banks and Jones pumping plants.

34 Maintenance of SWP and CVP facilities under Alternative 5A would not be expected to create new
 35 sources of bromide or contribute towards a substantial change in existing sources of bromide in the
 36 affected environment. Maintenance activities would not be expected to cause any substantial change
 37 in bromide such that MUN beneficial uses, or any other beneficial use, would be adversely affected
 38 anywhere in the affected environment.

39 ***NEPA Effects:*** In summary, the operations and maintenance activities under Alternative 5A, relative
 40 to the No Action Alternative (ELT and LLT) would result in an increased frequency of exceedance of
 41 the CALFED Drinking Water Program long-term bromide goal of 50 µg/L at the S. Fork Mokelumne
 42 River at Staten Island, Sacramento River at Emmaton, San Joaquin River at Antioch, Sacramento
 43 River at Mallard Island, and in Barker Slough. The frequency of exceedance of the 100 µg/L
 44 threshold for protection against the formation of disinfection byproducts in treated drinking water

1 would increase by 2% at Contra Costa Pumping Plant #1 and 1% at Franks Tract, Old River at Rock
2 Slough, and the San Joaquin River at Antioch. However, long-term average bromide concentrations
3 would increase only in the S. Fork Mokelumne River at Staten Island and Sacramento River at
4 Emmaton; there would be decreases in long-term average bromide concentrations at the other
5 assessment locations. The long-term bromide concentration in the S. Fork Mokelumne River at
6 Staten Island would be less than the concentration believed to be sufficient to meet currently
7 established drinking water criteria for disinfection byproducts, and the increase at Emmaton would
8 be very small (<1%). Thus, these increased bromide concentrations are not expected to result in
9 adverse effects to MUN beneficial uses, or any other beneficial use, at these locations. Based on these
10 findings, this effect is determined to not be adverse.

11 **CEQA Conclusion:** While greater water demands under Alternative 5A would alter the magnitude
12 and timing of reservoir releases north and east of the Delta, these activities would have negligible, if
13 any, effect on the sources of bromide, and ultimately the concentration of bromide in the
14 Sacramento River, the San Joaquin River, the eastside tributaries, and the various reservoirs of the
15 related watersheds, as described for Alternative 4 (see Section 8.3.3.9).

16 Under Alternative 5A there would be an increased frequency of exceedance of the CALFED Drinking
17 Water Program long-term bromide goal of 50 µg/L at the S. Fork Mokelumne River at Staten Island,
18 Old River at Rock Slough, Sacramento River at Emmaton, San Joaquin River at Antioch, and
19 Sacramento River at Mallard Island. Also, these locations (with the exception of the S. Fork
20 Mokelumne River) and the Franks Tract and Contra Costa Pumping Plant #1 locations, would have
21 an increased frequency of exceedance of 100 µg/L, which is the concentration believed to be
22 sufficient to meet currently established drinking water criteria for disinfection byproducts.
23 However, long-term average bromide concentrations would increase only in the S. Fork Mokelumne
24 River at Staten Island and Sacramento River at Emmaton and decrease at all other assessment
25 locations. The long-term bromide concentration in the S. Fork Mokelumne River at Staten Island (52
26 µg/L) would be less than the 100 µg/L believed to be sufficient to meet currently established
27 drinking water criteria for disinfection byproducts, and the increase at Sacramento River at
28 Emmaton would be very small (<1%). Further, as described for Alternative 4 (see Section 8.3.3.9),
29 the use of seasonal intakes at Antioch and Mallard Island is largely driven by acceptable water
30 quality, and thus has historically been opportunistic and opportunity to use these intakes would
31 remain. Thus, these increased bromide concentrations would not be expected to adversely affect
32 MUN beneficial uses, or any other beneficial use, at these locations.

33 The assessment of effects on bromide in the SWP/CVP Export Service Areas is based on assessment
34 of changes in bromide concentrations at Banks and Jones pumping plants. Long-term average
35 bromide concentrations at the Banks and Jones pumping plants are predicted to decrease by as
36 much as 30% relative to Existing Conditions and there would be less frequent exceedance of
37 bromide concentration thresholds.

38 Based on the above, Alternative 5A would not cause exceedance of applicable state or federal
39 numeric or narrative water quality objectives/criteria because none exist for bromide. Alternative
40 5A would not result in any substantial change in long-term average bromide concentration or
41 exceed 50 and 100 µg/L assessment threshold concentrations by frequency, magnitude, and
42 geographic extent that would result in adverse effects on any beneficial uses within affected water
43 bodies. Bromide is not a bioaccumulative constituent and thus concentrations under this alternative
44 would not result in bromide bioaccumulating in aquatic organisms. Increases in exceedances of the
45 100 µg/L assessment threshold concentration would be 4% or less at all locations assessed, which is

1 considered to be less than substantial long-term degradation of water quality. The levels of bromide
 2 degradation that may occur under the Alternative 5A would not be of sufficient magnitude to cause
 3 substantially increased risk for adverse effects on any beneficial uses of water bodies within the
 4 affected environment. Bromide is not CWA Section 303(d) listed and thus the minor increases in
 5 long-term average bromide concentrations would not affect existing beneficial use impairment
 6 because no such use impairment currently exists for bromide. Based on these findings, this impact is
 7 less than significant. No mitigation is required.

8 **Impact WQ-6: Effects on Bromide Concentrations Resulting from Implementation of**
 9 **Environmental Commitments 3, 4, 6-12, 15, and 16**

10 **NEPA Effects:** Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 would present
 11 no new sources of bromide to the affected environment, including areas Upstream of the Delta,
 12 within the Plan Area, and the SWP/CVP Export Service Areas. Some habitat restoration activities
 13 would occur on lands in the Delta formerly used for irrigated agriculture. Such replacement or
 14 substitution of land use activity would not be expected to result in new or increased sources of
 15 bromide to the Delta. Therefore, as they pertain to bromide, implementation of these Environmental
 16 Commitments would not be expected to adversely affect MUN beneficial use, or any other beneficial
 17 uses, of the affected environment.

18 Environmental Commitment 4 would result in some tidal habitat restoration, however, the areal
 19 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
 20 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
 21 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
 22 bromide concentration changes.

23 In summary, implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 under
 24 Alternative 5A relative to the No Action Alternative (ELT and LLT), would have negligible, if any,
 25 effects on bromide concentrations. Therefore, the effects on bromide from implementing
 26 Environmental Commitments 3, 4, 6-12, 15, and 16 are determined to not be adverse.

27 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 under
 28 Alternative 5A would not present new or substantially changed sources of bromide to the affected
 29 environment. Some Environmental Commitments may replace or substitute for existing irrigated
 30 agriculture in the Delta. This replacement or substitution would not be expected to substantially
 31 increase or present new sources of bromide. Thus, implementation of Environmental Commitments
 32 3, 4, 6-12, 15, and 16 would have negligible, if any, effects on bromide concentrations throughout
 33 the affected environment, would not cause exceedance of applicable state or federal numeric or
 34 narrative water quality objectives/criteria because none exist for bromide, and would not cause
 35 changes in bromide concentrations that would result in significant impacts on any beneficial uses
 36 within affected water bodies. Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16
 37 would not cause significant long-term water quality degradation such that there would be greater
 38 risk of significant impacts on beneficial uses, would not cause greater bioaccumulation of bromide,
 39 and would not further impair any beneficial uses due to bromide concentrations because no uses are
 40 currently impaired due to bromide levels. Based on these findings, this impact is considered less
 41 than significant. No mitigation is required.

1 **Impact WQ-7: Effects on Chloride Concentrations Resulting from Facilities Operations and**
2 **Maintenance**

3 ***Upstream of the Delta***

4 The effects of Alternative 5A on chloride concentrations in reservoirs and rivers upstream of the
5 Delta would be the similar to those effects described for Alternative 4 (see Section 8.3.3.9). Chloride
6 loading in these watersheds would remain unchanged and resultant changes in flows from altered
7 system-wide operations would have negligible, if any, effects on the concentration of chloride in the
8 rivers and reservoirs of these watersheds. There would be no expected change to the sources of
9 chloride in the Sacramento River and eastside tributary watersheds, and changes in the magnitude
10 and timing of reservoir releases north and east of the Delta would have negligible, if any, effect on
11 the sources, and ultimately the concentration of chloride in the Sacramento River, the eastside
12 tributaries, and the various reservoirs of the related watersheds. The modeled annual average lower
13 San Joaquin River flow at Vernalis would decrease slightly (1%) compared to Existing Conditions
14 and would remain virtually the same as the No Action Alternative (ELT), and thus flow changes
15 would not result in substantial chloride increases. Moreover, there are no existing municipal intakes
16 on the lower San Joaquin River. Consequently, Alternative 5A in the ELT would not be expected to
17 cause exceedances of chloride objectives/criteria or substantially degrade water quality with
18 respect to chloride, and thus would not adversely affect any beneficial uses of the Sacramento River,
19 the eastside tributaries, associated reservoirs upstream of the Delta, or the San Joaquin River.

20 Effects of Alternative 5A in reservoirs and rivers upstream of the Delta in the LLT relative to Existing
21 Conditions and the No Action Alternative (LLT) would be expected to be similar, because the climate
22 change and sea level rise that would occur in the LLT would not affect chloride sources in these
23 areas.

24 ***Delta***

25 Estimates of chloride concentrations at Delta assessment locations were generated using a mass
26 balance approach and EC-chloride relationships and DSM2 EC output. See Section 8.3.1.3, *Plan Area*,
27 for more information regarding these modeling approaches. The assessment below identifies
28 changes in chloride at Delta assessment locations based on both approaches.

29 Modeling of chloride using both the mass balance approach and EC-chloride relationship predicts
30 that Alternative 5A in the ELT would result in reduced long-term average chloride concentrations,
31 relative to Existing Conditions, for the 16-year period modeled at all assessment locations except for
32 the S. Fork Mokelumne River at Staten Island. The increase in long-term average chloride
33 concentration at Staten Island would be 1 mg/L (3%) based on the mass balance modeling and
34 <1 mg/L (1%) based on the EC-chloride relationship (Appendix 8G, *Chloride*, Tables CI-77 and CI-
35 78). These increases are extremely small in absolute terms and relative to applicable water quality
36 objectives, and are within the estimated modeling uncertainty. This differs from Alternative 4, under
37 which there would be increased long-term average chloride concentrations also at the North Bay
38 Aqueduct at Barker Slough. The change in long-term average chloride concentrations relative to the
39 No Action Alternative (ELT) would be similar to those relative to Existing Conditions.

40 The following outlines the modeled chloride changes relative to the applicable objectives and
41 beneficial uses of Delta waters.

1 *Municipal Beneficial Uses Relative to Existing Conditions*

2 Estimates of chloride concentrations generated using EC-chloride relationships were used to
3 evaluate the 150 mg/L Bay-Delta WQCP objective for municipal and industrial beneficial uses on a
4 basis of the percentage of years the chloride objective is exceeded for the modeled 16-year period.
5 The objective is exceeded if chloride concentrations exceed 150 mg/L for a specified number of days
6 in a given water year at Antioch and Contra Costa Pumping Plant #1. The modeled frequency of
7 objective exceedance would decrease at the Contra Costa Pumping Plant #1 from 7% of years under
8 Existing Conditions to 0% of years under Alternative 5A in the ELT (Appendix 8G, *Chloride*, Table Cl-
9 64).

10 Evaluation of the 250 mg/L Bay-Delta WQCP objective for chloride utilized results from both the
11 mass balance approach and EC-chloride relationship. The basis for the evaluation was the predicted
12 number of days the objective would be exceeded for the modeled 16-year period.

13 Based on the mass balance approach, there would be a decreased frequency of exceedance of the
14 250 mg/L objective under Alternative 5A, relative to Existing Conditions, at all locations except in
15 the Sacramento River at Mallard Island, San Joaquin River at Antioch, and the Sacramento River at
16 Emmaton. In the Sacramento River at Mallard Island, the frequency of objective exceedance would
17 increase from 85% under Existing Conditions to 86% under Alternative 5A for the entire period
18 modeled (Appendix 8G, *Chloride*, Table Cl-81). In the San Joaquin River at Antioch, there would be an
19 increase in chloride objective exceedance for the entire period modeled, from 66% under Existing
20 Conditions to 70% under Alternative 5A. In the Sacramento River at Emmaton, there would be an
21 increase in chloride objective exceedance during the drought period modeled, from 55% to 57%.

22 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
23 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
24 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
25 basis for the evaluation was the predicted number of days the objective was exceeded for the
26 modeled 16-year period. For Alternative 5A, the modeled frequency of objective exceedance would
27 decrease, from 6% of modeled days under Existing Conditions, to 5% of modeled days under
28 Alternative 5A (Appendix 8G, *Chloride*, Table Cl-63).

29 The mass balance results also indicate reduced assimilative capacity with respect to the 250 mg/L
30 objective during certain months and at certain locations. In the San Joaquin River at Antioch, there
31 would be a reduction in assimilative capacity in March and April of up to 18% for the 16-year period
32 modeled and 52% for the drought period modeled (Appendix 8G, *Chloride*, Table Cl-79). Assimilative
33 capacity at the Contra Costa Pumping Plant #1 also would be reduced, in February through April by
34 up to 8%, and in January of the drought period modeled by 4%.

35 When utilizing the EC-chloride relationship to model chloride concentrations for the 16-year period,
36 trends in frequency of exceedance and use of assimilative capacity would be similar to those
37 discussed when utilizing the mass balance modeling approach (Appendix 8G, *Chloride*, Tables Cl-80
38 and Cl-82). However, the EC-chloride relationships generally predicted changes of lesser magnitude,
39 where predictions of change utilizing the mass balance approach were generally of greater
40 magnitude, and thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases of such
41 disagreement, the approach that yielded the more conservative predictions was used as the basis for
42 determining adverse impacts.

1 *CWA Section 303(d) Listed Water Bodies—Relative to Existing Conditions*

2 Tom Paine Slough in the southern Delta is on the state’s CWA Section 303(d) list for chloride with
3 respect to the secondary MCL of 250 mg/L. Monthly average chloride concentrations at the Old
4 River at Tracy Road for the 16-year period modeled, which represents the nearest DSM2-modeled
5 location to Tom Paine Slough, would be generally similar under Alternative 5A in the ELT relative to
6 Existing Conditions, and thus, would not be further degraded on a long-term basis (Appendix 8G,
7 *Chloride*, Figure Cl-17).

8 Suisun Marsh also is on the state’s CWA Section 303(d) list for chloride in association with the Bay-
9 Delta WQCP objectives for maximum allowable salinity during the months of October through May,
10 which establish appropriate seasonal salinity conditions for fish and wildlife beneficial uses. With
11 respect to Suisun Marsh, the monthly average chloride concentrations for the 16-year period
12 modeled would generally increase by <10% under Alternative 5A in the ELT relative to Existing
13 Conditions in March and April at the Sacramento River at Mallard Island (Appendix 8G, *Chloride*,
14 Figure Cl-18), at Collinsville (Appendix 8G, Figure Cl-19), and in Montezuma Slough at Beldon’s
15 Landing (Appendix 8G, Figure Cl-20), and remain similar or decrease in all other months. Chloride
16 levels in Suisun Marsh are highly dynamic on a sub-daily basis as a result of tidal influences. The
17 changes identified above are small relative to normal day-to-day variability in chloride in Suisun
18 Marsh. For these reasons, any changes in chloride in Suisun Marsh are expected to have no adverse
19 effect on marsh beneficial uses. These changes reflect the effect of climate change and sea level rise,
20 as well as the alternative. Comparisons to the No Action Alternative (ELT) below provide an
21 assessment of the effect of the alternative alone.

22 *Municipal Beneficial Uses Relative to No Action Alternative (ELT)*

23 Similar to the assessment conducted for Existing Conditions, estimates of chloride concentrations
24 generated from EC-chloride relationships were used to evaluate the 150 mg/L Bay-Delta WQCP
25 objective for municipal and industrial beneficial uses. For Alternative 5A in the ELT, the modeled
26 frequency of objective exceedance would not change at the Contra Costa Pumping Plant #1—both
27 the No Action Alternative (ELT) and Alternative 5A in the ELT all would have 0% exceedance
28 (Appendix 8G, *Chloride*, Table Cl-64).

29 Based on the mass balance approach, the frequency of exceedance of the 250 mg/L objective under
30 Alternative 5A in the ELT would be the same, or would decrease, at all locations relative to the No
31 Action Alternative (ELT), except in the San Joaquin River at Antioch during the drought period
32 modeled (Appendix 8G, *Chloride*, Table Cl-81). The frequency of objective exceedance would
33 increase from 85% to 87% at Antioch.

34 Similarly, estimates of chloride concentrations generated using EC-chloride relationships and DSM2
35 EC output (see Section 8.3.1.3, *Plan Area*) were also used to evaluate the 250 mg/L Bay-Delta WQCP
36 objective for chloride at Contra Costa Pumping Plant #1, where daily average objectives apply. The
37 basis for the evaluation was the predicted number of days the objective was exceeded for the
38 modeled 16-year period. For Alternative 5A, the modeled frequency of objective exceedance would
39 decrease, from 8% of modeled days under the No Action Alternative (ELT), to 5% of modeled days
40 under Alternative 5A (Appendix 8G, *Chloride*, Table Cl-63).

41 The mass balance results indicate reduced assimilative capacity with respect to the 250 mg/L
42 objective for certain months and locations. In the San Joaquin River at Antioch, there would be a

1 reduction in assimilative capacity in April of 14% for the drought period modeled (Appendix 8G,
2 *Chloride*, Table Cl-79).

3 When utilizing the EC-chloride relationship to model monthly average chloride concentrations for
4 the 16-year period, trends in frequency of exceedance and use of assimilative capacity would be
5 similar to those discussed for the mass balance modeling approach (Appendix 8G, *Chloride*, Tables
6 Cl-80 and Cl-82). However, utilizing the EC-chloride relationships generally predicted changes of
7 lesser magnitude, where predictions of change utilizing the mass balance approach were generally
8 of greater magnitude, and thus more conservative. As discussed in Section 8.3.1.3, *Plan Area*, in cases
9 of such disagreement, the approach that yielded the more conservative predictions was used as the
10 basis for determining adverse impacts.

11 Figure Cl-21 in Appendix 8G, *Chloride*, shows chloride concentrations in April during the 5-year
12 drought period (1987–1991) at Antioch, where Table Cl-79 indicated 14% use of assimilative
13 capacity. The figure shows that during 2 of the 5 years, chloride concentrations increased relative to
14 the No Action Alternative (ELT) and decreased in the other 3 years. The absolute differences
15 estimated are fairly small and may be within modeling uncertainty. Figures Cl-22 and Cl-23 in
16 Appendix 8G show a box and whisker plot and exceedance plot for April at Antioch for all dry and
17 critical water years modeled (not just the 1987–1991 drought period). These graphs show that
18 while the median chloride concentration is increased relative to the No Action Alternative (ELT), the
19 maximum value decreased, while the 25th percentile and 75th percentile values remained about the
20 same. Based on this analysis, long-term degradation is not expected at Antioch in April during
21 drought years.

22 Based on the low level of water quality degradation estimated for the western Delta, and the lack of
23 exceedance of water quality objectives, Alternative 5A is not expected to have substantial adverse
24 effects on municipal and industrial beneficial uses in the western Delta.

25 *CWA Section 303(d) Listed Water Bodies—Relative to No Action Alternative (ELT)*

26 With respect to the state’s CWA Section 303(d) listing for chloride, Alternative 5A would generally
27 result in changes similar to those discussed for the comparison to Existing Conditions. Monthly
28 average chloride concentrations at Tom Paine Slough would not be further degraded on a long-term
29 basis, based on changes that would occur in Old River at Tracy Road (Appendix 8G, *Chloride*, Figure
30 Cl-17). Modeling indicated that monthly average chloride concentrations at source water channel
31 locations for the Suisun Marsh would remain similar or decrease relative to the No Action
32 Alternative (ELT) (Appendix 8G, Figures Cl-18, Cl-19, and Cl-20). For these reasons, any changes in
33 chloride in Suisun Marsh are expected to have no adverse effect on marsh beneficial uses.

34 The effects of Alternative 5A in the LLT in the Delta region, relative to Existing Conditions and the
35 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
36 climate change and sea level rise, additional outflow may be required at certain times to prevent
37 increases in chloride in the west Delta. Small increases in chloride concentrations may occur in some
38 areas, but it is not expected that these increases would cause exceedance of Bay-Delta WQCP
39 objectives of cause substantial long-term degradation that would impact municipal and industrial
40 beneficial uses.

1 **SWP/CVP Export Service Areas**

2 Under Alternative 5A in the ELT, long-term average chloride concentrations at the Banks and Jones
3 pumping plants, based on the mass balance analysis of modeling results for the 16-year period,
4 would decrease relative to Existing Conditions. Chloride concentrations would be reduced by 29%
5 at Banks pumping plant (Appendix 8G, *Chloride*, Table CI-77). At Jones pumping plant, chloride
6 concentrations would be reduced 25% (Appendix 8G, *Chloride*, Table CI-77). The frequency of
7 exceedances of applicable water quality objectives would be the same relative to Existing Conditions
8 (Appendix 8G, Table CI-81). The chloride concentration changes relative to the No Action Alternative
9 (ELT) would be similar. Consequently, water exported into the SWP/CVP Export Service Areas
10 would generally be of similar or better quality with regard to chloride relative to Existing Conditions
11 and the No Action Alternative (ELT). Results of the modeling approach which utilized a EC-chloride
12 relationship are consistent these results, and assessment of chloride using these modeling output
13 results in the same conclusions as for the mass balance approach (Appendix 8G, Tables CI-78 and CI-
14 82).

15 Commensurate with the reduced chloride concentrations in water exported to the SWP/CVP Export
16 Service Area, reduced chloride loading in the lower San Joaquin River would be anticipated which
17 would likely alleviate chloride concentrations at Vernalis.

18 The effects of Alternative in the LLT in the SWP/CVP Export Service Areas, relative to Existing
19 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
20 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
21 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

22 Maintenance of SWP and CVP facilities would not be expected to create new sources of chloride or
23 contribute towards a substantial change in existing sources of chloride in the affected environment.
24 Maintenance activities would not be expected to cause any substantial change in chloride such that
25 any long-term water quality degradation would occur, thus, beneficial uses would not be adversely
26 affected anywhere in the affected environment.

27 **NEPA Effects:** In summary, relative to the No Action Alternative (ELT and LLT), Alternative 5A
28 would not result in substantially increased chloride concentrations in the Delta on a long-term
29 average that would result in adverse effects on the municipal and industrial water supply beneficial
30 use, or any other beneficial use. Additional exceedance of the 150 mg/L and 250 mg/L objectives is
31 not expected, and substantial long-term degradation is not expected that would result in adverse
32 effects on the municipal and industrial water supply beneficial use, or any other beneficial use.
33 Based on these findings, this effect is determined to not be adverse.

34 **CEQA Conclusion:** Chloride is not a constituent of concern in the Sacramento River watershed
35 upstream of the Delta, thus river flow rate and reservoir storage reductions that would occur under
36 Alternative 5A relative to Existing Conditions, would not be expected to result in a substantial
37 adverse change in chloride levels. Additionally, relative to Existing Conditions, Alternative 5A would
38 not result in reductions in river flow rates (i.e., less dilution) or increased chloride loading such that
39 there would be any substantial increase in chloride concentrations upstream of the Delta in the San
40 Joaquin River watershed.

41 Relative to Existing Conditions, Alternative 5A would result in substantially increased chloride
42 concentrations in the Delta on a long-term average that would result in adverse effects on the
43 municipal and industrial water supply beneficial use. Additional exceedance of the 150 mg/L and

1 250 mg/L objectives is not expected, and substantial long-term degradation is not expected that
2 would result in adverse effects on the municipal and industrial water supply beneficial use.

3 Chloride concentrations would be reduced under Alternative 5A in water exported from the Delta to
4 the SWP/CVP Export Service Areas thus reflecting a potential improvement to chloride loading in
5 the lower San Joaquin River.

6 Chloride is not a bioaccumulative constituent, thus any increased concentrations under the
7 Alternative 5A would not result in substantial chloride bioaccumulation impacts on aquatic life or
8 humans. Alternative 5A maintenance would not result in any substantial changes in chloride
9 concentration upstream of the Delta or in the SWP/CVP Export Service Areas.

10 Based on these findings, this impact is determined to be less than significant. No mitigation is
11 required. Despite the fact that no mitigation is required, DWR proposed to further reduce any
12 impacts by implementing Mitigation Measure WQ-7e.

13 **Mitigation Measure WQ-7e: Implement Terms of the Contra Costa Water District**
14 **Settlement Agreement**

15 **Impact WQ-8: Effects on Chloride Concentrations Resulting from Implementation of**
16 **Environmental Commitments 3, 4, 6–12, 15, and 16**

17 *NEPA Effects:* The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
18 Alternative 5A would present no new direct sources of chloride to the affected environment,
19 including areas Upstream of the Delta, within the Plan Area, and the SWP/CVP Export Service Areas.
20 Consequently, as they pertain to chloride, implementation of these Environmental Commitments
21 would not be expected to adversely affect any of the beneficial uses of the affected environment.
22 Moreover, some habitat restoration activities would occur on lands within the Delta currently used
23 for irrigated agriculture. The potential reduction in irrigated lands within the Delta may result in
24 reduced discharges of agricultural field drainage with elevated chloride concentrations, which
25 would be considered an improvement relative to the No Action Alternative (ELT and LLT).
26 Therefore, the effects on chloride from implementing Environmental Commitments 3, 4, 6–12, 15,
27 and 16 are considered to be not adverse.

28 *CEQA Conclusion:* Implementation of the Environmental Commitments 3, 4, 6–12, 15, and 16 under
29 Alternative 5A would not present new or substantially changed sources of chloride to the affected
30 environment upstream of the Delta, within Delta, or in the SWP/CVP Export Service Areas.
31 Replacement of irrigated agricultural land uses in the Delta with habitat restoration may result in
32 some reduction in discharge of agricultural field drainage with elevated chloride concentrations,
33 thus resulting in improved water quality conditions. Based on these findings, this impact is
34 considered to be less than significant. No mitigation is required.

35 **Impact WQ-9: Effects on Dissolved Oxygen Resulting from Facilities Operations and**
36 **Maintenance**

37 As described in detail for Alternative 4 (see Section 8.3.3.9), DO levels are primarily affected by
38 water temperature, flow velocity, turbulence, amounts of oxygen demanding substances present
39 (e.g., ammonia, organics), and rates of photosynthesis (which is influenced by nutrient levels),
40 respiration, and decomposition. Water temperature and salinity affect the maximum DO saturation
41 level (i.e., the highest amount of oxygen the water can dissolve). Flow velocity affects the turbulence

1 and re-aeration of the water (i.e., the rate at which oxygen from the atmosphere can be dissolved in
2 water). High nutrient content can support aquatic plant and algae growth, which in turn generates
3 oxygen through photosynthesis and consumes oxygen through respiration and decomposition.

4 As described for Alternative 4, amounts of oxygen demanding substances present (e.g., ammonia,
5 organics) in the reservoirs and rivers upstream of the Delta, rates of photosynthesis (which is
6 influenced by nutrient levels/loading), and respiration and decomposition of aquatic life is not
7 expected to change sufficiently under Alternative 5A (ELT and LLT) to substantially alter DO levels
8 relative to Existing Conditions or the No Action Alternative (ELT and LLT). Further, the rivers
9 upstream of the Delta are well oxygenated and experience periods of supersaturation (i.e., when DO
10 level exceeds the saturation concentration). Because these are large, turbulent rivers, any reduced
11 DO saturation level that would be caused by an increase in temperature under Alternative 5A would
12 not be expected to cause DO levels to be outside of the range seen historically. Flow changes that
13 would occur under Alternative 5A would not be expected to have substantial effects on river DO
14 levels; likely, the changes would be immeasurable. This is because sufficient turbulence and
15 interaction of river water with the atmosphere would continue to occur to maintain water
16 saturation levels (due to these factors) at levels similar to that of Existing Conditions and the No
17 Action Alternative (ELT and LLT).

18 Also as described for Alternative 4, salinity changes would generally have relatively minor effects on
19 Delta DO levels. Further, the relative degree of tidal exchange of flows and turbulence, which
20 contributes to exposure of Delta waters to the atmosphere for reaeration, would not be expected to
21 substantially change relative to Existing Conditions or the No Action Alternative (ELT and LLT), such
22 that these factors would reduce Delta DO levels below objectives or levels that protect beneficial
23 uses. Similarly, increased temperature under Alternative 5A (ELT and LLT), which would be due to
24 climate change, would generally have relatively minor effects on Delta DO levels, relative to Existing
25 Conditions.

26 Similar to Alternative 4, flows in the San Joaquin River at Stockton under Alternative 5A were
27 evaluated and are shown in Figure 8-65b. The figure shows that while flows do would change
28 somewhat, they are would generally be within the range of flows seen under Existing Conditions and
29 the No Action Alternative. Reports indicate that the aeration facility performs adequately under the
30 range of flows from 250–1,000 cfs (ICF International 2010). Based on the above, the expected
31 changes in flows in the San Joaquin River at Stockton are not expected to substantially move the
32 point of minimum DO, and therefore the aeration facility will would likely still be located
33 appropriately to keep DO levels above Basin Plan objectives.

34 Overall, assuming continued operation of the aerators, the alternative is not expected to have a
35 substantial impact adverse effect on DO in the Deep Water Ship Channel. It is expected that DO levels
36 in the Deep Water Ship Channel, which is CWA Section 303(d) listed as impaired due to low DO,
37 would remain similar to those under Existing Conditions and the No Action Alternative (ELT and
38 LLT) or improve as TMDL-required studies are completed and actions are implemented to improve
39 DO levels. DO levels in other Clean Water Act Section 303(d)-listed waterways would not be
40 expected to change relative to Existing Conditions or the No Action Alternative (ELT and LLT), as the
41 circulation of flows, tidal flow exchange, and re-aeration would continue to occur.

42 In the SWP/CVP Export Service Areas, the primary factor that would affect DO in the conveyance
43 channels and ultimately the receiving reservoirs would be changes in the levels of nutrients and
44 oxygen-demanding substances and DO levels in the exported water. Because the biochemical oxygen

1 demand of the exported water would not be expected to substantially differ from that under Existing
2 Conditions or the No Action Alternative (ELT and LLT) due to water quality regulations, canal
3 turbulence and exposure of the water to the atmosphere and the algal communities that exist within
4 the canals would establish an equilibrium for DO levels within the canals. The same would occur in
5 downstream reservoirs.

6 **NEPA Effects:** Because DO levels are not expected to change substantially relative to the No Action
7 Alternative (ELT and LLT), the effects on DO from implementing Alternative 5A (ELT and LLT) are
8 determined to not be adverse.

9 **CEQA Conclusion:** The effects of Alternative 5A on DO levels in surface waters upstream of the Delta,
10 in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions would be
11 similar to those described for Alternative 4 (see Section 8.3.3.9). Reservoir storage reductions that
12 would occur under Alternative 5A, relative to Existing Conditions, would not be expected to result in
13 a substantial adverse change in DO levels in the reservoirs, because oxygen sources (surface water
14 aeration, aerated inflows, vertical mixing) would remain. Similarly, river flow rate reductions would
15 not be expected to result in a substantial adverse change in DO levels in the rivers upstream of the
16 Delta, given that mean monthly flows would remain within the ranges historically seen under
17 Existing Conditions and the affected river are large and turbulent. Any reduced DO saturation level
18 that may be caused by increased water temperature would not be expected to cause DO levels to be
19 outside of the range seen historically. Finally, amounts of oxygen demanding substances and salinity
20 would not be expected to change sufficiently to affect DO levels.

21 It is expected there would be no substantial change in Delta DO levels in response to a shift in the
22 Delta source water percentages under this alternative or substantial degradation of these water
23 bodies, with regard to DO. DO levels would be affected by nutrient loading, which the state regulates
24 the discharges of, and this loading would not be expected to lower DO levels relative to Existing
25 Conditions based on historical DO levels. Further, the anticipated changes in salinity would have
26 relatively minor effects on DO levels, and tidal exchange, which contribute to the reaeration of Delta
27 waters would not be expected to change substantially.

28 There is not expected to be substantial, if even measurable, changes in DO levels in the SWP/CVP
29 Export Service Areas waters, relative to Existing Conditions, because the biochemical oxygen
30 demand of the exported water would not be expected to substantially differ from that under Existing
31 Conditions (due to water quality regulations), canal turbulence and exposure of the water to the
32 atmosphere and the algal communities that exist within the canals would establish an equilibrium
33 for DO levels within the canals. The same would occur in downstream reservoirs.

34 Therefore, this alternative is not expected to cause additional exceedance of applicable water quality
35 objectives by frequency, magnitude, and geographic extent that would result in significant impacts
36 on any beneficial uses within affected water bodies. Because no substantial changes in DO levels are
37 expected, long-term water quality degradation would not be expected to occur, and, thus, beneficial
38 uses would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for
39 low DO, but because no substantial decreases in DO levels would be expected, greater degradation
40 and DO-related impairment of these areas would not be expected. Based on these findings, this
41 impact would be less than significant. No mitigation is required.

1 **Impact WQ-10: Effects on Dissolved Oxygen Resulting from Implementation of Environmental**
 2 **Commitments 3, 4, 6–12, 15, and 16**

3 **NEPA Effects:** Environmental Commitments 3, 4, 6–11 would involve habitat restoration actions.
 4 The increased habitat provided by these Environmental Commitments could contribute to an
 5 increased biochemical or sediment demand, through contribution of organic carbon and plants
 6 decaying. However, the areal extent of new habitat would be small relative to the existing and No
 7 Action Alternative habitat areas, and similar habitat existing in the Delta is not identified as
 8 contributing to adverse DO conditions. The remaining Environmental Commitments would not be
 9 expected to affect DO levels because they are actions that do not affect the presence of oxygen-
 10 demanding substances. Therefore, the effects on DO from implementing Environmental
 11 Commitments 3, 4, 6–12, 15, and 16 are determined to not be adverse.

12 **CEQA Conclusion:** It is expected that DO levels in the Upstream of the Delta Region, in the Plan Area,
 13 or in the SWP/CVP Export Service Areas following implementation of Environmental Commitments
 14 3–12, 15, and 16 under Alternative 5A would not be substantially different from existing DO
 15 conditions, because these would contribute to a minimal, localized change in oxygen-demanding
 16 substances associated with habitat restoration, if at all. Therefore, these Environmental
 17 Commitments are not expected to cause additional exceedance of applicable water quality objectives
 18 by frequency, magnitude, and geographic extent that would result in significant impacts on any
 19 beneficial uses within affected water bodies. Because no substantial changes in DO levels would be
 20 expected, long-term water quality degradation would not be expected, and, thus, beneficial uses
 21 would not be adversely affected. Various Delta waterways are CWA Section 303(d)-listed for low
 22 DO, but because no substantial decreases in DO levels would be expected, greater degradation and
 23 impairment of these areas would not be expected. Based on these findings, this impact would be less
 24 than significant. No mitigation is required.

25 **Impact WQ-11: Effects on Electrical Conductivity Concentrations Resulting from Facilities**
 26 **Operations and Maintenance**

27 ***Upstream of the Delta***

28 The effects of Alternative 5A on EC levels in reservoirs and rivers upstream of the Delta would be
 29 similar to those effects described for Alternative 4 (see Section 8.3.3.9). The extent of new urban
 30 growth would be less in the ELT, thus discharges of EC-elevating parameters in runoff and
 31 wastewater discharges to water bodies upstream of the Delta would be expected to be less than in
 32 the LLT. However, the state is regulating point source discharges of EC-related parameters and
 33 implementing a program to further decrease loading of EC-related parameters to tributaries. Based
 34 on these considerations, and those described in Section 8.3.3.9, EC levels (highs, lows, typical
 35 conditions) in the Sacramento River and its tributaries, the eastside tributaries, or their associated
 36 reservoirs upstream of the Delta would not be expected to be outside the ranges occurring under
 37 Existing Conditions.

38 For the San Joaquin River, increases in EC levels under Alternative 5A could occur, but would be
 39 slightly less than those described for Alternative 4 (see Section 8.3.3.9). This is because the effects of
 40 climate change on flows, which could affect dilution of high EC discharges, would be less in the ELT.
 41 The implementation of the adopted TMDL for the San Joaquin River at Vernalis and the ongoing
 42 development of the TMDL for the San Joaquin River upstream of Vernalis are expected to contribute
 43 to improved EC levels. Based on these considerations, substantial changes in EC levels in the San

1 Joaquin River relative to Existing Conditions would not be expected to be of sufficient magnitude
2 and geographic extent that would result in adverse effects on any beneficial uses, or substantially
3 degrade the quality of these water bodies, with regard to EC.

4 ***Delta***

5 Initial review of modeling results indicated that Alternative 5A would potentially result in an
6 increase in the number of days the Bay-Delta WQCP EC objectives would be exceeded in the
7 Sacramento River at Emmaton and the San Joaquin River at Jersey Point relative to Existing
8 Conditions, the San Joaquin River at San Andreas Landing relative to Existing Conditions and the No
9 Action Alternative (ELT), and the San Joaquin River at Prisoners Point relative to the No Action
10 Alternative (ELT) (Appendix 8H, *Electrical Conductivity*, Table EC-26). To understand and interpret
11 these results, considerations must be made regarding uncertainty in the modeling and results from
12 sensitivity analyses. In addition, modeling results indicate there would be small increases in long-
13 term monthly average EC at modeled Suisun Marsh locations relative to Existing Conditions. These
14 locations are addressed in detail below. At all other locations, the level of exceedance and modeled
15 average EC levels under the alternative was approximately equivalent or lower than under Existing
16 Conditions and the No Action Alternative (ELT).

17 *Sacramento River at Emmaton*

18 Modeling results indicated that the Emmaton EC objective would be exceeded more often under
19 Alternative 5A than under Existing Conditions, but less often relative to the No Action Alternative
20 (ELT). The modeling results also indicated that increases in EC could cause substantial water quality
21 degradation in summer months of dry and critical water years. However, these increases in
22 exceedance of the objective and degradation are expected to be addressed via real-time operations,
23 including real time management of the north Delta and south Delta intakes, as well as Delta Cross
24 Channel operation. Further discussion is provided below.

25 Modeling results indicated that the percentage of days the Emmaton EC objective would be
26 exceeded for the entire period modeled (1976–1991) would increase from 6% under Existing
27 Conditions to 10%; there would be a decrease of 2% relative to the No Action Alternative (ELT),
28 from 12% to 10% (Appendix 8H, *Electrical Conductivity*, Table EC-26). The percentage of days out of
29 compliance would increase from 11% under Existing Conditions to 20%; there would be a decrease
30 of 1% relative to the No Action Alternative (ELT), from 21% to 20% (Appendix 8H, Table EC-26).
31 The comparison of the alternative to Existing Conditions reflects changes due both to operation of
32 the alternative as well as effects of sea level rise due to climate change. The comparison of the
33 alternative to the No Action Alternative (ELT) reflects changes in EC due solely to operations of the
34 alternative. Based on the comparison to the No Action Alternative (ELT), the alternative would not
35 contribute to additional exceedance of the EC objective at Emmaton.

36 The results of the EC modeling indicate there would be months with substantial degradation relative
37 to the No Action Alternative (ELT), particularly during the drought period modeled. Long-term
38 average EC levels at Emmaton would increase in the months of July through September and
39 November by 1–7% for the entire period modeled (1976–1991), and in the months of July, August,
40 and November by 1–25% during the drought period modeled (1987–1991), relative to the No
41 Action Alternative (ELT) (Appendix 8H, *Electrical Conductivity*, Table EC-31). The largest increases
42 in EC would occur in dry and critical water year types. These periods of degradation are expected to
43 be addressed via real-time operations. The level to which modeling output depicts degradation of

1 water quality with respect to EC is primarily a function of the modeling not being able to fully
2 capture how the system would be operated in real-time to minimize or avoid such degradation

3 Discussions with SWP operators indicated that real-time operations would ensure that the Bay-
4 Delta WQCP EC objectives at Emmaton, applicable from April 1 through August 15, would be met. In
5 latter August and September, the Threemile Slough standard in the North Delta Water Agency
6 Agreement and the Bay-Delta WQCP municipal and industrial objective at Rock Slough are in effect.
7 During this period of the year, the coordinated operations of the SWP/CVP system strives to meet
8 both standards in the most water-efficient method available to the CVP and SWP. Real-time
9 operation would result in less EC degradation than depicted by modeling output because in order to
10 comply with Bay-Delta WQCP objectives and the the North Delta Water Agency Agreement during
11 the summer period, operators could, for example, increase upstream reservoir releases for
12 necessary periods of time, reduce North Delta diversions, and/or close (short-term) the Delta Cross
13 Channel. These options as well as real-time and forecasted tides, winds and barometric pressure are
14 considered when the projects schedule daily operations, which the modeling does not fully capture.

15 Alternative 5A does not change the Bay-Delta WQCP objectives or the the North Delta Water Agency
16 Agreement which are primary drivers of operations and resulting water quality in the Sacramento
17 River at at Emmaton during late August and September. Therefore, the EC degradation at Emmaton
18 that would occur upon implementation of Alternative 5A would be lesser than that shown by the
19 modeling and would not be expected to differ substantially from that which would occur under the
20 No Project Alternative because the compliance targets are not changing due to Alternative 5A during
21 these months and real-time operations would achieve the compliance targets.

22 The modeling results also show that in the remaining months there would be decreases in EC
23 relative to the No Action Alternative (ELT) of 2–7% for the entire period modeled and 1–10% for the
24 drought period modeled. These decreases would contribute to the long-term average EC levels being
25 similar to No Action Alternative (ELT) for the entire period modeled and decreasing by 1% for the
26 drought period modeled (Appendix 8H, *Electrical Conductivity*, Table EC-31).

27 *San Joaquin River at San Andreas Landing*

28 Alternative 5A is not expected to have adverse effects on EC in the San Joaquin River at San Andreas
29 Landing, relative to Existing Conditions and the No Action Alternative (ELT). Modeling results
30 estimated that the percentage of days the San Andreas Landing EC objective would be exceeded
31 would increase by <1% relative to Existing Conditions, and the percentage of days out of compliance
32 would increase from 1% under Existing Conditions to 2% (Appendix 8H, *Electrical Conductivity*,
33 Table EC-26). San Andreas Landing average EC would decrease by 7% for the entire period modeled
34 and 3% during the drought period modeled, relative to Existing Conditions (Appendix 8H, *Electrical*
35 *Conductivity*, Table EC-31). Results relative to the No Action Alternative (ELT) were similar
36 (Appendix 8H, *Electrical Conductivity*, Table EC-31). Sensitivity analyses performed for Alternative 4
37 Scenario H3 at the LLT indicate that many of these exceedances are likely modeling artifacts, and the
38 small number of remaining exceedances would be small in magnitude, lasting only a few days, and
39 could be addressed with real time operations of the SWP and CVP (see Section 8.3.1.1, *Models Used*
40 *and Their Linkages*, for a description of real time operations of the SWP and CVP). These sensitivity
41 analyses were only run at the LLT, but it is expected that the findings can generally be extended to
42 the ELT, because the factors affecting salinity findings in the sensitivity analysis (e.g., modeling
43 assumptions, physical hydrodynamic mechanisms) are similar between the ELT and LLT (see
44 Appendix 8H Attachment 1,).

1 *San Joaquin River at Prisoners Point*

2 Modeling results indicated that the EC objective that applies to the San Joaquin River between Jersey
3 Point and Prisoners Point would be exceeded at Prisoners Point more often under Alternative 5A
4 than under the No Action Alternative (ELT), but less often relative to Existing Conditions. The
5 exceedances relative to the No Action Alternative (ELT) are expected to be able to be addressed via
6 real-time operations, including real time management of the north Delta and south Delta intakes, as
7 well as Head of Old River Barrier management. Further discussion is provided below.

8 Modeling results estimated that the percentage of days the Prisoners Point EC objective would be
9 exceeded would increase from 2% under the No Action Alternative (ELT) to 4% and the percentage
10 of days out of compliance with the EC objective would increase from 2% under the No Action
11 Alternative (ELT) to 6% (Appendix 8H, *Electrical Conductivity*, Table EC-26). The magnitude and
12 duration of these differences is expected to be within the modeling uncertainty, indicating no
13 measurable change in EC would be expected in the environment.

14 *San Joaquin River at Jersey Point*

15 Modeling results indicated that the EC objective that applies between the San Joaquin River at Jersey
16 Point and Prisoners Point also would be exceeded at Jersey Point more often under Alternative 5A
17 than under Existing Conditions, and less often relative to the No Action Alternative (ELT). At Jersey
18 Point, modeling results estimated that the percentage of days the EC objective would be exceeded
19 would change from 0% under Existing Conditions, or 3% under the No Action Alternative (ELT), to
20 2%, and the percentage of days out of compliance with the EC objective would change from 0%
21 under Existing Conditions, or 3% under the No Action Alternative (ELT), to 2% (Appendix 8H,
22 *Electrical Conductivity*, Table EC-26). The incremental change in the frequency of objective
23 exceedance relative to the No Action Alternative (ELT), which reflects only the effects due to the
24 alternative, and not effects of climate change, sea level rise and water demands, would be a
25 reduction of 1%. Therefore, the alternative would not contribute to additional exceedances of the EC
26 objective at Jersey Point.

27 *Suisun Marsh*

28 For Suisun Marsh October–May is the period when Bay-Delta WQCP EC objectives for protection of
29 fish and wildlife apply. Modeling results indicate that average EC for the entire period modeled
30 would increase in the Sacramento River at Collinsville during the months of March and April relative
31 to Existing Conditions, by 0.1 mS/cm (Appendix 8H, *Electrical Conductivity*, Table EC-32). In
32 Montezuma Slough at National Steel, average EC levels would increase in March through May by
33 0.1–0.2 mS/cm (Appendix 8H, *Electrical Conductivity*, Table EC-33). There would be similarly
34 small increases in long-term average EC in the months of March through May in Montezuma Slough
35 near Beldon’s Landing, Chadbourne Slough near Sunrise Duck Club, and Suisun Slough near Volanti
36 Slough, ranging 0.1–0.4 mS/cm depending on month and location (Appendix 8H, *Electrical*
37 *Conductivity*, Tables EC-34 through EC-36). Relative to the No Action Alternative (ELT), the modeled
38 long-term average EC under the alternative would be similar or lower from October through May for
39 these locations (Appendix 8H, *Electrical Conductivity*, Tables EC-32 through EC-36).

40 The Suisun Marsh EC objectives are expressed as a monthly average of daily high tide EC, which
41 does not have to be met if it can be demonstrated “equivalent or better protection will be provided
42 at the location” (State Water Resources Control Board 2006:14). Long-term average EC increases
43 relative to Existing Conditions may, or may not, contribute to adverse effects on beneficial uses,

1 depending on how and when wetlands are flooded, soil leaching cycles, how agricultural use of
 2 water is managed, and future actions taken with respect to the Marsh. Given the Bay-Delta WQCP
 3 narrative objective regarding “equivalent or better protection” in lieu of meeting specific numeric
 4 objectives, the small increase in EC under Alternative 5A, relative to Existing Conditions, would not
 5 be expected to adversely affect beneficial uses of Suisun Marsh. While Suisun Marsh is CWA Section
 6 303(d) listed as impaired because of elevated EC, the potential increases in long-term average EC
 7 concentrations, relative to Existing Conditions, would not be expected to contribute to additional
 8 impairment, because the increase would be so small (<1 mS/cm) relative to the daily fluctuations in
 9 EC levels as to not be measurable and beneficial uses would not be adversely affected.

10 Further, the EC changes in Suisun Marsh relative to Existing Conditions reflect the influence of both
 11 operations of the alternative and sea level rise due to climate change, whereas the changes relative
 12 to the No Action Alternative (ELT) are due solely to operations of the alternative. As described
 13 above, there would be no increase in the long-term average EC at modeled Suisun Marsh locations,
 14 and for some locations long-term average EC would decrease. Therefore, it is expected that this
 15 alternative would not contribute to exceedances of EC objectives or additional impairment of
 16 beneficial uses, as affected by EC or other salinity-related parameters.

17 The effects of Alternative 5A in the LLT in the Delta region, relative to Existing Conditions and the
 18 No Action Alternative (LLT), would be expected to be similar to effects in the ELT. With greater
 19 climate change and sea level rise, additional outflow may be required at certain times to prevent
 20 increases in EC in the west Delta, but this requirement would not be due to the alternative.

21 ***SWP/CVP Export Service Areas***

22 Under Alternative 5A, at the Banks pumping plant, the frequency of exceedance of the EC objective
 23 would be 1% for the entire period modeled and 2% for the drought period modeled (Appendix 8H,
 24 *Electrical Conductivity*, Table EC-27). Relative to Existing Conditions, average EC levels under
 25 Alternative 5A would decrease 19% for the entire period modeled and 17% during the drought
 26 period modeled (Appendix 8H, *Electrical Conductivity*, Table EC-31). Relative to the No Action
 27 Alternative (ELT), average EC levels would similarly decrease, by 15% for the entire period modeled
 28 and drought period modeled ((Appendix 8H, *Electrical Conductivity*, Table EC-31).

29 At the Jones pumping plant, the frequency of exceedance of the EC objective would be 1% for the
 30 entire period modeled and 0% for the drought period modeled. Relative to Existing Conditions,
 31 average EC levels under Alternative 5A would decrease 16% for the entire period modeled and 17%
 32 during the drought period modeled. Relative to the No Action Alternative (ELT), average EC levels
 33 would similarly decrease, by 13% for the entire period modeled and 15% for the drought period
 34 modeled ((Appendix 8H, *Electrical Conductivity*, Table EC-31).

35 Based on the decreases in long-term average EC levels that would occur at the Banks and Jones
 36 pumping plants, Alternative 5A would not cause degradation of water quality with respect to EC in
 37 the SWP/CVP Export Service Areas. Rather, Alternative 5A would improve long-term average EC
 38 conditions in the SWP/CVP Export Service Areas.

39 Commensurate with the EC decrease in exported waters, an improvement in lower San Joaquin
 40 River average EC levels would be expected since EC in the lower San Joaquin River is, in part, related
 41 to irrigation water deliveries from the Delta. While the magnitude of this expected lower San
 42 Joaquin River improvement in EC is difficult to predict, the relative decrease in overall loading of EC-

1 elevating constituents to the Export Service Areas would likely alleviate or lessen any expected
2 increase in EC at Vernalis related to decreased annual average San Joaquin River flows.

3 The export area of the Delta is listed on the state's CWA Section 303(d) list as impaired due to
4 elevated EC Alternative 5A would result in lower average EC levels relative to Existing Conditions
5 and the No Action Alternative (ELT) and, thus, would not contribute to additional beneficial use
6 impairment related to elevated EC in the SWP/CVP Export Service Areas waters.

7 The effects of Alternative 5A in the LLT in the SWP/CVP Export Service Areas, relative to Existing
8 Conditions and the No Action Alternative (LLT), would be expected to be very similar to effects in
9 the ELT. The difference in these timeframes that could contribute to EC differences between the ELT
10 and LLT is climate change and sea level rise, and thus would not be due to the alternative.

11 **NEPA Effects:** In summary, based on the results of the modeling and sensitivity analyses conducted,
12 it is unlikely that there would be increased frequency of exceedance of agricultural EC objectives in
13 the western, interior, or southern Delta. However, modeling results indicate that there could be
14 increased long-term and drought period average EC levels during the summer months that would
15 occur in the western Delta (i.e., in the Sacramento River at Emmaton) under Alternative 5A relative
16 to the No Action Alternative (ELT), that could contribute to adverse effects on the agricultural
17 beneficial uses. In addition, the increased frequency of exceedance of the San Joaquin River at
18 Prisoners Point EC objective could contribute to adverse effects on fish and wildlife beneficial uses
19 (specifically, indirect adverse effects on striped bass spawning), though there is a high degree of
20 uncertainty associated with this impact. Suisun Marsh is CWA Section 303(d) listed as impaired due
21 to elevated EC, but EC levels are not expected to increase under Alternative 5A, relative to the No
22 Action Alternative (ELT), and thus it is not expected to contribute to additional beneficial use
23 impairment. The increases in EC in the Sacramento River at Emmaton, particularly during summer
24 months of dry and critical water years, and the additional exceedances of water quality objectives in
25 the San Joaquin River at Prisoners Point constitute an adverse effect on water quality. Mitigation
26 Measure WQ-11 would be available to reduce these effects.

27 **CEQA Conclusion:** River flow rate and reservoir storage reductions that would occur under
28 Alternative 5A, relative to Existing Conditions, would not be expected to result in a substantial
29 adverse change in EC levels in the reservoirs and rivers upstream of the Delta, given that: changes in
30 the quality of watershed runoff and reservoir inflows would not be expected to occur in the future;
31 the state's regulation of point-source discharge effects on Delta salinity-elevating parameters and
32 the expected further regulation as salt management plans are developed; the salt-related TMDLs
33 adopted and being developed for the San Joaquin River; and the expected improvement in lower San
34 Joaquin River average EC levels commensurate with the lower EC of the irrigation water deliveries
35 from the Delta.

36 Relative to Existing Conditions, Alternative 5A would not result in any substantial increases in long-
37 term average EC levels in the SWP/CVP Export Service Areas, and exceedance of the Bay-Delta
38 WQCP EC objective would be infrequent. Average EC levels for the entire period modeled would
39 decrease at both the Banks and Jones pumping plants and, thus, this alternative would not
40 contribute to additional beneficial use impairment related to elevated EC in the SWP/CVP Export
41 Service Areas waters. Rather, this alternative would improve long-term EC levels in the SWP/CVP
42 Export Service Areas, relative to Existing Conditions.

43 Further, relative to Existing Conditions, Alternative 5A would not result in substantial increases in
44 long-term average EC in Suisun Marsh. Thus, EC levels in Suisun Marsh are not expected to further

1 degrade existing EC levels and thus would not contribute additionally to adverse effects on the fish
2 and wildlife beneficial uses. Because EC is not bioaccumulative, any changes in long-term average EC
3 levels would not directly cause bioaccumulative problems in fish and wildlife. Suisun Marsh is CWA
4 Section 303(d) listed as impaired due to elevated EC, but EC levels are not expected to change
5 substantially under Alternative 5A, relative to Existing Conditions, and thus it is not expected that
6 they would contribute to additional beneficial use impairment.

7 In the Plan Area, Alternative 5A is not expected to result in an increase in the frequency with which
8 Bay-Delta WQCP EC objectives are exceeded, except for at the San Joaquin River at Jersey Point (fish
9 and wildlife objective: 2% increase). The increased frequency of exceedance is due to the combined
10 effects of operations of the alternative along with climate change, sea level rise and increased water
11 demands. A comparison to the No Action Alternative (ELT) results reveals that the alternative would
12 not contribute to additional exceedance at Jersey Point and, thus, there would likely be no adverse
13 effects to aquatic life at Jersey Point. However, there would be a discernible increased frequency of
14 exceedance of the fish and wildlife objective at Prisoners Point that could contribute to adverse
15 effects on aquatic life (specifically, indirect adverse effects on striped bass spawning), though there
16 is a high degree of uncertainty associated with this impact. However, by adaptively managing the
17 Head of Old River Barrier and the fraction of south Delta versus north Delta diversions, EC levels at
18 Prisoners Point would likely be decreased to a level that would not adversely affect aquatic life
19 beneficial uses.

20 Average EC levels at Emmaton were modeled to increase by 9% during the drought period modeled.
21 The largest monthly average increases in EC were modeled to occur during the summer months of
22 the drought period, and more generally in dry and critical water year types. The increases in
23 drought period average EC levels modeled could cause substantial water quality degradation that
24 would potentially contribute to adverse effects on the agricultural beneficial uses in the western
25 Delta. The comparison to Existing Conditions reflects changes in EC due to both Alternative 5A
26 operations and climate change/sea level rise. The adverse effects expected to occur at Emmaton
27 would be due in part to the effects of climate change/sea level rise, and in part due to Alternative 5A
28 operations. This is evidenced by the significant effects expected in the No Action Alternative (ELT) at
29 Emmaton relative to Existing Conditions, as well as the fact that a lesser level of adverse effects is
30 expected at Emmaton under Alternative 5A relative to the No Action Alternative (ELT). During
31 summer of dry and critical water years, additional flow in the Sacramento River at Emmaton would
32 reduce or eliminate increases in EC. It is expected that for July–August of dry and critical water
33 years, real-time operations that would include more precise management of upstream reservoir
34 releases on a daily basis and less pumping from the north Delta intakes and greater reliance on
35 south Delta intakes than that modeled would allow for enough flow in the Sacramento River at
36 Emmaton to reduce water quality degradation to levels closer to the No Action Alternative that
37 would not be expected to adversely affect beneficial uses. Because EC is not bioaccumulative, the
38 increases in long-term average EC levels would not directly cause bioaccumulative problems in
39 aquatic life or humans. The western Delta is CWA Section 303(d) listed for elevated EC and the
40 increased EC degradation that was modeled in the western Delta could make beneficial use
41 impairment measurably worse.

42 Based on these findings, this impact in the Plan Area is considered to be significant. Implementation
43 of Mitigation Measure WQ-11 would be expected to reduce these effects to a less-than-significant
44 level.

1 **Mitigation Measure WQ-11: Avoid or Minimize Reduced Water Quality Conditions**

2 Please see Mitigation Measure WQ-11 under Impact WQ-11 in the discussion of Alternative 4A.

3 **Mitigation Measure WQ-11e: Adaptively Manage Diversions at the North and South Delta**
 4 **Intakes to Reduce or Eliminate Water Quality Degradation in Western Delta**

5 Please see Mitigation Measure WQ-11e under Impact WQ-11 in the discussion of Alternative 4A.

6 **Impact WQ-12: Effects on Electrical Conductivity Resulting from Implementation of**
 7 **Environmental Commitments 3, 4, 6–12, 15, and 16**

8 **NEPA Effects:** The implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would
 9 present no new direct sources of EC to the affected environment, including areas upstream of the
 10 Delta, within the Delta region, and in the SWP/CVP Export Service Areas. As they pertain to EC,
 11 implementation of these Environmental Commitments would not be expected to adversely affect
 12 any of the beneficial uses of the affected environment. Moreover, some habitat restoration activities
 13 would occur on lands within the Delta currently used for irrigated agriculture. Such replacement or
 14 substitution of land use activity is not expected to result in new or increased sources of EC to the
 15 Delta and, in fact, could decrease EC through elimination of high EC agricultural runoff.

16 Environmental Commitment 4 would result in some tidal habitat restoration, however, the areal
 17 extent would be small relative to the existing and No Action Alternative tidal area and, thus not
 18 expected to appreciably affect the magnitude of daily tidal water exchange at the restoration areas
 19 or alter other hydrodynamic conditions in adjacent Delta channels that would result in measurable
 20 EC changes.

21 In summary, implementation of the Environmental Commitments would not be expected to
 22 adversely affect EC levels in the affected environment and thus would not adversely affect beneficial
 23 uses or substantially degrade water quality with regard to EC within the affected environment.
 24 Therefore, the effects on EC from implementing Environmental Commitments 3, 4, 6–12, 15, and 16
 25 are determined to not be adverse.

26 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 under
 27 Alternative 4A would not present new or substantially changed sources of EC to the affected
 28 environment. Some Environmental Commitments may replace or substitute for existing irrigated
 29 agriculture in the Delta. This replacement or substitution is not expected to substantially increase or
 30 present new sources of EC, and could actually decrease EC loads to Delta waters. Thus,
 31 implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would have negligible, if any,
 32 adverse effects on EC levels throughout the affected environment and would not cause exceedance
 33 of applicable state or federal numeric or narrative water quality objectives/criteria that would
 34 result in adverse effects on any beneficial uses within affected water bodies. Further,
 35 implementation of Environmental Commitments 3, 4, 6–12, 15, and 16 would not cause significant
 36 long-term water quality degradation such that there would be greater risk of adverse effects on
 37 beneficial uses. Based on these findings, this impact is considered to be less than significant. No
 38 mitigation is required.

1 **Impact WQ-13: Effects on Mercury Concentrations Resulting from Facilities Operations and** 2 **Maintenance**

3 ***Upstream of the Delta***

4 The effects of the Alternative 5A on mercury levels in surface waters upstream of the Delta relative
5 to Existing Conditions and the No Action Alternative (ELT and LLT) would be similar to those
6 described for Alternative 4 (see Section 8.3.3.9). This is because factors that affect mercury
7 concentrations in surface waters upstream of the Delta are similar under Alternatives 4 and 5A. The
8 changes in flow in the Sacramento River under Alternative 5A relative to Existing Conditions and the
9 No Action Alternative (ELT) would not be of the magnitude of storm flows, in which substantial
10 sediment-associated mercury is mobilized. Therefore, mercury loading should not be substantially
11 different due to changes in flow. In addition, even though they may be flow-affected, total mercury
12 concentrations remain well below criteria at upstream locations. Any negligible changes in mercury
13 concentrations that may occur in the water bodies of the affected environment located upstream of
14 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
15 any beneficial uses or substantially degrade the quality of these water bodies as related to mercury.
16 Both waterborne methylmercury concentrations and largemouth bass fillet mercury concentrations
17 are expected to remain above guidance levels at upstream of Delta locations, but would not change
18 substantially because the anticipated changes in flow are not expected to substantially change
19 mercury loading relative to Existing Conditions or the No Action Alternative (ELT).

20 The upstream of Delta areas in the north will benefit from the implementation of the Cache Creek,
21 Sulfur Creek, Harley Gulch, and Clear Lake Mercury TMDLs and the State Water Board's Statewide
22 Mercury Control Program. These projects will target specific sources of mercury and methylation
23 upstream of the Delta and could result in net improvement to Delta mercury loading in the future.
24 The implementation of these projects could help to ensure that upstream of Delta environments will
25 not be substantially degraded for water quality with respect to mercury or methylmercury.

26 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
27 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
28 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
29 effects on mercury in the LLT are expected to be similar to those described above.

30 ***Delta***

31 The effects of Alternative 5A on waterborne concentrations of mercury (Appendix 8I, *Mercury*, Table
32 I-17) and methylmercury (Appendix 8I, *Mercury*, Table I-18), and fish tissue mercury concentrations
33 for largemouth bass fillet (Appendix 8I, *Mercury*, Tables I-22a and I-22b) were evaluated for nine
34 Delta locations.

35 Increases in long-term average mercury concentrations relative to Existing Conditions and the No
36 Action Alternative (ELT) would be very small, 0.2 ng/L or less. Also, use of assimilative capacity for
37 mercury relative to the 25 ng/L ecological threshold under Alternative 5A, relative to Existing
38 Conditions and the No Action Alternative (ELT), would be very low, about 1% or less, as a long-term
39 average, for all Delta locations (Appendix 8I, *Mercury*, Table I-25). These concentration changes and
40 small changes in assimilative capacity for mercury are not expected to result in adverse (or positive)
41 effects to beneficial uses.

1 Changes in methylmercury concentrations in water also are expected to be very small. The greatest
2 annual average methylmercury concentration under Alternative 5A would be 0.168 ng/L for the San
3 Joaquin River at Buckley Cove, for the drought period modeled, which would be slightly higher than
4 Existing Conditions (0.161 ng/L) and the same as the No Action Alternative (ELT) (0.168 ng/L)
5 (Appendix 8I, *Mercury*, Table I-18). All methylmercury concentrations in water were estimated to
6 exceed the TMDL guidance objective of 0.06 ng/L under Existing Conditions and, therefore, no
7 assimilative capacity exists.

8 Fish tissue estimates for largemouth bass fillet show small or no increases in mercury
9 concentrations relative to Existing Conditions and the No Action Alternative (ELT) based on long-
10 term annual average concentrations for mercury at the Delta locations. Concentrations expected for
11 Alternative 5A, with Equation 1, show increases of 5% or less, relative to Existing Conditions and the
12 No Action Alternative (ELT), in all years (Appendix 8I, *Mercury*, Table I-22a). With Equation 2,
13 increases relative to Existing Conditions and the No Action Alternative (ELT) are estimated to be 7%
14 or less (Appendix 8I, *Mercury*, Table I-22b).

15 Because the increases are relatively small, and it is not evident that substantive increases are
16 expected at numerous locations throughout the Delta, these changes are expected to be within the
17 uncertainty inherent in the modeling approach, and would likely not be measurable in the
18 environment. See Appendix 8I, *Mercury*, for a complete discussion of the uncertainty associated with
19 the fish tissue estimates. Briefly, the bioaccumulation models contain multiple sources of
20 uncertainty associated with their development. These are related to: analytical variability; temporal
21 and/or seasonal variability in Delta source water concentrations of methylmercury;
22 interconversion of mercury species (i.e., the non-conservative nature of methylmercury as a
23 modeled constituent); and limited sample size (both in number of fish and time span over which the
24 measurements were made), among others. Although there is considerable uncertainty in the models
25 used, the results serve as a reasonable approximations of a very complex process. Considering the
26 uncertainty, small (i.e., < 20–25%) increases or decreases in modeled fish tissue mercury
27 concentrations at a low number of Delta locations (i.e., 2–3) should be interpreted to be within the
28 uncertainty of the overall approach, and not predictive of actual adverse effects. Larger increases, or
29 increases evident throughout the Delta, can be interpreted as more reliable indicators of potential
30 adverse effects.

31 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
32 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
33 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
34 effects on mercury in the LLT are expected to be similar to those described above.

35 ***SWP/CVP Export Service Areas***

36 The analysis of mercury and methylmercury in the SWP/CVP Export Service Areas was based on
37 concentrations estimated at the Banks and Jones pumping plants. Both waterborne total and
38 methylmercury concentrations for Alternative 5A, at the Jones and Banks pumping plants were
39 lower than Existing Conditions and the No Action Alternative (ELT) (Appendix 8I, *Mercury*, Tables I-
40 17 and I-18). Therefore, mercury shows an increased assimilative capacity at these locations
41 (Appendix 8I, *Mercury*, Table I-24).

42 The largest improvements in largemouth bass tissue mercury concentrations and Exceedance
43 Quotients ([EQs]); modeled tissue divided by TMDL guidance concentration) for Alternative 5A,
44 relative to Existing Conditions and the No Action Alternative (ELT) at any location within the Delta

1 are expected for the Banks and Jones pumping plants export pump locations. Concentrations
2 expected for Alternative 5A at the export pump locations with Equation 1 in all years show
3 decreases relative to Existing Conditions (4% to 5%) and relative to the No Action Alternative (ELT)
4 (6%) (Appendix 8I, *Mercury*, Table I-22a). Concentrations expected for Equation 2 in all years show
5 decreases relative to Existing Conditions (6% to 7%) and relative to the No Action Alternative (ELT)
6 (8%) (Appendix 8I, *Mercury*, Table I-22a).

7 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
8 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
9 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
10 effects on mercury in the LLT are expected to be similar to those described above.

11 **NEPA Effects:** Based on the above discussion, Alternative 5A would not cause concentrations of
12 mercury and methylmercury in water and fish tissue in the affected environment to be substantially
13 different from the No Action Alternative (ELT and LLT) and, thus, would not cause additional
14 exceedance of applicable water quality objectives/criteria by frequency, magnitude, and geographic
15 extent that would cause adverse effects on any beneficial uses of waters in the affected environment.
16 Because mercury concentrations are not expected to increase substantially, no long-term water
17 quality degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
18 Because any increases in mercury or methylmercury concentrations are not likely to be measurable,
19 changes in mercury concentrations or fish tissue mercury concentrations would not make any
20 existing mercury-related impairment measurably worse. In comparison to the No Action Alternative
21 (ELT and LLT), Alternative 5A would not be expected to increase levels of mercury by frequency,
22 magnitude, and geographic extent such that the affected environment would be expected to have
23 measurably higher body burdens of mercury in aquatic organisms, thereby substantially increasing
24 the health risks to wildlife (including fish) or humans consuming those organisms. Based on these
25 findings, the effects of Alternative 5A on mercury in the affected environment are considered to be
26 not adverse.

27 **CEQA Conclusion:** Under Alternative 5A, greater water demands and climate change would alter the
28 magnitude and timing of reservoir releases and river flows upstream of the Delta in the Sacramento
29 River watershed and eastside tributaries, relative to Existing Conditions. Concentrations of mercury
30 and methylmercury upstream of the Delta would not be substantially different relative to Existing
31 Conditions due to the lack of important relationships between mercury/methylmercury
32 concentrations and flow for the major rivers.

33 Methylmercury concentrations exceed criteria at all locations in the Delta and no assimilative
34 capacity exists. However, monthly average waterborne concentrations of total and methylmercury,
35 over the period of record under Alternative 5A would be very similar to Existing Conditions.
36 Similarly, estimates of fish tissue mercury concentrations show small differences would occur
37 among sites for Alternative 5A as compared to Existing Conditions for Delta sites.

38 Assessment of effects of mercury in the SWP/CVP Export Service Areas were based on effects on
39 mercury concentrations and fish tissue mercury concentrations at the Banks and Jones pumping
40 plants. The Banks and Jones pumping plants are expected to show increased assimilative capacity
41 for waterborne mercury and decreased fish tissue concentrations of mercury for Alternative 5A, as
42 compared to Existing Conditions.

43 As such, Alternative 5A is expected to cause additional exceedance of applicable water quality
44 objectives/criteria by frequency, magnitude, and geographic extent that would cause adverse effects

1 on any beneficial uses of waters in the affected environment. Because mercury concentrations are
2 not expected to increase substantially, no long-term water quality degradation is expected to occur
3 and, thus, no adverse effects to beneficial uses would occur. Because any increases in mercury or
4 methylmercury concentrations are not likely to be measurable, changes in mercury concentrations
5 or fish tissue mercury concentrations would not make any existing mercury-related impairment
6 measurably worse. In comparison to Existing Conditions, Alternative 5A would not increase levels of
7 mercury by frequency, magnitude, and geographic extent such that the affected environment would
8 be expected to have measurably higher body burdens of mercury in aquatic organisms, thereby
9 substantially increasing the health risks to wildlife (including fish) or humans consuming those
10 organisms. Based on these findings, this impact is considered to be less than significant. No
11 mitigation is required.

12 **Impact WQ-14: Effects on Mercury Concentrations Resulting from Implementation of**
13 **Environmental Commitments 3, 4, 6-12, 15, and 16**

14 **NEPA Effects:** The potential types of effects on mercury resulting from implementation of the
15 Environmental Commitments under Alternative 5A would be generally similar to those described
16 under Alternative 4 (see Section 8.3.3.9). However, the magnitude of effects on mercury and
17 methylmercury at locations upstream of the Delta, in the Delta, and the SWP/CVP Export Service
18 Areas related to habitat restoration would be considerably lower than described for Alternative 4.
19 This is because the amount of habitat restoration to be implemented under Alternative 5A would be
20 very low compared to the total proposed restoration area that would be implemented under
21 Alternative 4. The small amount of habitat restoration to be implemented under Alternative 5A may
22 occur on lands in the Delta formerly used for irrigated agriculture. Habitat restoration proposed
23 under Alternative 5A has the potential to increase water residence times and increase accumulation
24 of organic sediments that are known to enhance methylmercury bioaccumulation in biota in the
25 vicinity of the restored habitat areas. Design of restoration sites would be guided by Environmental
26 Commitment 12, which requires development of site-specific mercury management plans as
27 restoration actions are implemented. The effectiveness of minimization and mitigation actions
28 implemented according to the mercury management plans is not known at this time, although the
29 potential to reduce methylmercury concentrations exists based on current research. Although
30 Environmental Commitment 12 would be implemented with the goal to reduce this potential effect,
31 the uncertainties related to site-specific restoration conditions and the potential for increases in
32 methylmercury concentrations in the Delta in the vicinity of the restored areas. Therefore, the effect
33 of Environmental Commitments 3, 4, 6-12, 15, and 16 on mercury and methylmercury is considered
34 to be adverse.

35 **CEQA Conclusion:** There would be no substantial, long-term increase in mercury or methylmercury
36 concentrations or loads in the rivers and reservoirs upstream of the Delta or the waters exported to
37 the SWP/CVP Export Service Areas due to implementation of Environmental Commitments 3, 4, 6-
38 12, 15, and 16 relative to Existing Conditions. However, in the Delta, due to the small amount of tidal
39 restoration areas proposed, relative to Existing Conditions, uptake of mercury from water and/or
40 methylation of inorganic mercury may increase in localized areas as part of the creation of new,
41 marshy, shallow, or organic-rich restoration areas. Although not quantifiable, on a local level,
42 increases in methylmercury concentrations may be measurable. Methylmercury is CWA Section
43 303(d)-listed within the affected environment, and therefore any potential measurable increase in
44 methylmercury concentrations would make existing mercury-related impairment measurably
45 worse. Because mercury is bioaccumulative, increases in water-borne mercury or methylmercury

1 that could occur in some areas could bioaccumulate to somewhat greater levels in aquatic organisms
 2 and would, in turn, pose health risks to fish, wildlife, or humans. Design of restoration sites would be
 3 guided by Environmental Commitment 12, which requires development of site-specific mercury
 4 management plans as restoration actions are implemented. The effectiveness of minimization and
 5 mitigation actions implemented according to the mercury management plans is not known at this
 6 time, although the potential to reduce methylmercury concentrations exists based on current
 7 research. Although Environmental Commitment 12 would be implemented with the goal to reduce
 8 this potential effect, the uncertainties related to site specific restoration conditions and the potential
 9 for increases in methylmercury concentrations in the Delta result in this potential impact being
 10 considered significant. No mitigation measures would be available until specific restoration actions
 11 are proposed. Therefore, this impact is considered significant and unavoidable.

12 **Impact WQ-15: Effects on Nitrate Concentrations Resulting from Facilities Operations and** 13 **Maintenance**

14 *Upstream of the Delta*

15 As described for Alternative 4 (in Section 8.3.3.9), nitrate levels in the major rivers (Sacramento,
 16 Feather, American) are low, generally due to ample dilution available in the reservoirs and rivers
 17 relative to the magnitude of the point and non-point source discharges, and there is no correlation
 18 between historical water year average nitrate concentrations and water year average flow in the
 19 Sacramento River at Freeport. Consequently, any modified reservoir operations and subsequent
 20 changes in river flows under Alternative 5A, relative to Existing Conditions or the No Action
 21 Alternative (ELT), are expected to have negligible, if any, effects on average reservoir and river
 22 nitrate-N concentrations in the Sacramento River watershed upstream of the Delta.

23 In the San Joaquin River watershed, nitrate concentrations are higher than in the Sacramento River
 24 watershed, owing to use of nitrate based fertilizers throughout the lower watershed. The correlation
 25 between historical water year average nitrate concentrations and water year average flow in the San
 26 Joaquin River at Vernalis is a weak inverse relationship—that is, generally higher flows result in
 27 lower nitrate concentrations, while low flows result in higher nitrate concentrations (linear
 28 regression $r^2=0.49$; Figure 2 in Appendix 8J, *Nitrate*). Under Alternative 5A, long-term average flows
 29 at Vernalis would decrease an estimated 1% relative to Existing Conditions and would remain
 30 virtually the same relative to the No Action Alternative (ELT). Given the relatively small decreases in
 31 flows and the weak correlation between nitrate and flows in the San Joaquin River, it is expected
 32 that nitrate concentrations in the San Joaquin River would be minimally affected, if at all, by
 33 anticipated changes in flow rates under the No Action Alternative (ELT and LLT).

34 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 35 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 36 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 37 effects on nitrate in the LLT are expected to be similar to those described above.

38 Any negligible changes in nitrate concentrations that may occur under Alternative 5A in the water
 39 bodies of the affected environment located upstream of the Delta would not be of frequency,
 40 magnitude and geographic extent that would adversely affect any beneficial uses or substantially
 41 degrade the quality of these water bodies, with regard to nitrate.

1 **Delta**

2 Mass balance calculations indicate that under Alternative 5A, relative to Existing Conditions and the
 3 No Action Alternative (ELT), nitrate concentrations throughout the Delta are anticipated to remain
 4 low (<1.4 mg/L-N) relative to adopted objectives (Appendix 8J, *Nitrate*, Table 34). Although changes
 5 at specific Delta locations and for specific months may be substantial on a relative basis (Appendix
 6 8J, *Nitrate*, Table 41), the absolute concentration of nitrate in Delta waters would remain low (<1.4
 7 mg/L-N) in relation to the drinking water MCL of 10 mg/L-N, as well as all other thresholds (see
 8 *Nitrate* under Section 8.3.1.7, *Constituent-Specific Considerations Used in the Assessment*). Long-term
 9 average nitrate concentrations are anticipated to remain below 1 mg/L-N at all 11 Delta assessment
 10 locations except the San Joaquin River at Buckley Cove, where long-term average concentrations
 11 would be somewhat above 1 mg/L-N. Nevertheless, at this location, long-term average nitrate
 12 concentrations would be somewhat reduced under Alternative 5A relative to Existing Conditions
 13 and slightly increased relative to the No Action Alternative (ELT). No additional exceedances of the
 14 MCL are anticipated at any location under Alternative 5A (Appendix 8J, *Nitrate*, Table 34).

15 Use of assimilative capacity relative to the drinking water MCL of 10 mg/L-N under Alternative 5A
 16 would be low or negligible (i.e., <3%) in comparison to both Existing Conditions and the No Action
 17 Alternative (ELT), for all locations and months, for all modeled years (1976–1991), and for the
 18 drought period (1987–1991) (Appendix 8J, *Nitrate*, Table 42).

19 As described for Alternative 4, actual nitrate concentrations would likely be higher than the
 20 modeling results indicate in certain locations under Alternative 5A. This is the mass balance
 21 modeling does not account for contributions from the SRWTP, which would be implementing
 22 nitrification/partial denitrification, or Delta wastewater treatment plant dischargers that practice
 23 nitrification, but not denitrification. However, for the reasons described for Alternative 4, any
 24 increases in nitrate concentrations that may occur at certain locations within the Delta under
 25 Alternative 5A would not be of frequency, magnitude and geographic extent that would adversely
 26 affect any beneficial uses or substantially degrade the water quality at these locations, with regard
 27 to nitrate.

28 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 29 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 30 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 31 effects on nitrate in the LLT are expected to be similar to those described above.

32 ***SWP/CVP Export Service Areas***

33 Assessment of effects of Alternative 5A on nitrate in the SWP/CVP. Export Service Areas is based on
 34 effects on nitrate at the Banks and Jones pumping plants. Results of the mass balance calculations
 35 indicate that relative to Existing Conditions and the No Action Alternative (ELT), nitrate
 36 concentrations at Banks and Jones pumping plants under Alternative 5A are anticipated to decrease
 37 on a long-term average annual basis by 17% at the Banks pumping plant and 14% at the Jones
 38 pumping plant (Appendix 8J, *Nitrate*, Table 41). During the late summer, particularly in the drought
 39 period assessed, concentrations are expected to increase, but the absolute value of these changes
 40 (i.e., in mg/L-N) would be small. Additionally, given the many factors that contribute to potential
 41 algal blooms in the SWP and CVP canals within the Export Service Areas, and the lack of studies that
 42 have shown a direct relationship between nutrient concentrations in the canals and reservoirs and
 43 problematic algal blooms in these water bodies, there is no basis to conclude that these small (i.e.,
 44 generally <0.2 mg/L-N), seasonal increases in nitrate concentrations would increase the potential

1 for problem algal blooms in the SWP/CVP Export Service Areas. No additional exceedances of the
2 MCL are anticipated under Alternative 5A relative to Existing Conditions and the No Action
3 Alternative (ELT) (Appendix 8J, *Nitrate*, Table 34). On a monthly average basis and on a long-term
4 annual average basis, for all modeled years and for the drought period only, use of assimilative
5 capacity available under Existing Conditions and the No Action Alternative (ELT), relative to the 10
6 mg/L-N MCL, would be negligible (<2%) for both Banks and Jones pumping plants (Appendix 8J,
7 *Nitrate*, Table 42).

8 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
9 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
10 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
11 effects on nitrate in the LLT are expected to be similar to those described above.

12 Any increases in nitrate concentrations that may occur in water exported via Banks and Jones
13 pumping plants are not expected to result in adverse effects to beneficial uses or substantially
14 degrade the quality of exported water, with regard to nitrate.

15 **NEPA Effects:** Modified reservoir operations and subsequent changes in river flows under
16 Alternative 5a, relative to the No Action Alternative (ELT and LLT), are expected to have negligible,
17 if any, effects on reservoir and river nitrate concentrations upstream of Freeport in the Sacramento
18 River watershed and upstream of the Delta in the San Joaquin River watershed. In the Delta, nitrate
19 concentrations throughout the Delta are anticipated to remain low (<1.4 mg/L-N) relative to
20 adopted objectives. No additional exceedances of the 10 mg/L-N MCL are anticipated at any Delta
21 location, and use of assimilative capacity available under the No Action Alternative, relative to the
22 drinking water MCL of 10 mg/L-N, would be low. Long-term average nitrate concentrations at Banks
23 and Jones pumping plants are anticipated to differ negligibly relative to the No Action Alternative
24 (ELT and LLT) and no additional exceedances of the 10 mg/L-N MCL are anticipated. Therefore, the
25 effects on nitrate from implementing water conveyance facilities are considered to be not adverse.

26 **CEQA Conclusion:** Nitrate concentrations are generally low in the reservoirs and rivers of the
27 watersheds, owing to substantial dilution available for point sources and the lack of substantial
28 nonpoint sources of nitrate upstream of the SRWTP in the Sacramento River watershed, and in the
29 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers). Although
30 higher in the San Joaquin River watershed, nitrate concentrations are not well-correlated with flow
31 rates. Consequently, any modified reservoir operations and subsequent changes in river flows under
32 Alternative 5A, relative to Existing Conditions, are expected to have negligible, if any, effects on
33 reservoir and river nitrate concentrations upstream of Freeport in the Sacramento River watershed
34 and upstream of the Delta in the San Joaquin River watershed.

35 In the Delta, results of the mass balance calculations indicate that under Alternative 5A, relative to
36 Existing Conditions, nitrate concentrations throughout the Delta are anticipated to remain low (<1.4
37 mg/L-N) relative to adopted objectives. No additional exceedances of the 10 mg/L-N MCL are
38 anticipated at any location, and use of assimilative capacity available under Existing Conditions,
39 relative to the drinking water MCL of 10 mg/L-N, would be low or negligible (i.e., <3%) for virtually
40 all locations and months.

41 Assessment of effects of nitrate in the SWP/CVP Export Service Areas is based on effects on nitrate
42 concentrations at the Banks and Jones pumping plants. Results of the mass balance calculations
43 indicate that under Alternative 5A, relative to Existing Conditions, long-term average nitrate
44 concentrations at Banks and Jones pumping plants are anticipated to change negligibly. No

1 additional exceedances of the 10 mg/L-N MCL are anticipated, and use of assimilative capacity
2 available under Existing Conditions, relative to the MCL would be negligible (i.e., <2%) for both
3 Banks and Jones pumping plants for all months.

4 Based on the above, there would be no substantial, long-term increase in nitrate concentrations in
5 the rivers and reservoirs upstream of the Delta, in the Plan Area, or the SWP/CVP Export Service
6 Areas under Alternative 5A relative to Existing Conditions. As such, this alternative is not expected
7 to cause additional exceedance of applicable water quality objectives/criteria by frequency,
8 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
9 in the affected environment. Because nitrate concentrations are not expected to increase
10 substantially, no long-term water quality degradation is expected to occur and, thus, no adverse
11 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
12 environment and thus any increases that may occur in some areas and months would not make any
13 existing nitrate-related impairment measurably worse because no such impairments currently exist.
14 Because nitrate is not bioaccumulative, increases that may occur in some areas and months would
15 not bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
16 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
17 significant. No mitigation is required.

18 **Impact WQ-16: Effects on Nitrate Concentrations Resulting from Implementation of**
19 **Environmental Commitments 3, 4, 6-12, 15, and 16**

20 **NEPA Effects:** Some habitat restoration activities included in Environmental Commitments 3, 4, and
21 6-11 would occur on lands within the Delta formerly used for agriculture. As discussed for Impact
22 WQ-2, increased biota that may result in those areas may increase ammonia, which in turn may be
23 converted to nitrate by established microbial communities. However, the areal extent of the new
24 habitat implemented for the Environmental Commitments would be less than the existing and No
25 Action Alternative habitat areas, and similar habitat exists currently in the Delta and is not identified
26 as contributing to adverse nitrate conditions. Thus, these land use changes would not be expected to
27 substantially increase nitrate concentrations in the Delta. Implementation of Environmental
28 Commitments 12, 15, and 16 do not include actions that would affect nitrate sources or loading.
29 Based on these findings, the effects on nitrate from implementing Environmental Commitments 3, 4,
30 6-12, 15, and 16 are considered to be not adverse.

31 **CEQA Conclusion:** Land use changes that would occur from the Environmental Commitments are
32 not expected to substantially increase nitrate concentrations, because the amount of area to be
33 converted would be small relative to existing habitat, and existing habitats are not known for
34 contributing to adverse nitrate conditions. Thus, it is expected that implementation of
35 Environmental Commitments 3, 4, 6-12, 15, and 16 would not cause additional exceedance of
36 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
37 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
38 nitrate concentrations are not expected to increase substantially due to these Environmental
39 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
40 effects to beneficial uses would occur. Nitrate is not CWA Section 303(d) listed within the affected
41 environment and thus any minor increases that may occur in some areas would not make any
42 existing nitrate-related impairment measurably worse because no such impairments currently exist.
43 Because nitrate is not bioaccumulative, minor increases that may occur in some areas would not
44 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health

1 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
2 significant. No mitigation is required.

3 **Impact WQ-17: Effects on Dissolved Organic Carbon Concentrations Resulting from Facilities** 4 **Operations and Maintenance**

5 ***Upstream of the Delta***

6 The effects of Alternative 5A on DOC concentrations in reservoirs and rivers upstream of the Delta
7 would be similar to those effects described for Alternative 4 because factors affecting DOC
8 concentrations in these water bodies would be similar. Moreover, long-term average flow and DOC
9 levels in the Sacramento River at Hood and San Joaquin River at Vernalis are poorly correlated. Thus
10 changes in system operations and resulting reservoir storage levels and river flows under
11 Alternative 5A would not be expected to cause substantial long-term changes in DOC concentrations
12 in the water bodies upstream of the Delta. Any changes in DOC levels in water bodies upstream of
13 the Delta under Alternative 5A, relative to Existing Conditions and the No Action Alternative (ELT
14 and LLT), would not be of sufficient frequency, magnitude and geographic extent that would
15 adversely affect any beneficial uses or substantially degrade the quality of these water bodies.

16 ***Delta***

17 Under Alternative 5A, the geographic extent of effects pertaining to long-term average DOC
18 concentrations in the Delta would be less extensive, and the magnitude of predicted long-term
19 change and relative frequency of concentration threshold exceedances would be lower than
20 described for Alternative 4. The effects of Alternative 5A relative to Existing Conditions and the No
21 Action Alternative (ELT) are discussed together because the direction and magnitude of predicted
22 change are similar. Relative to the Existing Conditions and No Action Alternative (ELT), Alternative
23 5A would result in small increases in long-term average DOC concentrations for both the modeled
24 16-year period (1976–1991) and drought period (1987–1991) at several interior Delta locations
25 (increases up to 0.1 mg/L at Franks Tract, Old River at Rock Slough, and Contra Costa Pumping Plant
26 #1) (Appendix 8K, *Organic Carbon*, Table DOC-13). The increases in average DOC concentrations
27 would correspond to more frequent concentration threshold exceedances, with the greatest change
28 occurring at the Contra Costa Pumping Plant #1 associated with the 3 mg/L threshold (i.e., increase
29 from 52% under Existing Conditions to 61% under Alternative 5A for the modeled 16-year period).
30 The change in frequency of threshold concentration exceedances at other assessment locations
31 would be similar or lower.

32 While Alternative 5A would lead to slightly higher long-term average DOC concentrations at some
33 municipal water intakes and Delta interior locations, the predicted change would not be expected to
34 adversely affect MUN beneficial uses, or any other beneficial use. As discussed for Alternative 4,
35 substantial changes in ambient DOC concentrations would need to occur before significant changes
36 in drinking water treatment plant design or operations are triggered. The increases in long-term
37 average DOC concentrations estimated to occur at various Delta locations under Alternative 5A are
38 of sufficiently small magnitude that they would not require existing drinking water treatment plants
39 to substantially upgrade treatment for DOC removal above levels currently employed.

40 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
41 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
42 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
43 effects on DOC in the LLT are expected to be similar to those described above.

1 Relative to Existing Conditions and the No Action Alternative (ELT and LLT), Alternative 5A would
2 lead to predicted improvements in long-term average DOC concentrations at Barker Slough, as well
3 as Banks and Jones pumping plants (discussed below).

4 ***SWP/CVP Export Service Areas***

5 Under the Alternative 5A, long-term average DOC concentrations would decrease at Barker Slough
6 by 0.1 mg/L, and at both the Banks and Jones pumping plants by 0.2 mg/L, relative to Existing
7 Conditions. Reductions would be similar compared to No Action Alternative (ELT) (Appendix 8K,
8 *Organic Carbon*, Table DOC-13). Decreases in long-term average DOC would result in generally lower
9 exceedance frequencies for concentration thresholds, although the frequency of exceedances of the
10 3 mg/L threshold during the modeled drought period would increase at the Banks and Jones
11 pumping plants. Relative to Existing Conditions, exceedance of the 3 mg/L threshold would increase
12 from 57% to 70% at Banks pumping plant and from 72% to 85% at Jones pumping plant. There would
13 be little to no increase in exceedance of the 3 mg/L threshold relative to the No Action Alternative
14 (ELT).

15 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
16 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
17 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
18 effects on DOC in the LLT are expected to be similar to those described above.

19 Maintenance of SWP and CVP facilities under Alternative 5A would not be expected to create new
20 sources of DOC or contribute towards a substantial change in existing sources of DOC in the affected
21 area.

22 ***NEPA Effects:*** In summary, the operations and maintenance activities under Alternative 5A, relative
23 to the No Action Alternative (ELT and LLT), would not cause a substantial long-term change in DOC
24 concentrations in the water bodies upstream of the Delta, in the Delta, or in the SWP/CVP Export
25 Service Areas. The long-term average DOC concentrations at the Barker Slough and Banks and Jones
26 pumping plants are predicted to decrease by 0.2 mg/L, while long-term average DOC concentrations
27 for some Delta interior locations are predicted to increase by as much as 0.1 mg/L. However, the
28 increase in long-term average DOC concentration that could occur within the Delta interior would
29 not be of sufficient magnitude to adversely affect the MUN beneficial use, or any other beneficial
30 uses, of Delta waters. Based on these findings, the effect of operations and maintenance activities on
31 DOC under Alternative 5A is determined to be not adverse.

32 ***CEQA Conclusion:*** For the same reasons described for Alternative 4, the operations and
33 maintenance activities under Alternative 5A, relative to the Existing Conditions, would not cause a
34 substantial long-term change in DOC concentrations in the water bodies upstream of the Delta, in
35 the Delta, or in the SWP/CVP Export Service Areas. Any modified reservoir operations and
36 subsequent changes in river flows under Alternative 5A, relative to Existing Conditions, would not
37 be expected to result in a substantial adverse change in DOC levels upstream of the Delta. Moreover,
38 long-term average flow and DOC at Sacramento River at Hood and San Joaquin River at Vernalis are
39 poorly correlated; therefore, changes in river flows would not be expected to cause a substantial
40 long-term change in DOC concentrations upstream of the Delta.

41 Relative to Existing Conditions, the Alternative 5A would result in relatively small increases (i.e.,
42 ≤ 0.1 mg/L) in long-term average DOC concentrations at some interior Delta locations. The predicted
43 increases would not substantially increase the frequency with which long-term average DOC

1 concentrations exceeds 2, 3, or 4 mg/L. Because this alternative would lead to only slightly higher
 2 long-term average DOC concentrations at the interior Delta locations and some municipal water
 3 intakes, the predicted changes would not be expected to adversely affect MUN beneficial uses, or any
 4 other beneficial use.

5 Relative to Existing Conditions, Alternative 5A would result in reduced long-term average DOC
 6 concentrations at the Banks and Jones pumping plants and Barker Slough. However, Alternative 5A
 7 would result in slightly greater frequency of exceedance of the 3 mg/L DOC concentration threshold
 8 during the modeled drought period. Nevertheless, an overall improvement in DOC-related water
 9 quality would be predicted in the SWP/CVP Export Service Areas.

10 Based on the above, the operations and maintenance activities of Alternative 5A would not result in
 11 any substantial change in long-term average DOC concentration. The increases in long-term average
 12 DOC concentration that could occur within the Delta would not be of sufficient magnitude to
 13 adversely affect the MUN beneficial use, or any other beneficial uses, of Delta waters or waters of the
 14 SWP/CVP Service Area. Because DOC is not bioaccumulative, the increases in long-term average
 15 DOC concentrations would not directly cause bioaccumulative problems in aquatic life or humans.
 16 Finally, DOC is not causing beneficial use impairments and thus is not CWA Section 303(d) listed for
 17 any water body within the affected environment. Because long-term average DOC concentrations
 18 are not expected to increase substantially, no long-term water quality degradation with respect to
 19 DOC is expected to occur and, thus, no adverse effects on beneficial uses would occur. Based on
 20 these findings, this impact is considered to be less than significant. No mitigation is required.

21 **Impact WQ-18: Effects on Dissolved Organic Carbon Concentrations Resulting from**
 22 **Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16**

23 **NEPA Effects:** Relative to existing habitat and that to be developed under the No Action Alternative
 24 (ELT and LLT), the area of new habitat restoration implemented for the Environmental
 25 Commitments would be very small. Implementation of non-habitat restoration Environmental
 26 Commitments would not be expected to have substantial, if even measurable, effect on DOC
 27 concentrations upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas,
 28 because they would present no major sources of DOC to the affected environment. Consequently,
 29 any increases in average DOC levels in the affected environment are not expected to be of sufficient
 30 frequency, magnitude and geographic extent that would adversely affect the MUN beneficial use, or
 31 any other beneficial uses, of the affected environment, nor would potential increases substantially
 32 degrade water quality with regard to DOC. Based on these findings, the effect of the Environmental
 33 Commitments on DOC is determined to be not adverse.

34 **CEQA Conclusion:** Implementation of habitat restoration Environmental Commitments is not
 35 expected to cause a substantial long-term change in DOC concentrations in the water bodies
 36 upstream of the Delta, in the Delta, or in the SWP/CVP Export Service Areas, relative to the Existing
 37 Conditions, because the land area proposed for restoration would be relatively small compared to
 38 existing land area and sources of DOC. Implementation of other Environmental Commitments also
 39 would not be expected to have substantial, if even measurable, effect on DOC concentrations
 40 upstream of the Delta, within the Delta, and in the SWP/CVP Export Service Areas, because they
 41 would present no major sources of DOC to the affected environment. Consequently, increases in
 42 average DOC levels in the affected environment are not expected to be of sufficient frequency,
 43 magnitude and geographic extent that would adversely affect the MUN beneficial use, or any other
 44 beneficial uses, of the affected environment, nor would potential increases substantially degrade

1 water quality with regard to DOC. Furthermore, DOC is not bioaccumulative, therefore changes in
2 DOC concentrations would not cause bioaccumulative problems in aquatic life or humans. Finally,
3 DOC is not causing beneficial use impairments and thus is not CWA Section 303(d) listed for any
4 water body within the affected environment. Because long-term average DOC concentrations are not
5 expected to increase substantially, no long-term water quality degradation with respect to DOC is
6 expected to occur and, thus, no adverse effects on beneficial uses would occur. Based on these
7 findings, this impact is considered to be less than significant. No mitigation is required.

8 **Impact WQ-19: Effects on Pathogens Resulting from Facilities Operations and Maintenance**

9 The effects of operation of the water conveyance facilities under Alternative 5A on pathogen levels
10 in surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas
11 relative to Existing Conditions would be similar to those effects described for Alternative 4 (see
12 Section 8.3.3.9). As described for Alternative 4, pathogen concentrations in the Sacramento and San
13 Joaquin Rivers have a minimal relationship to flow rate in these rivers. Further, urban runoff
14 contributions during the dry season would be expected to be a relatively small fraction of the rivers'
15 total flow rates. During wet weather events, when urban runoff contributions would be higher, the
16 flows in the rivers also would be higher. Given the small magnitude of urban runoff contributions
17 relative to the magnitude of river flows and that pathogen concentrations in the rivers have a
18 minimal relationship to river flow rate, river flow rate and reservoir storage reductions that would
19 occur under Alternative 5A, relative to Existing Conditions and the No Action Alternative (ELT and
20 LLT), would not be expected to result in a substantial adverse change in pathogen concentrations in
21 the reservoirs and rivers upstream of the Delta.

22 The effects of Alternative 5A relative to Existing Conditions and the No Action Alternative (ELT and
23 LLT) would be changes in the relative percentage of water throughout the Delta being comprised of
24 various source waters (i.e., water from the Sacramento River, San Joaquin River, Bay water, eastside
25 tributaries, and agricultural return flow), due to potential changes in inflows particularly from the
26 Sacramento River watershed. However, as described for Alternative 4, it is expected there would be
27 no substantial change in Delta pathogen concentrations in response to a shift in the Delta source
28 water percentages under this alternative or substantial degradation of these water bodies, with
29 regard to pathogens, because it is expected that pathogen sources in close proximity to Delta sites
30 would have a greater influence on pathogen levels at the site, rather than the primary source(s) of
31 water to the site. In-Delta potential pathogen sources, including water-based recreation, tidal
32 habitat, wildlife, and livestock-related uses, would continue under this alternative. As such, there is
33 not expected to be substantial, if even measurable, changes in pathogen concentrations in the
34 SWP/CVP Export Service Area waters.

35 As such, Alternative 5A would not be expected to substantially increase the frequency with which
36 applicable Basin Plan objectives or U.S. EPA-recommended pathogen criteria would be exceeded in
37 water bodies of the affected environment located upstream of the Delta or substantially degrade the
38 quality of these water bodies, with regard to pathogens.

39 **NEPA Effects:** Because pathogen levels are expected to be minimally affected relative to the No
40 Action Alternative (ELT and LLT), the effects on pathogens from implementing Alternative 5A are
41 determined to not be adverse.

42 **CEQA Conclusion:** The effects of Alternative 5A on pathogen levels in surface waters upstream of the
43 Delta, in the Delta, and in the SWP/CVP Export Service Areas, relative to Existing Conditions, would
44 be similar to those described for Alternative 4 (see Section 8.3.3.9). This is because the factors that

1 would affect pathogen levels in the surface waters of these areas would be similar. Therefore, this
 2 alternative is not expected to cause additional exceedance of applicable water quality objectives by
 3 frequency, magnitude, and geographic extent that would cause adverse effects on any beneficial uses
 4 of waters in the affected environment. Because pathogen concentrations are not expected to
 5 increase substantially, no long-term water quality degradation for pathogens is expected to occur
 6 and, thus, no adverse effects on beneficial uses would occur. The San Joaquin River in the Stockton
 7 Deep Water Ship Channel is CWA Section 303(d) listed for pathogens. Because no measurable
 8 increase in Deep Water Ship Channel pathogen concentrations are expected to occur on a long-term
 9 basis, further degradation and impairment of this area is not expected to occur. Finally, pathogens
 10 are not bioaccumulative constituents. Based on these findings, this impact is considered to be less
 11 than significant. No mitigation is required.

12 **Impact WQ-20: Effects on Pathogens Resulting from Implementation of Environmental**
 13 **Commitments 3, 4, 6-12, 15, and 16**

14 **NEPA Effects:** Environmental Commitments 3, 4, and 6-11 would involve habitat restoration
 15 actions. This could result in localized increases in wildlife-related coliforms relative to the No Action
 16 Alternative (ELT and LLT). The Delta currently supports similar habitat types and, with the
 17 exception of the CWA Section 303(d) listing for the Stockton Deep Water Ship Channel, is not
 18 recognized as exhibiting pathogen concentrations that rise to the level of adversely affecting
 19 beneficial uses. As such, the potential increase in wildlife-related coliform concentrations due to
 20 tidal habitat creation is not expected to adversely affect beneficial uses. The remaining
 21 Environmental Commitments would not be expected to affect pathogen levels, because they are
 22 actions that do not affect the presence of pathogen sources. Based on these findings, the effects on
 23 pathogens from implementing Environmental Commitments 3, 4, 6-12, 15, and 16 are determined
 24 to not be adverse.

25 **CEQA Conclusion:** Implementation of Environmental Commitments 3, 4, and 6-11 could result in
 26 localized increases in wildlife-related coliforms relative to Existing Conditions. The Delta currently
 27 supports similar habitat types and, with the exception of the CWA Section 303(d) listing for the
 28 Stockton Deep Water Ship Channel, is not recognized as exhibiting pathogen concentrations that rise
 29 to the level of adversely affecting beneficial uses. As such, the potential increase in wildlife-related
 30 coliform concentrations due to tidal habitat creation is not expected to adversely affect beneficial
 31 uses. Therefore, the Environmental Commitments are not expected to cause additional exceedance
 32 of applicable water quality objectives by frequency, magnitude, and geographic extent that would
 33 cause adverse effects on any beneficial uses of waters in the affected environment. Because
 34 pathogen concentrations are not expected to increase substantially, no long-term water quality
 35 degradation for pathogens is expected to occur and, thus, no adverse effects on beneficial uses
 36 would occur. The San Joaquin River in the Stockton Deep Water Ship Channel is CWA Section 303(d)
 37 listed for pathogens. Because no measurable increase in Deep Water Ship Channel pathogen
 38 concentrations are expected to occur on a long-term basis, further degradation and impairment of
 39 this area is not expected to occur. Finally, pathogens are not bioaccumulative constituents. Based on
 40 these findings, this impact is considered to be less than significant. No mitigation is required.

41 **Impact WQ-21: Effects on Pesticide Concentrations Resulting from Facilities Operations and**
 42 **Maintenance**

43 The effects of Alternative 5A operations and maintenance on pesticide levels in surface waters
 44 upstream of the Delta, relative to Existing Conditions and the No Action Alternative (ELT), would be

1 similar to those expected to occur under Alternative 4 (see Section 8.3.3.9). This is because under
2 Alternative 5A, the primary factor that would influence pesticide concentrations in surface waters
3 upstream of the Delta—the effect of timing and magnitude of reservoir releases on dilution
4 capacity—is expected to change by a similar degree. Changes in average winter and summer flow
5 rates, relative to Existing Conditions and the No Action Alternative (ELT), are expected to be similar
6 to or less than changes in flow rates expected under Alternative 4 in the Sacramento River at
7 Freeport, American River at Nimbus, Feather River at Thermalito and the San Joaquin River at
8 Vernalis (Appendix 8L, *Pesticides*, Tables 1–4). Similarly, the primary factor that would influence
9 pesticide concentrations in surface waters of the Delta and in the SWP/CVP Export Service Areas
10 (i.e., changes in San Joaquin River, Sacramento River and Delta Agriculture source water fractions at
11 various Delta locations, including Banks and Jones pumping plants) is expected to change by a
12 similar degree. The percentage change in monthly average source water fractions would be similar
13 to changes expected under Alternative 4 (Appendix 8D, *Source Water Fingerprinting Results*).

14 It was concluded for Alternative 4, and thus for Alternative 5A based on similar flow changes, that
15 the potential average summer flow reductions would not be of sufficient magnitude to substantially
16 increase in-river pesticide concentrations or alter the long-term risk of pesticide-related effects on
17 aquatic life beneficial uses upstream of the Delta. Greater long-term average flow reductions, and
18 corresponding reductions in dilution/assimilative capacity, would be necessary before long-term
19 risk of pesticide related effects on aquatic life beneficial uses would be adversely altered. Similarly,
20 the modeled changes in the source water fractions of Sacramento River, San Joaquin River, and Delta
21 agriculture water under Alternative 5A would not be of sufficient magnitude to substantially alter
22 the long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial
23 uses of the Delta. Based on the general observation that San Joaquin River, in comparison to the
24 Sacramento River, is a greater contributor of organophosphate insecticides in terms of greater
25 frequency of incidence and presence at concentrations exceeding water quality benchmarks,
26 modeled increases in Sacramento River fraction at Banks and Jones would generally represent an
27 improvement in export water quality respective to pesticides.

28 The flow changes in the LLT would be expected in the ranges of that described above for Alternative
29 5A, relative to Existing Conditions and the No Action Alternative (ELT), and that described for
30 Alternative 4 relative to the No Action Alternative (LLT) in Section 8.3.3.9. Thus, similar to above
31 and Alternative 4, the flow changes that would occur in the LLT under Alternative 5A, relative to
32 Existing Conditions and the No Action Alternative (LLT), would not be expected to result in changes
33 in dilution of pesticides of sufficient magnitude to substantially alter the long-term risk of pesticide-
34 related toxicity to aquatic life, nor adversely affect other beneficial uses upstream of the Delta, in the
35 Delta, or the SWP/CVP Export Service Areas.

36 **NEPA Effects:** In summary, the changes in long-term average flows on the Sacramento, Feather,
37 American, and San Joaquin Rivers under Alternative 5A relative to the No Action Alternative (ELT
38 and LLT) would be of insufficient magnitude to substantially increase the long-term risk of
39 pesticide-related water quality degradation and related toxicity to aquatic life in these water bodies
40 upstream of the Delta. Similarly, changes in source water fractions to the Delta would be of
41 insufficient magnitude to substantially alter the long-term risk of pesticide-related water quality
42 degradation and related toxicity to aquatic life in the Delta or CVP/SWP Export Service Areas.
43 Therefore, the effects on pesticides from the water conveyance facilities are determined not to be
44 adverse.

1 **CEQA Conclusion:** Based on the discussion above, the effects of Alternative 5A on pesticide levels in
2 surface waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative
3 to Existing Conditions would be similar to or slightly less than those described for the Alternative 4.
4 Alternative 5A would not result in any substantial change in long-term average pesticide
5 concentration or result in substantial increase in the anticipated frequency with which long-term
6 average pesticide concentrations would exceed aquatic life toxicity thresholds or other beneficial
7 use effect thresholds upstream of the Delta, at the 11 assessment locations analyzed for the Delta, or
8 the SWP/CVP service area. Numerous pesticides are currently used throughout the affected
9 environment, and while some of these pesticides may be bioaccumulative, those present-use
10 pesticides for which there is sufficient evidence for their presence in waters affected by SWP and
11 CVP operations (i.e., diazinon, chlorpyrifos, diuron, and pyrethroids) are not considered
12 bioaccumulative, and thus changes in their concentrations would not directly cause bioaccumulative
13 problems in aquatic life or humans. Furthermore, while there are numerous CWA Section 303(d)
14 listings throughout the affected environment that name pesticides as the cause for beneficial use
15 impairment, the modeled changes in upstream river flows and Delta source water fractions under
16 Alternative 5A would not be expected to make any of these beneficial use impairments measurably
17 worse. Because long-term average pesticide concentrations are not expected to increase
18 substantially, no long-term water quality degradation with respect to pesticides is expected to occur
19 and, thus, no adverse effects on beneficial uses would occur. Based on these findings, this impact is
20 considered to be less than significant. No mitigation is required.

21 **Impact WQ-22: Effects on Pesticide Concentrations Resulting from Implementation of**
22 **Environmental Commitments 3, 4, 6-12, 15, and 16**

23 **NEPA Effects:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that would
24 contribute long-term additional loading of pesticides, and the potential short-term loading from
25 former agricultural lands would be expected to degrade and dissipate rapidly. Therefore, relative to
26 the No Action Alternative (ELT and LLT), the effects on pesticides from implementing
27 Environmental Commitments 3, 4, 6-12, 15, and 16 are determined to be not adverse.

28 **CEQA Conclusion:** Environmental Commitments 3, 4, 6-12, 15, and 16 do not involve actions that
29 would contribute long-term additional loading of pesticides, and the potential short-term loading
30 from former agricultural lands would be expected to degrade and dissipate rapidly, such that
31 pesticide levels would differ little from Existing Conditions. Therefore, implementation of
32 Environmental Commitments 3, 4, 6-12, 15, and 16 would not cause substantial long-term increase
33 in pesticide concentrations in the rivers and reservoirs upstream of the Delta, in the Delta Region, or
34 the SWP/CVP Export Service Areas. As such, these Environmental Commitments are not expected to
35 cause additional exceedance of applicable water quality objectives by frequency, magnitude, and
36 geographic extent that would cause adverse effects on any beneficial uses of waters in the affected
37 environment. Because pesticide concentrations are not expected to increase substantially, no long-
38 term water quality degradation for pesticides is expected to occur and, thus, no adverse effects to
39 beneficial uses would occur. Furthermore, any negligible changes in long-term pesticide
40 concentrations that may occur throughout the affected environment would not be expected to make
41 any existing beneficial use impairments measurably worse. Environmental Commitments 3, 4, 6-12,
42 15, 16 do not include the use of pesticides known to be bioaccumulative in animals or humans, nor
43 do the Environmental Commitments propose the use of any pesticide currently named in a CWA
44 Section 303(d) listing of the affected environment. Based on these findings, this impact is considered
45 to be less than significant. No mitigation is required.

1 **Impact WQ-23: Effects on Phosphorus Concentrations Resulting from Facilities Operations**
2 **and Maintenance**

3 The effects of Alternative 5A on phosphorus concentrations in surface waters upstream of the Delta,
4 in the Delta, and in the SWP/CVP Export Service Areas would be similar to those described for
5 Alternative 4 (see Section 8.3.3.9). This is because factors which affect phosphorus concentrations in
6 surface waters of these areas are the same under Alternative 4 and Alternative 5A. As described for
7 Alternative 4, phosphorus loading to waters upstream of the Delta is not anticipated to change, and
8 because changes in flows do not necessarily result in changes in concentrations or loading of
9 phosphorus to these water bodies, substantial changes in phosphorus concentration are not
10 anticipated under Alternative 5A, relative to Existing Conditions or the No Action Alternative (ELT),
11 upstream of the Delta. Phosphorus concentrations may increase during January through March at
12 locations in the Delta where the source fraction of San Joaquin River water increases, due to the
13 higher concentration of phosphorus in the San Joaquin River during these months compared to
14 Sacramento River water or San Francisco Bay water. However, based on the DSM2 fingerprinting
15 results (Figures 353–374 in Appendix 8D, *Source Water Fingerprinting Results*), together with
16 source water concentrations (in Figure 8-56), the magnitude of increases during these months is
17 expected to be negligible to low (i.e., <0.02 mg/L) at all Delta locations relative to Existing
18 Conditions and the No Action Alternative (ELT and LLT). Thus, phosphorus concentrations in the
19 Delta and waters exported from Banks and Jones pumping plants to the SWP/CVP Export Service
20 Areas are expected to be similar to Existing Conditions and the No Action Alternative (ELT and LLT).

21 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
22 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
23 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
24 effects on phosphorus in the LLT are expected to be similar to those described above.

25 **NEPA Effects:** In summary, operation of the water conveyance facilities would have little to no effect
26 on phosphorus concentrations in water bodies upstream of the Delta, in the Plan Area, and the
27 waters exported to the SWP/CVP Export Service Areas, relative to the No Action Alternative (ELT
28 and LLT). Thus, effects of the water conveyance facilities on phosphorus are considered to be not
29 adverse.

30 **CEQA Conclusion:** The effects of Alternative 5A on phosphorus levels in surface waters upstream of
31 the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to Existing Conditions
32 would be similar to those described for the Alternative 4. There would be no substantial, long-term
33 increase in phosphorus concentrations in the rivers and reservoirs upstream of the Delta, in the Plan
34 Area, or the waters exported to the CVP and SWP service areas under Alternative 5A relative to
35 Existing Conditions. As such, this alternative is not expected to cause additional exceedance of
36 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
37 would cause adverse effects on any beneficial uses of waters in the affected environment. Because
38 phosphorus concentrations are not expected to increase substantially, no long-term water quality
39 degradation is expected to occur and, thus, no adverse effects to beneficial uses would occur.
40 Phosphorus is not CWA Section 303(d) listed within the affected environment and thus any minor
41 increases that may occur in some areas would not make any existing phosphorus-related
42 impairment measurably worse because no such impairments currently exist. Because phosphorus is
43 not bioaccumulative, minor increases that may occur in some areas would not bioaccumulate to
44 greater levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife,

1 or humans. Based on these findings, this impact is considered to be less than significant. No
2 mitigation is required.

3 **Impact WQ-24: Effects on Phosphorus Concentrations Resulting from Implementation of**
4 **Environmental Commitments 3, 4, 6–12, 15, and 16**

5 **NEPA Effects:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that would
6 contribute long-term additional loading of phosphorus. Therefore, relative to the No Action
7 Alternative (ELT and LLT), the effects on phosphorus from implementing Environmental
8 Commitments 3, 4, 6–12, 15, and 16 are considered to be not adverse.

9 **CEQA Conclusion:** Environmental Commitments 3, 4, 6–12, 15, and 16 do not involve actions that
10 would contribute long-term additional loading of phosphorus. Therefore, there would be no
11 substantial, long-term increase in phosphorus concentrations in the rivers and reservoirs upstream
12 of the Delta, in the Delta Region, or the waters exported to the SWP/CVP Export Service Areas due to
13 implementation of these Environmental Commitments relative to Existing Conditions. Because
14 phosphorus concentrations are not expected to increase substantially due to these Environmental
15 Commitments, no long-term water quality degradation is expected to occur and, thus, no adverse
16 effects to beneficial uses would occur. Phosphorus is not CWA Section 303(d) listed within the
17 affected environment and, thus, the Environmental Commitments would not make any existing
18 phosphorus-related impairment measurably worse because no such impairments currently exist.
19 Because phosphorus is not bioaccumulative, any increases that may occur in some areas would not
20 bioaccumulate to greater levels in aquatic organisms that would, in turn, pose substantial health
21 risks to fish, wildlife, or humans. Based on these findings, this impact is considered to be less than
22 significant. No mitigation is required.

23 **Impact WQ-25: Effects on Selenium Concentrations Resulting from Facilities Operations and**
24 **Maintenance**

25 ***Upstream of the Delta***

26 The effects of Alternative 5A on selenium concentrations in reservoirs and rivers upstream of the
27 Delta would be similar to those effects described for Alternative 4 (see Section 8.3.3.9), because
28 factors affecting selenium concentrations in these water bodies would be similar. Substantial point
29 sources of selenium do not exist upstream in the Sacramento River watershed, in the watersheds of
30 the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), or upstream of the Delta in
31 the San Joaquin River watershed. Nonpoint sources of selenium within the watersheds of the
32 Sacramento River and the eastern tributaries also are relatively low, resulting in generally low
33 selenium concentrations in the reservoirs and rivers of those watersheds. Consequently, any
34 modified reservoir operations and subsequent changes in river flows under Alternative 5A, relative
35 to Existing Conditions or the No Action Alternative (ELT and LLT), are expected to have negligible, if
36 any, effects on reservoir and river selenium concentrations upstream of Freeport in the Sacramento
37 River watershed or in the eastern tributaries upstream of the Delta. Similarly, it is expected that
38 selenium concentrations in the San Joaquin River would be minimally affected, if at all, by
39 anticipated changes in flow rates under Alternative 5A, given the relatively small decreases in flows
40 and the considerable variability in the relationship between selenium concentrations and flows in
41 the San Joaquin River. Any negligible changes in selenium concentrations that may occur in the
42 water bodies of the affected environment located upstream of the Delta would not be of frequency,

1 magnitude, and geographic extent that would adversely affect any beneficial uses or substantially
2 degrade the quality of these water bodies as related to selenium.

3 **Delta**

4 Alternative 5A would result in small changes in average selenium concentrations in water relative to
5 Existing Conditions and No Action Alternative (ELT) at all modeled Delta assessment locations
6 (Appendix 8M, *Selenium*, Table M-33). Long-term average concentrations at some interior and
7 western Delta locations would increase by 0.01 µg/L for the entire period modeled (1976–1991).
8 These small increases in selenium concentrations in water would result in small reductions (2% or
9 less) in available assimilative capacity for selenium, relative to USEPA’s draft water quality criterion
10 of 1.3 µg/L (Appendix 8M, Table M-46). The long-term average selenium concentrations in water
11 under Alternative 5A (range 0.09–0.39 µg/L) would be similar to Existing Conditions (range 0.09–
12 0.41 µg/L) and the No Action Alternative (ELT) (range 0.09–0.39 µg/L), and would be below the
13 draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

14 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 5A would result in
15 small changes (less than 1%) in estimated selenium concentrations in most biota (whole-body fish,
16 bird eggs [invertebrate diet or fish diet], and fish fillets) throughout the Delta, with little difference
17 among locations (Appendix 8M, *Selenium*, Tables M-36 and M-40). Level of Concern Exceedance
18 Quotients (i.e., modeled tissue divided by Level of Concern benchmarks) for selenium
19 concentrations in those biota for all years and for drought years are less than 1.0, indicating low
20 probability of adverse effects. Similarly, Advisory Tissue Level Exceedance Quotients for selenium
21 concentrations in fish fillets for all years and drought years are less than 1.0. Estimated selenium
22 concentrations in sturgeon for the San Joaquin River at Antioch are predicted to increase by 7%
23 relative to Existing Conditions (from about 4.7 to about 5.0 mg/kg dry weight) and by 4% relative to
24 the No Action Alternative (ELT) in all years (from about 4.8 to about 5.0 mg/kg dry weight). For
25 sturgeon in the Sacramento River at Mallard Island concentrations are predicted to increase by
26 about 5% relative to Existing Conditions in all years (from about 4.4 to 4.6 mg/kg dry weight) and
27 by 3% relative to the No Action Alternative in all years (from about 4.5 to 4.6 mg/kg dry weight)
28 (Appendix 8M, *Selenium*, Tables M-41 and M-42). Selenium concentrations in sturgeon during
29 drought years are expected to increase by about 3–5% relative to Existing Conditions (from about
30 6.8 to 7.2 mg/kg dry weight) and 1–2% relative to the No Action Alternative at those locations (from
31 about 7.0 to 7.2 mg/kg dry weight) (Appendix 8M, *Selenium*, Tables M-41 and M-42). Detection of
32 small changes in whole-body sturgeon such as those estimated for the western Delta would require
33 very large sample sizes because of the inherent variability in fish tissue selenium concentrations.
34 Low Toxicity Threshold Exceedance Quotients for selenium concentrations in sturgeon in the
35 western Delta would exceed 1.0 for drought years at both locations (as they do for Existing
36 Conditions and the No Action Alternative (ELT)); for all years the Exceedance Quotient would be 1.0
37 or less (Appendix 8M, Table M-43). The High Toxicity Threshold Quotient would be less than 1.0 at
38 both locations for all years and drought years (Appendix 8M, Table M-43).

39 The disparity between larger estimated changes for sturgeon and smaller changes for other biota is
40 attributable largely to differences in modeling approaches, as described in Appendix 8M, *Selenium*.
41 The model for most biota was calibrated to encompass the varying concentration-dependent uptake
42 from waterborne selenium concentrations (expressed as the K_d , which is the ratio of selenium
43 concentrations in particulates [as the lowest level of the food chain] relative to the waterborne
44 concentration) that was exhibited in data for largemouth bass in 2000, 2005, and 2007 at various
45 locations across the Delta. In contrast, the modeling for sturgeon could not be similarly calibrated at

1 the two western Delta locations and used literature-derived uptake factors and trophic transfer
2 factors for the estuary from Presser and Luoma (2013). As noted in the Appendix 8M, there was a
3 significant negative log-log relationship of K_d to waterborne selenium concentration that reflected
4 the greater bioaccumulation rates for bass at low waterborne selenium than at higher
5 concentrations. There was no difference in bass selenium concentrations in the Sacramento River at
6 Rio Vista in comparison to the San Joaquin River at Vernalis in 2000, 2005, and 2007 [Foe 2010],
7 despite a nearly 10-fold difference in waterborne selenium. Thus, there is more confidence in the
8 site-specific modeling based on the Delta-wide model that was calibrated for bass data than in the
9 estimates for sturgeon based on “fixed” K_{ds} for all years and for drought years without regard to
10 waterborne selenium concentration at the two locations in different time periods.

11 Residence time of water in the Delta is expected to increase relative to Existing Conditions primarily
12 as a result of habitat restoration (8,000 acres of tidal habitat restoration and enhancements in the
13 Yolo Bypass) that is assumed to occur under the No Action Alternative (ELT) separate from
14 Alternative 5A. Although estimates of the residence time increases are not available for Alternative
15 5A, estimates for Alternative 5 at the Late Long Term (presented in Table 8-60a in Section 8.3.1.7 in
16 the *Microcystis* subsection) which contained 65,000 acres of tidal restoration are available, and is
17 expected that residence time increases under Alternative 5A would be substantially less than
18 identified for Alternative 5 in the table.

19 If increases in fish tissue or bird egg selenium were to occur as a result of increased residence time,
20 the increases would likely be of concern only where fish tissues or bird eggs are already elevated in
21 selenium to near or above thresholds of concern. That is, where biota concentrations are currently
22 low and not approaching thresholds of concern (which, as discussed above, is the case throughout
23 the Delta, except for sturgeon in the western Delta), changes in residence time alone would not be
24 expected to cause them to then approach or exceed thresholds of concern. Thus, the most likely area
25 in which biota tissues would be at levels high enough that additional bioaccumulation due to
26 increased residence time would be a concern is the western Delta and Suisun Bay for sturgeon.
27 Based on the expected minor increases in residence time in the western Delta, any increases are not
28 expected to be of sufficient magnitude to substantially affect selenium bioaccumulation.

29 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 5A would result in
30 essentially no change in selenium concentrations throughout the Delta for most biota (less than
31 1%), although larger increases in selenium concentrations are predicted for sturgeon in the western
32 Delta. Concentrations of selenium in sturgeon would exceed only the lower benchmark during the
33 drought period, indicating a low potential for effects. The modeling of bioaccumulation for sturgeon
34 is less calibrated to site-specific conditions than that for other biota, which was calibrated on a
35 robust dataset for modeling of bioaccumulation in largemouth bass as a representative species for
36 the Delta. Overall, Alternative 5A would not be expected to substantially increase the frequency with
37 which the applicable water quality criterion or toxicity and level of concern benchmarks would be
38 exceeded in the Delta (there being only a small increase for sturgeon relative to the low benchmark
39 and no exceedance of the high benchmark) or to substantially degrade the quality of water in the
40 Delta, with regard to selenium. These changes would be similar to those described for Alternative 4.

41 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
42 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
43 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
44 effects on selenium in the LLT are expected to be similar to those described above.

1 **SWP/CVP Export Service Areas**

2 Alternative 5A would result in small (0.03 µg/L) decreases in long-term average selenium
 3 concentrations in water at the Banks and Jones pumping plants, relative to Existing Conditions and
 4 the No Action Alternative (ELT), for the entire period modeled (Appendix 8M, *Selenium*, Table M-
 5 33). These decreases in long-term average selenium concentrations in water would result in
 6 increases in available assimilative capacity for selenium at these pumping plants, relative to the
 7 USEPA's draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-46). The long-term average
 8 selenium concentrations in water for Alternative 5A (range 0.18–0.25 µg/L) would be well below
 9 the draft water quality criterion of 1.3 µg/L (Appendix 8M, Table M-33).

10 Relative to Existing Conditions and the No Action Alternative (ELT), Alternative 5A would result in
 11 small changes (about 1% or less) in estimated selenium concentrations in biota (whole-body fish,
 12 bird eggs [invertebrate diet], bird eggs [fish diet], and fish fillets) (Appendix 8M, *Selenium*, Table M-
 13 40). Concentrations in biota would not exceed any selenium toxicity or level of concern benchmarks
 14 for Alternative 5A (Appendix 8M, Table M-40).

15 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
 16 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
 17 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
 18 effects on selenium in the LLT are expected to be similar to those described above.

19 **NEPA Effects:** Relative to the No Action Alternative (ELT and LLT), Alternative 5A would result in
 20 essentially negligible changes in selenium concentrations in water upstream of the Delta. Similarly,
 21 there would be negligible changes in selenium water and most biota concentrations in the Delta,
 22 with no exceedances of benchmarks for biological effects. For sturgeon in the Delta, there would be
 23 only a small increase of threshold exceedance relative to the low benchmark for sturgeon and no
 24 exceedance of the high benchmark. At the Banks and Jones pumping plants, Alternative 5A would
 25 cause no increases in the frequency with which applicable benchmarks would be exceeded and
 26 would slightly improve the quality of water in selenium concentrations. Therefore, the effects on
 27 selenium (both as waterborne and as bioaccumulated in biota) from Alternative 5A are considered
 28 to be not adverse.

29 **CEQA Conclusion:** There are no substantial point sources of selenium in watersheds upstream of the
 30 Delta, and no substantial nonpoint sources of selenium in the watersheds of the Sacramento River
 31 and the eastern tributaries. Nonpoint sources in the San Joaquin Valley that contribute selenium to
 32 the Delta will be controlled through a TMDL developed by the Central Valley Water Board (2001) for
 33 the lower San Joaquin River, established limits for the Grassland Bypass Project, and Basin Plan
 34 objectives (Central Valley Regional Water Quality Control Board 2010d; State Water Resources
 35 Control Board 2010b, 2010c) that are expected to result in decreasing discharges of selenium from
 36 the San Joaquin River to the Delta. Consequently, any modified reservoir operations and subsequent
 37 changes in river flows under Alternative 5A, relative to Existing Conditions, are expected to cause
 38 negligible changes in selenium concentrations in water. Any negligible changes in selenium
 39 concentrations that may occur in the water bodies of the affected environment located upstream of
 40 the Delta would not be of frequency, magnitude, and geographic extent that would adversely affect
 41 any beneficial uses or substantially degrade the quality of these water bodies as related to selenium.

42 Relative to Existing Conditions, modeling estimates indicate Alternative 5A would result in
 43 essentially no change in selenium concentrations in water or most biota throughout the Delta, with
 44 no exceedances of benchmarks for biological effects. The Low Toxicity Threshold Exceedance

1 Quotient for selenium concentrations in sturgeon for all years in the San Joaquin River at Antioch
 2 would increase slightly, from 0.94 for Existing Conditions to 1.0 for Alternative 5A. Concentrations
 3 of selenium in sturgeon would exceed only the lower benchmark during the drought period,
 4 indicating a low potential for effects. Overall, Alternative 5A would not be expected to substantially
 5 increase the frequency with which applicable benchmarks would be exceeded in the Delta (there
 6 being only a small increase for sturgeon exceedance relative to the low benchmark for sturgeon and
 7 no exceedance of the high benchmark) or substantially degrade the quality of water in the Delta,
 8 with regard to selenium.

9 Assessment of effects of selenium in the SWP/CVP Export Service Areas is based on effects on
 10 selenium concentrations at the Banks and Jones pumping plants. Relative to Existing Conditions,
 11 Alternative 5A would cause no increases in the frequency with which applicable benchmarks would
 12 be exceeded, and would slightly improve the quality of water in selenium concentrations at the
 13 Banks and Jones pumping plants.

14 Based on the above, selenium concentrations that would occur in water under Alternative 5A would
 15 not cause additional exceedances of applicable state or federal numeric or narrative water quality
 16 objectives/criteria, or other relevant water quality effects thresholds identified for this assessment,
 17 by frequency, magnitude, and geographic extent that would result in adverse effects to one or more
 18 beneficial uses within affected water bodies. In comparison to Existing Conditions, water quality
 19 conditions under Alternative 5A would not increase levels of selenium by frequency, magnitude, and
 20 geographic extent such that the affected environment would be expected to have measurably higher
 21 body burdens of selenium in aquatic organisms, thereby substantially increasing the health risks to
 22 wildlife (including fish) or humans consuming those organisms. Water quality conditions under this
 23 alternative with respect to selenium would not cause long-term degradation of water quality in the
 24 affected environment, and therefore would not result in use of available assimilative capacity such
 25 that exceedances of water quality objectives/criteria would be likely and would result in
 26 substantially increased risk for adverse effects to one or more beneficial uses. This alternative would
 27 not further degrade water quality by measurable levels, on a long-term basis, for selenium and, thus,
 28 cause the CWA Section 303(d)-listed impairment of beneficial use to be made discernibly worse.
 29 Based on these findings, this impact is considered to be less than significant. No mitigation is
 30 required.

31 **Impact WQ-26: Effects on Selenium Concentrations Resulting from Implementation of** 32 **Environmental Commitments 3, 4, 6-12, 15, and 16**

33 **NEPA Effects:** Environmental Commitments 3, 4, 6-12, 15, and 16 would not increase selenium
 34 loading, and the amount of restoration that would occur would be minimal relative to the area of the
 35 Delta and implemented such that any localized changes in residence time are unlikely to measurably
 36 change selenium concentrations in water or biota relative to the No Action Alternative (ELT and
 37 LLT). Therefore, the effects on selenium from implementing Environmental Commitments 3, 4, 6-
 38 12, 15, and 16 are determined to be not adverse.

39 **CEQA Conclusion:** Environmental Commitments 3, 4, 6-12, 15, and 16 would not increase selenium
 40 loading, and the amount of restoration that would occur would be minimal relative to the area of the
 41 Delta and implemented such that any localized changes in residence time are unlikely to measurably
 42 change selenium concentrations in water or biota relative to Existing Conditions. Therefore, it is
 43 expected that with implementation of these Environmental Commitments there would be no
 44 substantial, long-term increase in selenium concentrations in water in the rivers and reservoirs

1 upstream of the Delta, water in the Delta, or the waters exported to the SWP/CVP Export Service
 2 Areas, relative to Existing Conditions. As such, these Environmental Commitments would not
 3 contribute to additional exceedances of applicable water quality objectives/criteria. Given the
 4 factors discussed in the assessment above and for Alternative 4 (see Section 8.3.3.9), any increases
 5 in bioaccumulation rates from waterborne selenium that could occur in some areas as a result of
 6 increased water residence times would not be of sufficient magnitude and geographic extent that
 7 any portion of the Delta would be expected to have measurably higher body burdens of selenium in
 8 aquatic organisms, and therefore would not substantially increase risk for adverse effects to
 9 beneficial uses. Environmental Commitments 3, 4, 6–12, 15, and 16 would not cause long-term
 10 degradation of water quality resulting in sufficient use of available assimilative capacity such that
 11 occasionally exceeding water quality objectives/criteria would be likely. Also, these Environmental
 12 Commitments would not result in substantially increased risk for adverse effects to any beneficial
 13 uses. Furthermore, although the Delta is a CWA Section 303(d)-listed water body for selenium, given
 14 the discussion in the assessment above, it is unlikely that restoration areas would result in
 15 measurable increases in selenium in fish tissues or bird eggs such that the beneficial use impairment
 16 would be made discernibly worse.

17 Because it is unlikely that substantial increases in selenium in fish tissues or bird eggs would occur
 18 such that effects on aquatic life beneficial uses would be anticipated, and because of the avoidance
 19 and minimization measures that are designed to further minimize and evaluate the risk of such
 20 increases (see BDCP Appendix 3.C, *Avoidance and Minimization Measures*, for more detail on
 21 AMM27) as well as the Selenium Management environmental commitment (see Appendix 3B,
 22 *Environmental Commitments, AMMs, and CMs*), this impact is considered less than significant. No
 23 mitigation is required.

24 **Impact WQ-27: Effects on Trace Metal Concentrations Resulting from Facilities Operations** 25 **and Maintenance**

26 The effects of operation of the water conveyance facilities under Alternative 5A on trace metal
 27 concentrations in surface waters upstream of the Delta, relative to Existing Conditions and the No
 28 Action Alternative (ELT and LLT) would be similar to those effects described for Alternative 4 (see
 29 Section 8.3.3.9).

30 Given the poor association of dissolved trace metal concentrations with flow, river flow rate and
 31 reservoir storage reductions that would occur under Alternative 5A, relative to Existing Conditions
 32 and the No Action Alternative (ELT and LLT), would not be expected to result in a substantial
 33 adverse change in trace metal concentrations in the reservoirs and rivers upstream of the Delta.

34 In the Delta, for metals of primarily aquatic life concern (copper, cadmium, chromium, lead, nickel,
 35 silver, and zinc), average and 95th percentile trace metal concentrations of the primary source
 36 waters to the Delta are very similar, and very large changes in source water fraction would be
 37 necessary to effect a relatively small change in trace metal concentration at a particular Delta
 38 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
 39 waters are all below their respective water quality criteria, including those that are hardness-based
 40 (see Tables 8-51 and 8-52 in Section 8.3.1.7, *Construction-Specific Considerations Used in the*
 41 *Assessment*). No mixing of these three source waters could result in a metal concentration greater
 42 than the highest source water concentration, and given that the average and 95th percentile source
 43 water concentrations for copper, cadmium, chromium, lead, nickel, silver, and zinc do not exceed
 44 their respective criteria, more frequent exceedances of criteria in the Delta would not occur. For

1 metals of primarily human health and drinking water concern (arsenic, iron, manganese), average
2 and 95th percentile concentrations are also very similar (see Tables 8–10 in Appendix 8N, *Trace*
3 *Metals*) and average concentrations are below human health criteria. No mixing of these three
4 source waters could result in a metal concentration greater than the highest source water
5 concentration, and given that the average water concentrations for arsenic, iron, and manganese do
6 not exceed water quality criteria, more frequent exceedances of drinking water criteria in the Delta
7 would not be expected to occur.

8 Because Alternative 5A would not result in substantial increases in trace metal concentrations in the
9 water exported from the Delta or diverted from the Sacramento River through the proposed
10 conveyance facilities, there is not expected to be substantial changes in trace metal concentrations
11 in the SWP/CVP Export Service Areas, relative to Existing Conditions or the No Action Alternative
12 (ELT and LLT).

13 In the LLT, the Delta source water fractions may be different from those occurring in the ELT due to
14 changes in upstream hydrology and Delta hydrodynamics from additional climate change and sea
15 level rise. These effects would occur independent of the alternative and, thus, the alternative-specific
16 effects on trace metals in the LLT are expected to be similar to those described above.

17 As such, Alternative 5A would not be expected to substantially increase the frequency with which
18 applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
19 affected environment or substantially degrade the quality of these water bodies, with regard to trace
20 metals.

21 **NEPA Effects:** Alternative 5A would not be expected to substantially increase the frequency with
22 which applicable Basin Plan objectives or CTR criteria would be exceeded in the water bodies of the
23 affected environment or substantially degrade the quality of these water bodies, with regard to trace
24 metals, relative to the No Action Alternative (ELT and LLT). Therefore, the effects on trace metals
25 from implementing Alternative 5A are determined to not be adverse.

26 **CEQA Conclusion:** While Alternative 5A would alter the magnitude and timing of reservoir releases
27 north, south and east of the Delta, this would have no substantial effect on the various watershed
28 sources of trace metals. Moreover, long-term average flow and trace metals at Sacramento River at
29 Hood and San Joaquin River at Vernalis are poorly correlated; therefore, changes in river flows
30 would not be expected to cause a substantial long-term change in trace metal concentrations
31 upstream of the Delta.

32 Average and 95th percentile trace metal concentrations are very similar across the primary source
33 waters to the Delta. Given this similarity, very large changes in source water fraction would be
34 necessary to effect a relatively small change in trace metal concentration at a particular Delta
35 location. Moreover, average and 95th percentile trace metal concentrations for these primary source
36 waters are all below their respective water quality criteria. No mixing of these three source waters
37 could result in a metal concentration greater than the highest source water concentration, and given
38 that trace metals do not already exceed water quality criteria, more frequent exceedances of criteria
39 in the Delta would not be expected to occur under Alternative 5A.

40 Because Alternative 5A is not expected to result in substantial changes in trace metal concentrations
41 in Delta waters, which includes Banks and Jones pumping plants, effects on trace metal
42 concentrations in the SWP/CVP Export Service Area are expected to be negligible.

1 As such, this alternative is not expected to cause additional exceedance of applicable water quality
2 objectives by frequency, magnitude, and geographic extent that would cause adverse effects on any
3 beneficial uses of waters in the affected environment. Because trace metal concentrations are not
4 expected to increase substantially, no long-term water quality degradation for trace metals is
5 expected to occur and, thus, no adverse effects to beneficial uses would occur. Furthermore, any
6 negligible changes in long-term trace metal concentrations that may occur in water bodies of the
7 affected environment would not be expected to make any existing beneficial use impairments
8 measurably worse. The trace metals discussed in this assessment are not considered
9 bioaccumulative, and thus would not directly cause bioaccumulative problems in aquatic life or
10 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
11 is required.

12 **Impact WQ-28: Effects on Trace Metal Concentrations Resulting from Implementation of**
13 **Environmental Commitments 3, 4, 6-12, 15, and 16**

14 *NEPA Effects:* Because Environmental Commitments 3, 4, 6-12, 15, and 16 present no new sources
15 of trace metals to the affected environment, the effects on trace metal concentrations from
16 implementing these Environmental Commitments are determined to be not adverse.

17 *CEQA Conclusion:* Implementation of Environmental Commitments 3, 4, 6-12, 15, and 16 would not
18 cause substantial long-term increase in trace metal concentrations in the rivers and reservoirs
19 upstream of the Delta, in the Delta Region, or the SWP/CVP Export Service Areas, because they
20 present no new sources of trace metals to the affected environment. As such, this alternative is not
21 expected to cause additional exceedance of applicable water quality objectives by frequency,
22 magnitude, and geographic extent that would cause adverse effects on any beneficial uses of waters
23 in the affected environment. Because trace metal concentrations are not expected to increase
24 substantially, no long-term water quality degradation for trace metals is expected to occur and, thus,
25 no adverse effects to beneficial uses would occur. Furthermore, any negligible changes in long-term
26 trace metal concentrations that may occur throughout the affected environment would not be
27 expected to make any existing beneficial use impairments measurably worse. The trace metals
28 discussed in this assessment are not considered bioaccumulative, and thus would not directly cause
29 bioaccumulative problems in aquatic life or humans. Based on these findings, this impact is
30 considered to be less than significant. No mitigation is required.

31 **Impact WQ-29: Effects on TSS and Turbidity Resulting from Facilities Operations and**
32 **Maintenance**

33 As described for Alternative 4 (see Section 8.3.3.9), the operation of the water conveyance facilities
34 under Alternative 5A is expected to have a minimal effect on TSS and turbidity levels in surface
35 waters upstream of the Delta, in the Delta, and in the SWP/CVP Export Service Areas relative to
36 Existing Conditions and the No Action Alternative (ELT and LLT). This is because the factors that
37 would affect TSS and turbidity levels in the surface waters of these areas would be the same. TSS
38 concentrations and turbidity levels in rivers upstream of the Delta are affected primarily by: 1) TSS
39 concentrations and turbidity levels of the water released from the upstream reservoirs, 2) erosion
40 occurring within the river channel beds, which is affected by river flow velocity and bank protection,
41 3) TSS concentrations and turbidity levels of tributary inflows, point-source inputs, and nonpoint
42 runoff as influenced by surrounding land uses; and 4) phytoplankton, zooplankton and other
43 biological material in the water. Within the Delta, TSS concentrations and turbidity levels in Delta
44 waters are affected by TSS concentrations and turbidity levels of inflows (and associated sediment

1 load), as well as fluctuation in flows within the channels due to the tides, with sediments depositing
2 as flow velocities and turbulence are low at periods of slack tide, and sediments becoming
3 suspended when flow velocities and turbulence increase when tides are near the maximum. TSS and
4 turbidity variations can also be attributed to phytoplankton, zooplankton and other biological
5 material in the water. These factors would be similar under Alternative 5A and Alternative 4, are
6 expected to be minimally different from Existing Conditions and the No Action Alternative (ELT and
7 LLT). Because Alternative 5A is expected to have minimal effect on TSS concentrations and turbidity
8 levels in Delta waters, including water exported at the south Delta pumps, relative to Existing
9 Conditions or the No Action Alternative (ELT and LLT), Alternative 5A also is expected to have
10 minimal effect on TSS concentrations and turbidity levels in the SWP/CVP Export Service Areas
11 waters.

12 **NEPA Effects:** Because TSS concentrations and turbidity levels are expected to be minimally affected
13 relative to the No Action Alternative (ELT and LLT), the effects on TSS and turbidity from
14 implementing Alternative 5A are determined to not be adverse.

15 **CEQA Conclusion:** As described for Alternative 4 (see Section 8.3.3.9) changes in river flow rate and
16 reservoir storage that would occur under Alternative 5A, relative to Existing Conditions, would not
17 be expected to result in a substantial adverse change in TSS concentrations and turbidity levels in
18 the reservoirs and rivers upstream of the Delta, given that suspended sediment concentrations are
19 more affected by season than flow. Within the Delta, geomorphic changes associated with sediment
20 transport and deposition are usually gradual, occurring over years, and high storm event inflows
21 would not be substantially affected. Thus, it is expected that the TSS concentrations and turbidity
22 levels in the affected channels would not be substantially different from the levels under Existing
23 Conditions. There is not expected to be substantial, if even measurable, changes in TSS
24 concentrations and turbidity levels in the SWP/CVP Export Service Areas waters under Alternative
25 5A, relative to Existing Conditions, because this alternative is not expected to result in substantial
26 changes in TSS concentrations and turbidity levels at the south Delta export pumps, relative to
27 Existing Conditions. Therefore, this alternative is not expected to cause additional exceedance of
28 applicable water quality objectives where such objectives are not exceeded under Existing
29 Conditions. Because TSS concentrations and turbidity levels are not expected to be substantially
30 different, long-term water quality degradation is not expected, and, thus, beneficial uses are not
31 expected to be adversely affected. Finally, TSS and turbidity are neither bioaccumulative nor CWA
32 Section 303(d) listed constituents. Based on these findings, this impact is considered to be less than
33 significant. No mitigation is required.

34 **Impact WQ-30: Effects on TSS and Turbidity Resulting from Implementation of** 35 **Environmental Commitments 3, 4, 6-12, 15, and 16**

36 **NEPA Effects:** Localized, temporary changes in TSS and turbidity could occur associated with the
37 restoration actions of Environmental Commitments 3, 4, 6-12, 15, and 16. However, these changes
38 would be gradual and not expected to substantially differ from No Action Alternative (ELT and LLT)
39 conditions. Therefore, the effects on TSS and turbidity from implementing these Environmental
40 Commitments are determined to be not adverse.

41 **CEQA Conclusion:** It is expected that the TSS concentrations and turbidity levels Upstream of the
42 Delta, in the Plan Area, and the SWP/CVP Export Service Areas due to implementation of
43 Environmental Commitments 3, 4, 6-12, 15, and 16 would not be substantially different relative to
44 Existing Conditions, except within localized areas of the Delta modified through creation of habitat

1 and open water. Therefore, this alternative is not expected to cause additional exceedance of
2 applicable water quality objectives where such objectives are not exceeded under Existing
3 Conditions. Because TSS concentrations and turbidity levels Upstream of the Delta, in the greater
4 Plan Area, and in the SWP/CVP Export Service Areas are not expected to be substantially different,
5 long-term water quality degradation is not expected relative to TSS and turbidity, and, thus,
6 beneficial uses are not expected to be adversely affected. Finally, TSS and turbidity are neither
7 bioaccumulative nor CWA Section 303(d) listed constituents. Based on these findings, this impact is
8 considered to be less than significant. No mitigation is required.

9 **Impact WQ-31: Water Quality Effects Resulting from Construction-Related Activities for the** 10 **Water Conveyance Facilities and Environmental Commitments**

11 The potential construction-related water quality effects that would occur under Alternative 5A
12 would similar to the effects described for Alternative 4A (see Section 8.3.4.2). This is because the
13 type, size, and number of construction activities for water conveyance facilities and Environmental
14 Commitments that would occur under Alternative 5A would be similar to Alternative 4A. The
15 construction-related activities for the water conveyance facilities under Alternative 5A would be
16 similar to those described for Alternative 4A. However, there would be less construction activity due
17 to the fewer intakes constructed and the area of in-water habitat restoration activities implemented
18 under Alternative 5A would be less.

19 **NEPA Effects:** The types and magnitude of potential construction-related water quality effects
20 associated with implementation of Alternative 2D would be very similar to the effects discussed for
21 Alternative 4A. Nevertheless, the construction of water supply facilities and Environmental
22 Commitments, with the implementation of the BMPs specified in Appendix 3B, *Environmental*
23 *Commitments, AMMs, and CMs*, and other agency permitted construction requirements, would result
24 in the potential water quality effects being largely avoided and minimized. The specific
25 Environmental Commitments that would be implemented under Alternative 5A would be similar to
26 those described for Alternative 4A. Consequently, relative to the No Action Alternative (ELT),
27 Alternative 5A would not be expected to cause exceedance of applicable water quality
28 objectives/criteria or substantial water quality degradation with respect to constituents of concern,
29 and thus would not adversely affect any beneficial uses upstream of the Delta, in the Delta, or in the
30 SWP/CVP Export Service Areas. Therefore, with implementation of environmental commitments
31 presented in Appendix 3B, the potential construction-related water quality effects are considered to
32 be not adverse.

33 **CEQA Conclusion:** Because environmental commitments would be implemented under Alternative
34 5A for construction-related activities along with agency-issued permits that also contain
35 construction requirements to protect water quality, the construction-related effects, relative to
36 Existing Conditions, would not be expected to cause or contribute to substantial alteration of
37 existing drainage patterns which would result in substantial erosion or siltation on- or off-site,
38 substantial increased frequency of exceedances of water quality objectives/criteria, or substantially
39 degrade water quality with respect to the constituents of concern on a long-term average basis, and
40 thus would not adversely affect any beneficial uses in water bodies upstream of the Delta, within the
41 Delta, or in the SWP/CVP Export Service Areas. Moreover, because the construction-related
42 activities would be temporary and intermittent in nature, the construction would involve negligible
43 discharges, if any, of bioaccumulative or CWA Section 303(d) listed constituents to water bodies of
44 the affected environment. As such, construction activities would not contribute measurably to
45 bioaccumulation of contaminants in organisms or humans or cause CWA Section 303(d)

1 impairments to be discernibly worse. Based on these findings, this impact is determined to be less
2 than significant. No mitigation is required.

3 **Impact WQ-32: Effects on *Microcystis* Bloom Formation Resulting from Facilities Operations** 4 **and Maintenance**

5 ***Upstream of the Delta***

6 Adverse effects from *Microcystis* upstream of the Delta have only been documented in lakes such as
7 Clear Lake, where eutrophic levels of nutrients give cyanobacteria a competitive advantage over
8 other phytoplankton during the bloom season. Large reservoirs upstream of the Delta are typically
9 characterized by low nutrient concentrations, where other phytoplankton outcompete
10 cyanobacteria, including *Microcystis*. In the rivers and streams of the Sacramento River watershed,
11 watersheds of the eastern tributaries (Cosumnes, Mokelumne, and Calaveras Rivers), and the San
12 Joaquin River upstream of the Delta under Existing Conditions, bloom development is limited by
13 high water velocity and low residence times. These conditions are not expected to change under
14 Alternative 5A or the No Action Alternative (ELT and LLT). Consequently, any modified reservoir
15 operations under Alternative 5A are not expected to promote *Microcystis* production upstream of
16 the Delta, relative to Existing Conditions and the No Action Alternative (ELT and LLT).

17 ***Delta***

18 During the June through October period when *Microcystis* blooms occur in the Delta, it is a
19 combination of flows, associated residence time, and water temperatures that are believed to most
20 influence *Microcystis* bloom formation.

21 Under Alternative 5A, a portion of the Sacramento River water which is conveyed through the Delta
22 to the south Delta intakes under Existing Conditions would be replaced at various locations
23 throughout the Delta by other source water due to diversion of Sacramento River water at the north
24 Delta intakes. The changes in flow paths of water through the Delta and change in operation of the
25 south Delta pumps that would occur due to facilities operations and maintenance of Alternative 5A
26 could result in localized increases in residence time in various Delta sub-regions and decreases in
27 residence time in other areas. Because there is no published analysis of the relationship between
28 *Microcystis* occurrence and residence time, there is uncertainty on how increased residence times
29 may affect *Microcystis* occurrences (ICF International 2016). Further,, in general, there is substantial
30 uncertainty regarding the extent that facilities operations and maintenance of Alternative 5A would
31 result in a net increase in water residence times at various locations throughout the Delta, relative
32 to Existing Conditions. In addition to the effects of operations and maintenance of Alternative 5A,
33 increases in water residence times are expected occur due to separate factors and actions
34 concurrent with the alternative, including habitat restoration (8,000 acres of tidal habitat
35 restoration and enhancements in the Yolo Bypass) and sea level rise due to climate change.

36 To ensure project operations do not create increased *Microcystis* blooms in the Delta, water flow
37 through Delta channels can be managed through real-time operations particularly the balancing of
38 the north and south Delta diversions. By operating the south Delta pumps more frequently during
39 periods conducive to increased *Microcystis* blooms, residence times can be managed to decrease the
40 potential for blooms to develop, and thus decrease potential microcystin increases due to project
41 operations. As such, effects of Alternative 5A on *Microcystis* levels, and thus microcystin
42 concentrations in the Delta, would not be made more adverse relative to Existing Conditions and the
43 No Action Alternative (ELT and LLT).

1 Water temperature is also a critical parameter that has been related to *Microcystis* blooms in the
2 Delta. Since Delta water temperatures are largely driven by air temperature, climate change that
3 increases air temperatures relative to Existing Conditions would be expected to increase ambient
4 water temperatures in the Delta by 1.3–2.5°F. These climate changes in the ELT are expected to
5 occur in the Delta under the No Action Alternative, relative to Existing Conditions. Alternative 5A
6 operations and maintenance is not expected to cause increased Delta water temperatures, relative
7 to Existing Conditions or the No Action Alternative.

8 In summary, increased frequency and magnitude of *Microcystis* blooms may occur in the Delta in the
9 future, relative to Existing Conditions, due to factors unrelated to the project alternative, including:
10 1) increased residence times resulting from restoration activities and climate change-related sea
11 level rise and 2) climate change-related increased Delta water temperatures. If *Microcystis*
12 occurrences did increase in certain sub-regions of the Delta in the future, there would also be the
13 potential for increased microcystin presence in the Delta, relative to Existing Conditions. To ensure
14 project operations under Alternative 2D do not create significant increases in *Microcystis* blooms in
15 the Delta, that may be associated with increased residence times, water flow through Delta channels
16 would be managed through real-time operations.

17 **SWP/CVP Export Service Area**

18 As described above for the Delta, source waters to the south Delta intakes could be adversely
19 affected relative to Existing Conditions by *Microcystis* both from an increase in Delta water
20 temperatures associated with climate change, and from an increase in water residence times. The
21 impacts from increased Delta water residence times would be primarily related to habitat
22 restoration (8,000 acres of tidal habitat restoration and enhancements in the Yolo Bypass) that is
23 assumed to occur separate from Alternative 5A. The combined effect of these factors on the
24 potential for *Microcystis* blooms in source waters to the south Delta intakes is expected to be much
25 greater than the influence of operations and maintenance of Alternative 5A, the effects of which will
26 be mitigated through real time operations. Increases in ambient air temperatures due to climate
27 change relative to Existing Conditions are expected under this alternative. Increases in ambient air
28 temperatures are expected to result in warmer ambient water temperatures, and thus conditions
29 more suitable to *Microcystis* growth, in the water bodies of the SWP/CVP Export Service Areas. The
30 incremental increase in long-term average air temperatures would be less at the ELT (2.0°F),
31 compared to the LLT (4.0°F).

32 As discussed in the Delta section above, Alternative 5A is not expected to substantially adversely
33 affect by *Microcystis* blooms, relative to Existing Conditions and the No Action Alternative (ELT and
34 LLT). Additionally, residence time and water temperature conditions in the SWP/CVP Export Service
35 Areas are not expected to become more conducive to *Microcystis* bloom formation due to the
36 operations and maintenance of Alternative 5A, relative to Existing Conditions and the No Action
37 Alternative (ELT), because water residence times are projected to increase in the SWP/CVP Export
38 Service Areas and any temperature increases there would be due to climate change not due to
39 Alternative 2D.

40 **NEPA Effects:** Modified reservoir operations under Alternative 5A are not expected to promote
41 *Microcystis* production upstream of the Delta, relative to the No Action Alternative (ELT and LLT).
42 Similarly, operations and maintenance of Alternative 5A is not expected to substantially increase
43 water residence times or ambient water temperatures in the Delta, including at the Banks and Jones
44 pumping plants, and thus is not expected to result in adverse effects on *Microcystis* in the Delta,

1 relative to No Action Alternative (ELT and LLT). Lack of adverse effects on *Microcystis* in the Delta
 2 would mean that Delta waters diverted into the SWP/CVP Export Service Areas would not be
 3 adversely affected. Finally, the potential for *Microcystis* bloom formation within the SWP/CVP
 4 Export Service Area water bodies and canals would not be expected to change substantially, if at all,
 5 because water residence times are not projected to increase in the SWP/CVP Export Service Areas
 6 and any temperature increases there would be due to climate change and not due to Alternative 5A.
 7 Thus, the effects on *Microcystis* in surface waters upstream of the Delta, in the Delta, and in the
 8 SWP/CVP Export Service Areas from implementing Alternative 5A are determined to be not adverse.

9 **CEQA Conclusion:** Modified reservoir operations under Alternative 5A are not expected to promote
 10 *Microcystis* production upstream of the Delta, relative to the Existing Conditions. Increased
 11 frequency and magnitude of *Microcystis* blooms may occur in the Delta in the future, relative to
 12 Existing Conditions, due to increased residence times resulting from restoration activities unrelated
 13 to the project alternative, as well as climate change and sea level rise that are expected to increase
 14 Delta water temperatures. Such increases in residence time and water temperatures would not be
 15 caused by implementation of Alternative 5A. Operations and maintenance of Alternative 5A,
 16 including the use of real-time operations, are not expected to result in flow and temperature
 17 conditions in the Delta, including at the Banks and Jones pumping plants, that would cause
 18 substantial increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms. As
 19 such, this alternative would not be expected to cause additional exceedance of applicable water
 20 quality objectives/criteria by frequency, magnitude, and geographic extent that would cause
 21 significant impacts on any beneficial uses of waters in the affected environment. *Microcystis* and
 22 microcystins are not CWA Section 303(d) listed within the affected environment and thus any
 23 increases that could occur in some areas of the Delta would not make any existing *Microcystis*
 24 impairment measurably worse because no such impairments currently exist. Microcystin, the toxin
 25 produced by *Microcystis*, is bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential
 26 increases in *Microcystis* occurrences due to climate change and sea level rise may lead to increased
 27 microcystin presence in the Delta, relative to Existing Conditions. This has potential to cause
 28 microcystins to bioaccumulate to greater levels in aquatic organisms that would, in turn, pose health
 29 risks to fish, wildlife or humans. While long-term water quality degradation may occur and, thus,
 30 impacts on beneficial uses could occur, these impacts are not related to implementation of
 31 Alternative 5A. Although there is uncertainty regarding this impact, the effects on *Microcystis* from
 32 implementing water conveyance facilities are determined to be less than significant. No mitigation is
 33 required.

34 **Impact WQ-33: Effects on *Microcystis* Bloom Formation Resulting from Environmental** 35 **Commitments**

36 Effects on *Microcystis* from implementation of Environmental Commitments under Alternative 5A
 37 would be the same as those described for Alternative 4A.

38 **NEPA Effects:** Based on the discussion for Impact WQ-33 in Section 8.3.4.2, the effects on *Microcystis*
 39 from implementing Environmental Commitments 3, 4, 6–12, 15, and 16 are determined to be not
 40 adverse.

41 **CEQA Conclusions:** Based on the discussion for Impact WQ-33 in Section 8.3.4.2, Environmental
 42 Commitments 3, 4, 6–12, 15, and 16 would not be expected to cause additional exceedance of
 43 applicable water quality objectives/criteria by frequency, magnitude, and geographic extent that
 44 would cause significant impacts on any beneficial uses of waters in the affected environment.

1 *Microcystis* and microcystins are not CWA Section 303(d) listed within the affected environment and
 2 thus any increases that could occur in some areas would not make any existing *Microcystis*
 3 impairment measurably worse because no such impairments currently exist. However, it is possible
 4 that increases in the frequency, magnitude, and geographic extent of *Microcystis* blooms in the Delta
 5 would occur at the early long-term for reasons unassociated with implementation of the
 6 Environmental Commitments, including tidal habitat restoration. Further, microcystin is
 7 bioaccumulative in the Delta foodweb (Lehman 2010). Thus, potential increases in *Microcystis*
 8 occurrences may lead to increased microcystin presence in the Delta relative to Existing Conditions.
 9 This has potential to cause microcystins to bioaccumulate to greater levels in aquatic organisms that
 10 would, in turn, pose health risks to fish, wildlife or humans. While long-term water quality
 11 degradation related to microcystins levels may occur and, thus, significant impacts on beneficial
 12 uses could occur, these impacts are not related to implementation of the Environmental
 13 Commitments. Therefore, the effects on *Microcystis* from implementing the Environmental
 14 Commitments are determined to be less than significant. No mitigation is required.

15 **Impact WQ-34: Effects on San Francisco Bay Water Quality Resulting from Facilities**
 16 **Operations and Maintenance and Environmental Commitments**

17 The effects analysis presented in the preceding impacts (Impact WQ-1 through WQ-33) concluded
 18 that Alternative 5A would have a less-than-significant impact/no adverse effect on the following
 19 constituents in the Delta:

- 20 • Boron
- 21 • Bromide
- 22 • Chloride
- 23 • DOC
- 24 • DO
- 25 • Pathogens
- 26 • Pesticides
- 27 • Trace metals
- 28 • Turbidity and TSS
- 29 • *Microcystis*

30 Elevated concentrations of boron are of concern in drinking and agricultural water supplies.
 31 Chloride, DOC, and bromide concentrations also are of concern in drinking water supplies. However,
 32 waters in the San Francisco Bay are not designated to support MUN and AGR beneficial uses.
 33 Changes in Delta DO, pathogens, pesticides, trace metals, and turbidity and TSS are not anticipated
 34 to be of a frequency, magnitude and geographic extent that would adversely affect any beneficial
 35 uses or substantially degrade the quality of the Delta. Changes in *Microcystis* would be primarily due
 36 to factors unassociated with the project alternative. Thus, changes in boron, bromide, chloride, DOC,
 37 DO, pathogens, pesticides, trace metals, turbidity and TSS, and *Microcystis* in Delta outflow
 38 associated with implementation of Alternative 5A, relative to Existing Conditions and the No Action
 39 Alternative (ELT and LLT) are not anticipated to be of a frequency, magnitude and geographic extent
 40 that would adversely affect any beneficial uses or substantially degrade the quality of the of San
 41 Francisco Bay, as described for Alternative 4 (see Section 8.3.3.9).

1 Elevated EC is of concern for its effects on the AGR beneficial use and fish and wildlife beneficial
2 uses. San Francisco Bay does not have an AGR beneficial use designation. As described for
3 Alternative 4, salinity throughout San Francisco Bay is largely a function of the tides, as well as to
4 some extent the freshwater inflow from upstream. However, the changes in Delta outflow due to
5 Alternative 5A, relative to Existing Conditions and the No Action Alternative (ELT and LLT), would
6 be minor compared to tidal flows, and thus no substantial adverse effects on salinity, or fish and
7 wildlife beneficial uses, downstream of the Delta are expected.

8 Also, as described for Alternative 4, changes in nutrient loading would not be expected to contribute
9 to adverse effects to beneficial uses. Changes in nitrogen (ammonia and nitrate) loading to Suisun
10 and San Pablo Bays under Alternative 5A, relative to Existing Conditions and the No Action
11 Alternative (ELT and LLT), would not adversely impact primary productivity in these embayments
12 because light limitation and grazing currently limit algal production in these embayments. Nutrient
13 levels and ratios are not considered a direct driver of *Microcystis* and cyanobacteria levels in the
14 North Bay. The only postulated effect of changes in phosphorus loads to Suisun and San Pablo Bays
15 is related to the influence of nutrient stoichiometry on primary productivity. However, there is
16 uncertainty regarding the impact of nutrient ratios on phytoplankton community composition and
17 abundance. As described for Alternative 4, any effect on phytoplankton community composition
18 would likely be small compared to the effects of grazing from introduced clams and zooplankton in
19 the estuary. Therefore, changes in total nitrogen and phosphorus loading that would occur in Delta
20 outflow to San Francisco Bay, relative to Existing Conditions and the No Action Alternative (ELT and
21 LLT), shown in Appendix 80, *San Francisco Bay Analysis*, Table 80-1, are not expected to result in
22 degradation of water quality with regard to nutrients that would result in adverse effects to
23 beneficial uses.

24 Similar to Alternative 4, loads of mercury and methylmercury from the Delta to San Francisco Bay
25 are estimated to change relatively little due to changes in source water fractions and net Delta
26 outflow that would occur under Alternative 5A, relative to Existing Conditions and the No Action
27 Alternative (ELT and LLT) (Appendix 80, *San Francisco Bay Analysis*, Tables 80-2). Also, there would
28 be no incremental increase in dissolved selenium concentrations in the North Bay, relative to
29 Existing Conditions under this alternative (Appendix 80, Table 80-3).

30 **NEPA Effects:** Based on the discussion above, Alternative 5A, relative to the No Action Alternative
31 (ELT and LLT), would not cause further degradation to water quality with respect to boron,
32 bromide, chloride, DO, DOC, EC, mercury, pathogens, pesticides, selenium, nutrients (ammonia,
33 nitrate, phosphorus), trace metals, turbidity and TSS, or *Microcystis* in the San Francisco Bay.
34 Further, changes in these constituent concentrations in Delta outflow would not be expected to
35 cause changes in Bay concentrations of frequency, magnitude, and geographic extent that would
36 adversely affect any beneficial uses. In summary, effects on the San Francisco Bay from
37 implementation of water conveyance facilities and Environmental Commitments 3, 4, 6-12, 15, and
38 16 are considered to be not adverse.

39 **CEQA Conclusion:** As with Alternative 4, Alternative 5A would not be expected to cause long-term
40 degradation of water quality in San Francisco Bay resulting in sufficient use of available assimilative
41 capacity such that occasionally exceeding water quality objectives/criteria would be likely and
42 would result in substantially increased risk for adverse effects to one or more beneficial uses.
43 Further, this alternative would not be expected to cause additional exceedance of applicable water
44 quality objectives/criteria in the San Francisco Bay by frequency, magnitude, and geographic extent
45 that would cause significant impacts on any beneficial uses of waters in the affected environment.

1 Any changes in boron, bromide, chloride, and DOC in the San Francisco Bay would not adversely
2 affect beneficial uses, because the uses most affected by changes in these parameters, MUN and AGR,
3 are not beneficial uses of the Bay. Further, no substantial changes in DO, pathogens, pesticides, trace
4 metals, turbidity or TSS, and *Microcystis* are anticipated in the Delta due to the implementation of
5 Alternative 5A, relative to Existing Conditions, therefore, no substantial changes to these
6 constituents levels in the Bay are anticipated. Changes in Delta salinity would not contribute to
7 measurable changes in Bay salinity, as the change in Delta outflow would be two to three orders of
8 magnitude lower than (and thus minimal compared to) the Bay's tidal flow and thus, have minimal
9 influence on salinity changes. Changes in nutrient load, relative to Existing Conditions, are expected
10 to have minimal effect on water quality degradation, primary productivity, or phytoplankton
11 community composition. As with Alternative 4, the change in mercury and methylmercury load
12 (which is based on source water and Delta outflow), relative to Existing Conditions, would be within
13 the level of uncertainty in the mass load estimate and not expected to contribute to water quality
14 degradation, make the CWA Section 303(d) mercury impairment measurably worse or cause
15 mercury/methylmercury to bioaccumulate to greater levels in aquatic organisms that would, in
16 turn, pose substantial health risks to fish, wildlife, or humans. Similarly, based on Alternative 4
17 estimates, the increase in selenium load would be minimal, and total and dissolved selenium
18 concentrations would be expected to be the same as Existing Conditions, and less than the target
19 associated with white sturgeon whole-body fish tissue levels for the North Bay. Thus, the change in
20 selenium load is not expected to contribute to water quality degradation, or make the CWA Section
21 303(d) selenium impairment measurably worse or cause selenium to bioaccumulate to greater
22 levels in aquatic organisms that would, in turn, pose substantial health risks to fish, wildlife, or
23 humans. Based on these findings, this impact is considered to be less than significant. No mitigation
24 is required.

25 **8.3.5 Cumulative Analysis**

26 The cumulative effects analysis for water quality considers past, present, and reasonably
27 foreseeable projects or programs in combination with the effects of the project alternatives. This
28 assessment discusses only water quality constituents which could be affected, in part, from
29 construction and implementation of the project alternatives. Constituents or constituent groups
30 which could not be affected by the project alternatives are identified and addressed in the water
31 quality Screening Analysis presented in Appendix 8C. The majority of the constituents assessed in
32 the Screening Analysis have not been detected in the major source waters to the Delta, and others
33 that have been detected have generally not exceeded water quality objectives/criteria or would not
34 be affected by construction and implementation of the project alternatives. Consequently, they are
35 not specifically addressed in this cumulative assessment. For a discussion of cumulative effects
36 related to water temperature, see Chapter 11, *Fish and Aquatic Resources*.

1 **Table 8-76. Effects on Water Quality from the Programs, Projects, and Policies Considered for**
 2 **Cumulative Analysis**

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
Regulatory-, Discharge-, and Source Control-Related Actions				
Sacramento Regional County Sanitation District	SRWTP Facility Upgrade Project (EchoWater Project)	Final Environmental Impact Report certified September 2014; construction has been initiated	Upgrade existing secondary treatment facilities to advanced unit processes including improved nitrification/denitrification and filtration.	Reduced discharge concentration and mass of many constituents in wastewater to Sacramento River.
Sacramento County, Sacramento, Citrus Heights, Elk Grove, Folsom, Galt, and Rancho Cordova	Sacramento Stormwater Quality Partnership	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to Sacramento River.
San Joaquin County, Stockton, Tracy, and the State Water Resources Control Board	San Joaquin County, Stockton, and Tracy Stormwater Management Programs	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to San Joaquin River.
Yolo County, Public Works Division	Yolo County Stormwater Management Program	Ongoing and future actions	Development and implementation of federal stormwater compliance programs	Reduced discharge concentration and mass of many constituents in stormwater to Yolo Bypass.
Central Valley Water Board	Irrigated Lands Regulatory Program	Ongoing and future actions	Prevent agricultural discharges from impairing the waters that receive runoff.	Reduced discharge concentration and mass of many constituents in agricultural drainage to the Delta and tributaries.
Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Grassland Bypass Project, 2010-2019	Ongoing and future actions	Agricultural drainage management actions to reduce selenium discharges.	Goal is regulatory compliance for reduced selenium discharges to San Joaquin River.
Bureau of Reclamation and San Luis & Delta Mendota Water Authority	Agricultural Drainage Selenium Management Program Plan	Ongoing and future actions	Agricultural drainage management actions to reduce selenium discharges.	Goal is regulatory compliance for reduced selenium discharges to San Joaquin River.
California Department of Water Resources and Bureau of Reclamation	Franks Tract Project	Proposed	Proposed operable gates to control channel flows at key locations to reduce sea water intrusion.	Goal is reduced western Delta salinity.
Central Valley Water Board	Sacramento-San Joaquin Delta Estuary TMDL for Methylmercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
Central Valley Water Board	Total Maximum Daily Load for Selenium in the Lower San Joaquin River	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of selenium.
Central Valley Water Board	San Joaquin River Selenium TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of selenium.
Central Valley Water Board	Central Valley Pesticide TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pesticides.
Central Valley Water Board	Salt and Boron TMDL for the Lower San Joaquin River	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of salts and boron.
Central Valley Water Board	Cache Creek, Bear Creek, Sulphur Creek, and Harley Gulch TMDL for Mercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	Clear Lake Mercury TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	American River TMDL for Methylmercury	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of mercury and methylmercury formation.
Central Valley Water Board	Central Valley Organochlorine Pesticide TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of legacy organochlorine pesticides.
Central Valley Water Board	Central Valley Diuron TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of diuron pesticide.
Central Valley Water Board	Central Valley Pyrethroid Pesticides TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pyrethroid pesticides.
Central Valley Water Board	Stockton Urban Waterbodies Pathogen TMDL	Ongoing and future actions	Regulatory and implementation actions to achieve compliance with water quality objectives.	Goal is reduced source loading of pathogens in urban stormwater runoff.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Water Resources	Biological Opinion on the Long-Term Operations of the Central Valley Project and State Water Project (Delta smelt)	Ongoing and future actions	Regulatory program and actions for CVP/SWP water supply operations for recovery of Delta smelt population. Actions include habitat, flow, and water quality management.	Actions may affect seasonal and long-term Delta water quality conditions.
U.S. Department of Commerce, National Marine Fisheries Service, Bureau of Reclamation, and California Department of Water Resources	Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project	Ongoing and future actions	Regulatory program and actions for CVP/SWP water supply operations for recovery of special-status anadromous fish. Actions include habitat, flow, and water quality management.	Actions may affect seasonal and long-term Delta water quality conditions.
Restoration Actions				
California Department of Fish and Wildlife	Ecosystem Restoration Program Conservation Strategy		Actions to address the critical environmental conditions in the Delta and Suisun Marsh/Bay including Delta flows and habitat restoration.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Fish and Wildlife, U.S. Fish and Wildlife Service, Bureau of Reclamation, and Suisun Marsh Charter Group	Suisun Marsh Habitat Management, Preservation, and Restoration Plan	Ongoing	Seasonal wetland and tidal marsh restoration actions in Suisun Marsh.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Final Environmental Impact Report, September 2014	Seasonal wetland and tidal marsh restoration actions in western Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
California Department of Water Resources and Department of Fish and Wildlife	Cache Slough Area Restoration	Ongoing and future actions	Enhancement and restoration of existing and potential open water, marsh, floodplain and riparian habitat in northern Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.
Reclamation District 2093	Liberty Island Conservation Bank	Future	Tidal marsh restoration project in northern Delta.	Changes in tidal prism and salinity patterns; potential incremental increase methylmercury formation and contribution to Delta load.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Quality
California Department of Water Resources	California Water Action Plan	Initiated in January 2014	This plan lays out a roadmap for the next 5 years for actions that would fulfill 10 key themes. In addition, the plan describes certain specific actions and projects that call for improved water management throughout the state.	Actions implemented may affect seasonal and long-term Delta water quality conditions.
Delta Conservancy	California EcoRestore	Initiated in 2015	This program will accelerate and implement a suite of Delta restoration actions for up to 30,000 acres of fish and wildlife habitat by 2020.	Potential for effects on water quality at various Delta locations related to changes in hydrodynamics near restoration actions.

1

2 **8.3.5.1 Cumulative Effects of the No Action Alternative**

3 Water quality conditions upstream of the Delta, in the Delta Region, and in the SWP/CVP export
4 service areas of the affected environment are expected to change as a result of past, present, and
5 reasonably foreseeable future projects, population growth, climate change, and changes in water
6 quality regulations (e.g., completion of TMDLs, adoption of new or more restrictive
7 criteria/objectives). Many past, present, and reasonably foreseeable future projects are identified
8 and described in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*
9 *Alternative, and Cumulative Impact Conditions*, and specific projects or regulatory programs that are
10 either ongoing or proposed for future implementation, and thus, could affect future cumulative
11 water quality conditions, are listed in Table 8-76. The combined water quality effects of projects
12 considered in the cumulative condition will vary, including potential contribution to the degradation
13 of various water quality parameters, whereas others will function to improve constituent-specific
14 water quality in certain areas. Future population growth may produce increased constituent
15 loadings to the water bodies of the affected environment through increased urban stormwater
16 runoff, increased POTW discharges, and changes in land uses. Climate change is anticipated to cause
17 salinity increases in the western and southern Delta due to sea level rise. This is evidenced by the
18 increase in violations of the Bay-Delta WQCP electrical conductivity objective in the Sacramento
19 River at Emmatton under the No Action Alternative, relative to Existing Conditions, as described in
20 Section 8.3.3.1. Conversely, changes in water quality regulations generally are in a direction that will
21 result in improvements in water quality (e.g., increased monitoring and restrictions on urban
22 stormwater runoff, completion of TMDLs to lessen or eliminate existing beneficial use impairments
23 through improved water quality, more restrictive regulations on POTW discharges, new and/or
24 more restrictive water quality criteria/objectives in Basin Plans).

25 Some water quality constituents are at levels under Existing Conditions that cause some impact to
26 beneficial uses. These include:

- 27 ● Bromide
- 28 ● Chloride

- 1 • Electrical Conductivity
- 2 • Mercury
- 3 • Organic Carbon
- 4 • Pesticides and Herbicides
- 5 • Selenium

6 Under the cumulative No Action Alternative, even with consideration of the factors that will affect
 7 water quality discussed above, these constituents are expected to remain at levels that will cause
 8 some impact to beneficial uses. In addition, the frequency, magnitude, and geographic extent of
 9 *Microcystis* blooms in Delta waters may increase in the future as Delta water temperatures increase
 10 due to climate change. Thus, for the purposes of NEPA, water quality conditions for the constituents
 11 listed above, and possibly for *Microcystis* blooms in Delta waters as well, under the cumulative No
 12 Action Alternative constitute an adverse environmental condition. The cumulative effect of the No
 13 Action Alternative for all other water quality constituents is not adverse.

14 Although the constituents listed above are at levels under Existing Conditions that cause some
 15 impact to beneficial uses, the only constituents for which the cumulative effects of the No Action
 16 Alternative are expected to adversely affect beneficial uses, relative to Existing Conditions, are
 17 electrical conductivity, chloride, and possibly *Microcystis* blooms in Delta waters, due to the effects
 18 of climate change and sea level rise. Thus, for the purposes of CEQA, water quality conditions for
 19 electrical conductivity chloride, and *Microcystis* blooms in Delta waters under the cumulative No
 20 Action Alternative constitute a significant environmental condition. The cumulative effect of the No
 21 Action Alternative for all other water quality constituents is less than significant, relative to Existing
 22 Conditions.

23 **8.3.5.2 Concurrent Project Effects**

24 The constituent assessments of the BDCP alternatives evaluated the effects of the water conveyance
 25 facilities, plus the hydrodynamic effects of CM2 and CM4, separately from the effects of CM2–CM21.
 26 Similarly, the constituent assessments for Alternatives 4A, 2D, and 5A evaluated the effects of the
 27 water conveyance facilities separately from the effects of the Environmental Commitments. This
 28 section discusses the potential for the concurrent implementation of the water conveyance facilities
 29 with the other conservation measures/Environmental Commitments under the action alternatives
 30 to result in more substantial effects to water quality than identified in the separate constituent
 31 assessments of these project components. This discussion is organized according to the geographic
 32 regions of the affected environment—Upstream of Delta, Delta Region, SWP/CVP Export Service
 33 Areas—because implementation of the project components differs in these areas. For the SWP/CVP
 34 Export Service Areas region of the affected environment (e.g., south of Delta and North Bay
 35 Aqueduct) the discussion of concurrent water quality effects is based on water quality changes in
 36 the Delta at the export pumping plants, because no conservation measures/Environmental
 37 Commitments would be implemented in this portion of the affected environment.

38 ***Upstream of the Delta***

39 *BDCP Alternatives*

40 In areas upstream of the Delta, the conservation measures or components of these measures that
 41 would be implemented in addition to the water conveyance facilities would be: 1) *CM2 Yolo Bypass*

1 *Fisheries Enhancement, 2) CM18 Conservation Hatcheries, and 3) CM19 Urban Stormwater Treatment.*
 2 CM2 is not expected to alter water quality in the Sacramento River, as the measure is primarily to
 3 improve fish habitat through modifications to Fremont Weir to increase the frequency, duration and
 4 magnitude of floodplain inundation in the bypass. CM18 involves the operation of a new fish
 5 hatchery, discharges from which would be required to meet NPDES permit requirements to protect
 6 water quality and beneficial uses. CM19 may involve actions to improve stormwater quality coming
 7 from urban areas outside the Delta, but that drain to Delta waters, and would result in either no
 8 effect or beneficial effects on water quality upstream of the Delta. All other conservation measures
 9 would be implemented in the Delta region. Maintenance activities associated with the physical
 10 structures would not result in substantial, adverse effects on water quality. Consequently, the
 11 concurrent implementation of the water conveyance facilities and restoration activities under the
 12 BDCP alternatives would not result in new, more adverse effects/significant impacts to water
 13 quality beyond those described in the separate impact assessments for these alternatives.

14 *Alternatives 4A, 2D, and 5A*

15 None of the conservation measures discussed for the BDCP alternatives for the upstream of Delta
 16 region would be implemented as components of Alternatives 4A, 2D, and 5A, and no Environmental
 17 Commitments would be implemented in this region. Consequently, the concurrent implementation
 18 of the water conveyance facilities and Environmental Commitments under Alternatives 4A, 2D, and
 19 5A would not result in new, more adverse effects/significant impacts on water quality beyond those
 20 described in the separate impact assessments for these alternatives.

21 ***Delta and SWP/CVP Export Service Areas***

22 *BDCP Alternatives*

23 The water quality assessment for the Delta region concluded that the separate impacts of the water
 24 conveyance facilities and CM2–CM21 under the BDCP alternatives would not be adverse/would be
 25 less than significant for ammonia, boron, DO, nitrate+nitrite, pathogens, phosphorus, trace metals,
 26 and turbidity/TSS. For water quality conditions of these constituents to be adverse/ significant
 27 under the concurrent implementation of the water conveyance facilities and CM2–CM21 would
 28 require that CM2–C21 implementation contribute additional loading of these constituents or
 29 otherwise alter conditions beyond the hydrodynamic effects of the water conveyance facilities to
 30 result in adverse conditions. However, when considered concurrently, CM1–CM21 are not expected
 31 to result in new, previously unidentified adverse/significant impacts, relative to the individual
 32 impact determinations, for the reasons provided below.

- 33 ● **Ammonia:** Ammonia concentrations under the water conveyance facilities will be lower in the
 34 Delta due to lower Sacramento River concentrations resulting from a separate project being
 35 implemented by the Sacramento Regional County Sanitation District, which will result
 36 substantially reduced ammonia discharges from the Sacramento Regional Wastewater
 37 Treatment Plant. CM2–CM21 are not expected to substantially alter ammonia concentrations in
 38 the affected environment. Thus, concurrent implementation of CM1–CM21 would not result in
 39 adverse ammonia conditions.
- 40 ● **Boron and Trace Metals:** CM2–CM21 would not present new or substantially changed sources
 41 of boron or trace metals in the Delta. Thus, their concurrent implementation with CM1 would
 42 not result in adverse boron and trace metals conditions.

- 1 • **DO:** DO conditions under the water conveyance facilities are expected to be similar to Existing
2 Conditions, and CM2–CM21 are not expected to contribute oxygen-demanding substances at
3 levels that would adversely affect DO levels. Further, CM14 would contribute to improving DO
4 conditions in the Stockton Deep Water Channel. Thus, concurrent implementation of CM1–CM21
5 would not result in adverse DO conditions.
- 6 • **Nitrate+nitrite:** Long-term average nitrate+nitrite concentrations are anticipated to remain
7 low with implementation of the water conveyance facilities. CM2–CM21 would not present new
8 or substantially changed sources of nitrate+nitrite in the Delta. Conversely, it is expected there
9 may be a decrease in nitrate+nitrite concentrations as lands used for agriculture are converted
10 for restoration, thus reducing fertilizer application on these lands. Thus, their concurrent
11 implementation with the water conveyance facilities would not result in adverse nitrate+nitrite
12 conditions.
- 13 • **Pathogens:** Pathogens conditions under the water conveyance facilities are expected to be
14 similar to Existing Conditions. Thus, its concurrent implementation with the restoration
15 activities would not make pathogens conditions adverse.
- 16 • **Phosphorus:** The water conveyance facilities are not expected to substantially change
17 phosphorus concentrations, because concentrations in Delta source water are similar
18 throughout the year. The restoration activities are not anticipated to contribute additional
19 phosphorus load. Thus, concurrent implementation of the water conveyance facilities with the
20 restoration activities would not result in adverse phosphorus conditions.
- 21 • **Turbidity/TSS:** Turbidity/TSS conditions under the water conveyance facilities are expected to
22 be similar to Existing Conditions. Thus, its concurrent implementation with the restoration
23 activities would not make turbidity/TSS conditions adverse.

24 The assessment of bromide, chloride, and EC conditions in the Delta concluded that CM1 plus the
25 hydrodynamic effects associated with CM2 and CM4 under the BDCP alternatives would result in an
26 adverse effect/significant and unavoidable impact, to varying degrees. Implementation of CM2–
27 CM21 would not present new or substantially changed sources of these constituents in the Delta
28 beyond the effects on hydrodynamics. Thus, their concurrent implementation with CM1 would not
29 result in more adverse/significant bromide, chloride, and EC conditions than has been described for
30 the separate conservation measures.

31 The assessment of dissolved organic carbon (DOC) conditions in the Delta concluded that
32 implementation of CM1 of Alternatives 1A–3, 4, or 5 would not result in an adverse effect/significant
33 impact, whereas, implementation of CM2–CM21 under these alternatives would result in an
34 adverse/significant and unavoidable impact associated with the creation of the restoration areas.
35 Concurrent implementation of CM1 with CM2–CM21 under Alternatives 1A–3, 4, or 5 is not expected
36 to result in more adverse/significant impacts than described for the separate conservation
37 measures, because the long-term average DOC increases resulting from CM1 would be
38 comparatively small and within the uncertainty in the contributions that would result from the
39 restorations areas. Conversely, the assessment of CM1 under Alternatives 6A–9 concluded
40 significant and unavoidable impacts for DOC. The adverse/significant conditions under CM1
41 concurrent with the conditions anticipated for CM2–CM21 may be more adverse/significant than
42 when considered separately, particularly because the projected long-term average DOC increases
43 under CM1 would be a measurable, additive contribution.

1 The assessment of pesticide conditions in the Delta concluded that implementation of CM1 under
2 Alternatives 1A–3, 4, or 5 would not result in an adverse effect/significant impact, whereas
3 Alternatives 6A–9 would result in significant and unavoidable impacts for pesticides, because of
4 potential adverse increases at Franks Tract, Rock Slough, and Contra Costa Pumping Plant No. 1. The
5 assessment of CM2–CM21, for all alternatives, identified an adverse/significant and unavoidable
6 impact associated with *CM13 Invasive Aquatic Vegetation Control*. However, concurrent
7 implementation of CM1 with CM2–CM21, under all BDCP alternatives, is not expected to result in
8 more adverse/significant impacts than described for the separate conservation measures, because
9 the effects of CM13 would primarily occur in the vicinity of pesticide application, and mitigation is
10 proposed to apply pesticides in a manner that minimizes the risk to human health, non-target
11 organisms, and the aquatic ecosystem.

12 The assessment of mercury conditions in the Delta concluded that implementation of CM1 under
13 Alternatives 1A–3, 4, or 5 would not result in an adverse effect/significant impact, whereas,
14 implementation of CM2–CM21 under these alternatives would result in an adverse/significant and
15 unavoidable impact associated with the creation of the restoration areas. Concurrent
16 implementation of CM1 with CM2–CM21 under Alternatives 1A–3, 4, or 5 is not expected to result in
17 more adverse/significant impacts than described for the separate conservation measures, because
18 the mercury conditions in water and fish resulting from CM1 would be similar to Existing
19 Conditions. Conversely, the assessment of CM1 under Alternatives 6A–9 concluded significant and
20 unavoidable impacts for mercury. The adverse/significant conditions under CM1 concurrent with
21 the conditions anticipated for CM2–CM21 may be more adverse/significant than when considered
22 separately, particularly because of the bioaccumulative properties of mercury and because the Delta
23 is already impaired due to elevated mercury.

24 The assessment of selenium conditions in the Delta concluded that implementation of CM1 under
25 Alternatives 1A–3, 4, or 5 would not result in an adverse effect/significant impact, whereas
26 conditions under Alternatives 6A–9 would be adverse/significant and unavoidable. Selenium
27 conditions resulting from implementation of CM2–CM21 under all BDCP alternatives were
28 determined to not be adverse/less than significant. Of concern for selenium is increased exposure of
29 aquatic organisms through increased water residence time and selenium concentrations. However,
30 the impact assessment concluded that CM2–CM21 would not contribute substantially to these
31 conditions, because factors would also be in place to minimize selenium exposure, including TMDLs
32 to reduce loading to the system, wetland design to prevent buildup of selenium in restoration areas,
33 and implementation of *AMM27 Selenium Management* (see Appendix 3.C, *Avoidance and*
34 *Minimization Measures*, of the BDCP). Thus, concurrent implementation of CM1 and CM2–CM21 is
35 not anticipated to result in more adverse/significant impacts than has been described for the
36 separate conservation measures.

37 The assessment of *Microcystis* conditions in the Delta concluded that CM1 plus the hydrodynamic
38 effects associated with CM2 and CM4 under the BDCP alternatives would result in an adverse
39 effect/significant impact. Effects of CM2–CM21, beyond the increase in residence time and localized
40 water temperature described in the separate impacts assessments, would not present new,
41 previously unidentified impacts. Thus, concurrent implementation of CM1–CM21 would not result in
42 more adverse/significant *Microcystis* conditions than has been described for the separate
43 conservation measures.

1 *Alternatives 4A, 2D, and 5A*

2 The water quality assessment for the Delta region concluded that the separate impacts of the water
 3 conveyance facilities and Environmental Commitments under Alternatives 4A, 2D, and 5A would not
 4 be adverse/would be less than significant for ammonia, boron, bromide, chloride, DO,
 5 nitrate+nitrite, dissolved organic carbon, pathogens, pesticides, phosphorus, selenium, trace metals,
 6 turbidity/TSS, and *Microcystis*. For water quality conditions of these constituents to be adverse/
 7 significant under the concurrent implementation of the water conveyance facilities and
 8 Environmental Commitments would require that the Environmental Commitments implementation
 9 contribute additional loading of these constituents or otherwise alter conditions beyond the
 10 hydrodynamic effects of the water conveyance facilities to result in adverse conditions. However,
 11 when considered concurrently, the water conveyance facilities and Environmental Commitments
 12 are not expected to result in new, previously unidentified adverse/significant impacts, relative to
 13 the individual impact determinations.

14 As described above for the BDCP alternatives, ammonia concentrations under the non-HCP
 15 alternatives' water conveyance facilities would be lower in the Delta, and the Environmental
 16 Commitments are not expected to substantially alter ammonia concentrations in the affected
 17 environment. Thus, concurrent implementation of the water conveyance facilities and
 18 Environmental Commitments would not result in adverse ammonia conditions.

19 Similarly, the Environmental Commitments would not present new or substantially changed sources
 20 of boron, bromide, chloride, DO-consuming substances, nitrate+nitrite, pathogens, pesticides,
 21 phosphorus, trace metals, or turbidity/TSS in the Delta. Thus, their concurrent implementation with
 22 water conveyance facilities would not result in adverse conditions for these constituents.

23 The assessment of EC conditions in the Delta concluded that water conveyance facilities under
 24 Alternatives 4A, 2D, and 5A would result in not adverse/less than significant impacts with
 25 implementation of identified mitigation measures. Implementation of Environmental Commitments
 26 would not present new or substantially changed sources of salinity-related constituents in the Delta
 27 that would affect EC levels. Thus, their concurrent implementation with water conveyance facilities
 28 would not result in more adverse/significant EC conditions than has been described for the separate
 29 project components.

30 The assessment of mercury conditions in the Delta concluded that the water conveyance facilities
 31 under Alternatives 4A, 2D, and 5A would not result in an adverse effect/significant impact, whereas,
 32 implementation of Environmental Commitments under these alternatives would result in an
 33 adverse/significant and unavoidable impact associated with the creation of the restoration areas.
 34 Concurrent implementation of water conveyance facilities with the Environmental Commitments is
 35 not expected to result in more adverse/significant impacts than described for the separate project
 36 components, because the mercury conditions in water and fish resulting from water conveyance
 37 facilities would be similar to Existing Conditions.

38 **8.3.5.3 Cumulative Effects of the Action Alternatives**

39 When the effects of the action alternatives on water quality are considered in connection with the
 40 potential effects of past, present, and reasonably foreseeable projects or programs, the potential
 41 cumulative effects on water quality range from beneficial to potentially adverse, depending upon
 42 water quality constituent/parameter and location. This cumulative analysis thus follows the list
 43 approach outlined in CEQA guidelines 15130(b)(1), the list including the defined past, present, and

1 foreseeable actions in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*
2 *Alternative, and Cumulative Impact Conditions*, and in particular the future potential actions listed in
3 Table 8-76.

4 If the cumulative water quality condition (which includes implementation of the action alternative
5 along with past, present, and reasonably foreseeable future projects, population growth, climate
6 change, and changes in water quality regulations) for a constituent or group of constituents within a
7 defined region of the affected environment is determined not to be adverse for the purposes of
8 NEPA compliance (or less than significant under CEQA), then no further assessment is conducted.
9 No further assessment is conducted because a cumulative condition that is non-adverse (NEPA
10 terminology) or less than significant (CEQA terminology) demonstrates that the action alternative
11 would not have adverse effects that are individually minor but that would “cumulate” or “be
12 additive” with those of other past, present, and reasonably foreseeable projects to result in an
13 adverse (significant) cumulative effect.

14 Conversely, if the cumulative water quality condition for a particular constituent is determined to be
15 adverse for NEPA purposes or significant for CEQA purposes, then further assessment is conducted.
16 For compliance with State CEQA Guidelines Section 15130, further assessment is provided to
17 determine if implementation of the action alternatives would contribute considerably to that
18 significantly impacted cumulative condition. If implementation of an action alternative would not
19 contribute considerably to the significantly impacted cumulative water quality condition identified,
20 then no further mitigation is required. However, if implementation of an action alternative would
21 contribute considerably to the adverse (significant) cumulative water quality condition identified,
22 then mitigation for the action alternative’s cumulatively considerable contribution to the identified
23 adverse (significant) cumulative water quality condition is proposed (if any is at least potentially
24 feasible). For the purposes of NEPA compliance, the context and intensity of the potential action
25 alternative-related contribution to any adverse (significant) cumulative condition is evaluated and
26 mitigation measures are identified that would reduce or minimize the action alternative’s
27 contribution to the cumulative impact.

28 The potential for cumulative impacts on water quality for the action alternatives is assessed for:
29 1) construction-related activities, 2) water conveyance facilities operations and maintenance, and
30 3) implementation of conservation measures/Environmental Commitments for the same geographic
31 scope (Affected Environment) as done for individual action alternatives analyses. Each action
32 alternative is assessed for each of these three impact assessment categories. Effects are specifically
33 discussed by region of the affected environment (i.e., Upstream of the Delta, Delta Region, and
34 SWP/CVP Export Service Areas) and by constituent or constituent groups. Individual discussions for
35 specific action alternatives are provided only if the anticipated effects under one or more action
36 alternatives can be meaningfully distinguished from the effects anticipated under other alternatives.
37 If the contributions of the various action alternatives to a cumulative condition cannot be readily
38 distinguished from one another, then a single assessment that addresses all action alternatives is
39 provided.

1 **Cumulative Impact WQ-1: Cumulative Impacts on Water Quality Resulting from Construction-** 2 **Related Activities**

3 ***Upstream of the Delta***

4 *BDCP Alternatives*

5 Construction activities upstream of the Delta would be tied to conservation measures for the BDCP
6 alternatives. Conservation measures or components of these measures that would be constructed in
7 areas upstream of the Delta would be: 1) *CM2 Yolo Bypass Fisheries Enhancement* (i.e., the Fremont
8 Weir component of the action), 2) *CM18 Conservation Hatcheries* (i.e., the new hatchery facility), and
9 3) *CM19 Urban Stormwater Treatment*. Neither the construction to be undertaken nor the
10 techniques and conservation measures to be employed upstream of the Delta would differ
11 sufficiently among alternatives to warrant separate alternative-specific discussions here. Hence, the
12 BDCP alternatives are discussed collectively in this cumulative assessment. Construction of
13 individual components necessitated by CM2, CM18, and CM19 could involve site preparation and
14 earthwork adjacent to water bodies of the affected environment. If so, their construction also would
15 include water quality protection actions in the form of environmental commitments (see Appendix
16 3B, *Environmental Commitments, AMMs, and CMs*) and related water quality protection actions
17 issued in agency permits required for construction and operation of facilities. Such actions would
18 include SWPPPs that would minimize erosion of soils into water bodies and would
19 minimize/eliminate the direct spilling of earthmoving equipment fuels, oils, and other construction
20 materials into water bodies, thus minimizing any effects on water quality in adjacent water bodies.
21 Other water quality protection actions issued in agency permits would include those in the State
22 Water Board's NPDES Stormwater General Permit for Stormwater Discharges Associated with
23 Construction and Land Disturbance Activities (Order No. 2009-0009-DWQ/NPDES Permit No.
24 CAS000002), project-specific WDRs or CWA Section 401 water quality certification from the
25 appropriate Central Valley Water Board, CDFW Streambed Alteration Agreements, and USACE CWA
26 Section 404 dredge and fill permits. Thus, construction activities associated with the BDCP
27 Alternatives would not contribute considerably to any adverse (significant) cumulative water
28 quality condition upstream of the Delta, nor would construction-related effects make an otherwise
29 non-adverse (significant) cumulative water quality condition adverse in this region.

30 *Alternatives 4A, 2D, and 5A*

31 Alternatives 4A, 2D, and 5A do not include related Environmental Commitments in the upstream of
32 Delta region; thus, the construction-related effects described above for the BDCP alternatives do not
33 apply to these alternatives.

34 ***Delta***

35 The construction of new conveyance facilities under all action alternatives, and construction
36 associated with implementing restoration actions, particularly CM2–CM10 under the BDCP
37 alternatives (Environmental Commitments 3, 4, 6, 7, and 9–10 under Alternatives 4A, 2D, and 5A),
38 could result in elevated turbidity/TSS in surface waters adjacent to construction activities due to the
39 erosion of disturbed soils and associated sedimentation entering Delta waterways or other
40 construction-related wastes (e.g., concrete, asphalt, cleaning agents, paint, and trash). In addition,
41 the use of heavy earthmoving equipment adjacent to Delta waterways may result in spills and
42 leakage of oils, gasoline, diesel fuel, and related petroleum contaminants used in the fueling and
43 operation of such construction equipment. The extensive construction activities that will be

1 necessary to implement the new conveyance facilities, and CM4–CM10 under the BDCP alternatives
2 (Environmental Commitments 4, 6, 7, and 9–10 under Alternatives 4A, 2D, and 5A) would involve a
3 variety of land disturbances in the Delta including vegetation removal; grading and excavation of
4 soils; establishment of roads-bridges, staging, and storage areas; in-water sediment dredging and
5 dredge material storage; and hauling and placement or disposal of excavated soils and dredge
6 materials. Although the number of intakes to be constructed, pipeline alignments and other
7 construction aspects vary among the action alternatives, all action alternatives involve sufficient
8 construction activities that, if conducted improperly, could adversely affect Delta water quality.

9 Although action alternatives having greater number of intakes and greater construction activities
10 pose a greater overall potential to adversely affected water quality, adverse water quality effects for
11 all action alternatives will be avoided or reduced to less than substantial levels in the same manner,
12 which is by implementing proper conservation measures and obtaining and abiding by agency-
13 issued permits need for construction activities (e.g., State Water Board’s NPDES Stormwater General
14 Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities
15 (Order No. 2009-0009-DWQ/NPDES Permit No. CAS000002), possibly project-specific WDRs, CWA
16 Section 401 water quality certification from the appropriate Central Valley Water Board, CDFW
17 Streambed Alteration Agreements, and USACE CWA Section 404 dredge and fill permits). Because of
18 this commonality among alternatives regarding potential for construction-related water quality
19 effects, and the common means of avoiding or reducing such effects, all action alternatives are
20 assessed collectively rather than individually.

21 As described for all action alternatives in Sections 8.3.3 and 8.3.4, the implementation of
22 construction-related environmental commitments (Appendix 3B, *Environmental Commitments*,
23 *AMMs*, and *CMs*) and abiding by agency-issued permits need for construction activities will reduce
24 potential construction-related water quality impacts in the Delta to less-than-significant levels.
25 Moreover, the cumulative condition for turbidity/TSS and petroleum contaminants in Delta waters
26 are not expected to be adverse. This is due, in large part, to the implementation (or planned
27 implementation) of construction-related environmental commitments (Appendix 3B) and agency
28 permitted construction “best management practices” for construction of not only the selected action
29 alternative (including its conservation measures/Environmental Commitments), but also other past,
30 present, and reasonably foreseeable future projects. Because construction-related effects on all
31 water quality constituents/parameters would be minimized through environmental commitments
32 (Appendix 3B) and permitted construction “best management practices” in the agency-issued
33 permits discussed above, construction activities associated with the action alternatives would not
34 contribute considerably to any adverse (significant) cumulative water quality condition in the Delta,
35 nor would construction-related effects make an otherwise non-adverse (significant) cumulative
36 water quality condition adverse.

37 ***SWP/CVP Export Service Areas***

38 Because construction-related activities associated with the action alternatives are not expected to
39 contribute considerably to any adverse (significant) cumulative Delta water quality condition,
40 including conditions at the Banks and Jones pumping plants, which are the primary locations of
41 water export to the SWP/CVP Export Service Areas, the construction of these alternatives would not
42 contribute considerably to any adverse (significant) cumulative water quality condition in water
43 bodies located in the SWP/CVP Export Service Areas.

1 **NEPA Effects:** The action alternatives involve minimal construction elements upstream of the Delta
 2 and would include implementation of construction-related environmental commitments (Appendix
 3 3B, *Environmental Commitments, AMMs, and CMs*) that would mitigate any temporary construction-
 4 related effects on water quality. Thus their construction would not adversely affect any cumulative
 5 water quality constituent/parameter condition upstream of the Delta. Construction of conveyance
 6 facilities and conservation measures/Environmental Commitments for the action alternatives could
 7 potentially result in temporary water quality effects on Delta turbidity/TSS levels and petroleum
 8 contaminants. However, the cumulative condition for Delta turbidity/TSS and petroleum
 9 contaminants would not be adverse for several reasons. First, there is currently no adverse
 10 conditions for turbidity/TSS levels and petroleum contaminants in the Delta. Second,
 11 implementation of construction-related environmental commitments (Appendix 3B) for the action
 12 alternative to be implemented and use of related construction BMPs for other projects would reduce
 13 effects on these and other Delta water quality constituents/parameters. Third, because
 14 construction-related effects on water quality are temporary in nature, they tend not to be
 15 cumulative over time (i.e., construction effects on water quality are not permanent).

16 **CEQA Conclusion.** The temporary construction-related effects on water quality resulting from
 17 constructing the action alternatives, including conservation measures/Environmental
 18 Commitments, would not contribute considerably to any significant cumulative Delta water quality
 19 condition, nor would construction-related effects make an otherwise non-adverse cumulative Delta
 20 water quality condition for any constituent/parameter potentially significant. Because construction-
 21 related activities are not expected to contribute considerably to any significant cumulative Delta
 22 water quality condition, they also would not contribute considerably to any significant cumulative
 23 water quality condition in water bodies located in the SWP/CVP Export Service Areas. No mitigation
 24 is required.

25 **Cumulative Impact WQ-2: Cumulative Impacts on Water Quality Upstream of the Delta**
 26 **Resulting from Facilities Operations and Maintenance and Conservation Measures (or**
 27 **Environmental Commitments)**

28 Constituent loading from upstream watersheds and resultant concentrations/levels in the water
 29 bodies upstream of the Delta would remain unchanged, or would be negligibly affected, by
 30 implementation of facilities operations and maintenance under the action alternatives. Changes in
 31 seasonal reservoir storage levels and river flows from altered system-wide operations under the
 32 action alternatives would have negligible, if any, effects on water quality in the rivers and reservoirs
 33 upstream of the Delta. Consequently, facilities operations and maintenance under any of the action
 34 alternatives would not be expected to contribute considerably to any cumulative water quality
 35 condition within the affected environment, upstream of the Delta.

36 Conservation measures or components of these measures that would be implemented as part of the
 37 BDCP alternatives in areas upstream of the Delta would be: 1) *CM2 Yolo Bypass Fisheries*
 38 *Enhancement*, 2) *CM18 Conservation Hatcheries*, and 3) *CM19 Urban Stormwater Treatment*. CM2 is a
 39 fish enhancement measure and, thus, is not expected to alter water quality upstream of the Delta.
 40 (Note: Alternatives 4A, 2D, and 5A do not contain Environmental Commitments related to CM2,
 41 CM18, or CM19). CM18 involves the operation of a new fish hatchery, discharges from which would
 42 be required to meet NPDES permit requirements to protect water quality and beneficial uses. CM19
 43 may involve actions to improve stormwater quality coming from urban areas outside the Delta, but
 44 that drain to Delta waters, and would result in either no effect or beneficial effects on water quality
 45 upstream of the Delta. All other conservation measures would be implemented in the Delta region.

1 Maintenance activities associated with the physical structures would not result in substantial,
 2 adverse effects on water quality. Consequently, the implementation of CM2–CM21 is not expected to
 3 contribute considerably to any cumulative water quality condition within the affected environment,
 4 upstream of the Delta.

5 **NEPA Effects:** Implementation of the action alternatives facilities operations and maintenance, and
 6 their associated conservation measures/Environmental Commitments, would have negligible, if any,
 7 water quality effects on water bodies of the affected environment located upstream of the Delta. Any
 8 negligible effects that may occur would not contribute considerably to any adverse cumulative
 9 water quality condition in water bodies upstream of the Delta, nor would the action alternatives
 10 effects make an otherwise non-adverse cumulative water quality condition for any
 11 constituent/parameter adverse.

12 **CEQA Conclusion.** Because the potential effects of facilities operations and maintenance and
 13 associated conservation measures/Environmental Commitments on water quality upstream of the
 14 Delta would be minimal, implementation of the action alternatives would not contribute
 15 considerably to any significant cumulative water quality condition upstream of the Delta, No
 16 mitigation is required.

17 **Cumulative Impact WQ-3: Cumulative Impacts on Water Quality in the Delta and SWP/CVP**
 18 **Export Service Areas Resulting from Facilities Operations and Maintenance and Conservation**
 19 **Measures (or Environmental Commitments)**

20 When the effects of implementing any one of the action alternatives on water quality are considered
 21 (including the new conveyance facilities, fish screens, gates and other physical structures and their
 22 operations and maintenance activities) together with the potential effects of projects listed in
 23 Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and*
 24 *Cumulative Impact Conditions*, and Table 8-76, the cumulative water quality condition in the Delta
 25 Region and SWP/CVP Export Service Areas for the following constituents is considered to not be
 26 adverse. Additional discussion for these water quality constituents is provided below.

- 27 ● Ammonia
- 28 ● Boron
- 29 ● DO
- 30 ● Nitrate + Nitrite
- 31 ● Pathogens
- 32 ● Phosphorus
- 33 ● Trace metals
- 34 ● Turbidity/TSS

35 **Ammonia**

36 Ammonia levels are not expected to be adverse under the cumulative condition as a result of the
 37 Sacramento Regional Wastewater Treatment Plant, and other publicly owned treatment works
 38 (POTWs) that discharge to the Delta, nitrifying their effluent that is discharged to Delta tributaries
 39 and waters.

1 **Boron**

2 The lower San Joaquin River is listed on the State's CWA Section 303(d) list of impaired water
3 bodies for salt and boron (State Water Resources Control Board 2011). Boron is paired with salt in
4 this listing due to its regular association with saline waters. The Central Valley Water Board has
5 prepared a TMDL with an implementation program where it is expected that actions taken to
6 control salts also will control boron as well (Central Valley Water Board 2004). With regulatory
7 actions being taken to improve boron concentrations (and salinity in general on the San Joaquin
8 River), the cumulative condition for boron is considered to not be adverse.

9 **Dissolved Oxygen**

10 DO throughout the Delta is generally suitable for beneficial use protection, with the notable
11 exception of the Stockton Deep Water Ship Channel. The TMDL for DO and related actions (e.g.,
12 Stockton Deep Water Ship Channel aeration facility) is expected to further improve DO levels in the
13 future. Thus, DO levels under the cumulative condition are not expected to be adverse.

14 **Nitrate/Nitrite**

15 Similar to ammonia levels, nitrate/nitrite levels in the Delta may be reduced in the future as POTWs
16 discharging to Delta waters implement de-nitrification processes. The Central Valley Water Board is
17 currently permitting such requirements with regularity and thus notable reductions in POTW-
18 related nitrate/nitrite discharges are expected in the future, and other new or greater sources are
19 not anticipated that would offset such point-source reductions. Thus, nitrate/nitrite levels under the
20 cumulative condition are not expected to be adverse.

21 **Pathogens**

22 Similarly, increasingly stringent state regulations on both POTWs and urban runoff through the
23 NPDES program is anticipated to reduce pathogen loading to Delta waters from these sources. As
24 discussed in the project-specific analyses of alternatives, pathogen levels in the Delta are most
25 affected by local factors, primarily local land uses and associated runoff from such lands. Conversion
26 of Delta agricultural lands to tidal wetlands under the action alternatives may alter levels of
27 coliforms and *E. coli* (either up or down), but would be expected to reduce loading of
28 *Cryptosporidium*. Moreover, increased municipal wastewater discharges resulting from future
29 population growth would not be expected to measurably increase pathogen concentrations in
30 receiving waters due to State and Federal water quality regulations requiring disinfection of effluent
31 discharges and the State's implementation of Title 22 filtration requirements for many wastewater
32 dischargers in the Sacramento River and San Joaquin River watersheds. Municipal stormwater
33 regulations and permits have become increasingly stringent in recent years, and such further
34 regulation of urban stormwater runoff is expected to continue in the future. The ability of storm
35 water BMPs to consistently reduce pathogen loadings and the extent of future implementation is
36 uncertain, but would be expected to improve as new technologies are continually tested and
37 implemented. Also, some of the urbanization may occur on lands used by other pathogens sources,
38 such as grazing lands, resulting in a change in pathogen source, but not necessarily an increase (and
39 possibly a decrease) in pathogen loading. In sum, Delta pathogen levels are not anticipated to be
40 adverse under the cumulative condition.

1 Phosphorus

2 Primary sources of phosphorus to Delta waters include agriculture, municipal POTWs, individual
3 septic treatment systems, urban runoff, stream bank erosion, and decaying plant material. Currently,
4 Delta phosphorous levels are not of substantial concern to state water quality regulatory agencies,
5 nor is there clear evidence that phosphorous levels are adversely affecting Delta beneficial uses. Due
6 to increased regulations and regulatory monitoring anticipated in the future, which may include
7 water quality objectives for phosphorus at some point in the future, loading from agriculture,
8 municipal POTWs, individual septic treatment systems, and urban runoff are all expected to remain
9 at similar levels to that under current conditions, or decline, under the future cumulative condition.
10 Loadings from stream bank erosion and decaying plants are not expected to change notably in the
11 future. Hence, phosphorus levels are not anticipated to be adverse under the cumulative condition.

12 Trace Metals

13 Primary sources of trace metals to Delta waters include acid mine drainage (e.g., zinc, cadmium,
14 copper, lead) from abandoned and inactive mines (i.e., Iron Mountain and Spring Creek mines) in the
15 Shasta watershed area, which enter the Sacramento River system through Shasta Lake and Keswick
16 Reservoir, agriculture (e.g., copper and zinc), POTW discharges (e.g., copper, zinc, and aluminum),
17 and urban runoff (e.g., zinc, copper, lead, cadmium). Continued efforts to control acid mine drainage
18 into the Sacramento River system and increasingly stringent regulations are expected in the future.
19 Monitoring and regulatory controls on agricultural runoff, POTW discharges, and urban runoff are
20 anticipated to prevent trace metal concentration under the cumulative condition from becoming
21 adverse.

22 Turbidity/TSS

23 Future land use changes could have minor effects on TSS concentrations and turbidity levels
24 throughout the affected environment. Site-specific and temporal exceptions may occur due to
25 localized temporary construction activities, dredging activities, development, or other land use
26 changes. These localized actions would generally require agency permits that would regulate and
27 limit both their short-term and long-term effects on TSS concentrations and turbidity levels to less-
28 than substantial levels. Construction activities are closely regulated under construction NPDES
29 permits, which require the preparation of SWPPPs and the implementation of agency permitted
30 construction BMPs that will minimize sedimentation into adjacent water bodies which would, in
31 turn, increase turbidity/TSS. Moreover, construction projects are short-term in nature and thus
32 their effects on turbidity/TSS tend not to be additive among multiple construction activities over
33 time. Consequently, Delta turbidity/TSS levels under the cumulative condition are not expected to
34 be adverse.

35 Because the cumulative water quality condition in the Delta for the constituents discussed above are
36 considered to not be adverse in the Delta when considering all past, present, and reasonably
37 foreseeable projects and regulatory actions, and because this cumulative condition includes the
38 anticipated effects of implementing the facilities operations and maintenance of any one of the
39 action alternatives, along with their associated conservation measures/Environmental
40 Commitments, none of these alternatives would contribute to an adverse (significant) cumulative
41 condition for these constituents either in the Delta Region or the SWP/CVP Export Service Areas.

42 Cumulative water quality conditions for the constituents listed below are considered to be adverse,
43 or have reasonable potential to be adverse, in portions of the Delta. Adverse (significant) cumulative

1 water quality conditions for these constituents are expected when the effects of implementing any
 2 one of the action alternatives on water quality are considered (including the new conveyance
 3 facilities, fish screens, gates and other physical structures and their operations and maintenance
 4 activities) together with the effects of past, present, and reasonably foreseeable projects, including
 5 those listed in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project*
 6 *Alternative, and Cumulative Impact Conditions.*

- 7 • Bromide
- 8 • Chloride
- 9 • Electrical Conductivity
- 10 • Mercury
- 11 • *Microcystis* Blooms
- 12 • Organic Carbon
- 13 • Pesticides and Herbicides
- 14 • Selenium

15 Each of the constituents listed above, for which the cumulative Delta conditions are determined to
 16 be adverse, or potentially adverse, are discussed further below to determine whether
 17 implementation of the action alternatives would contribute considerably to these adverse
 18 (significant) cumulative water quality conditions.

19 ***Bromide***

20 The cumulative condition for bromide is considered adverse in the Delta, because of marked
 21 increases in bromide concentrations anticipated to occur in the northwest Delta, including at the
 22 North Bay Aqueduct intake at Barker Slough. The primary driver of the adverse (significant)
 23 cumulative condition is the amount and location of tidal habitat restoration assumed to be
 24 implemented as part of the cumulative condition. This tidal habitat restoration would be
 25 implemented a component of the BDCP alternatives' conservation measures, or as part of separate
 26 actions (e.g., the California Water Action Plan/EcoRestore) for Alternatives 4A, 2D, and 5A, which
 27 will affect Delta hydrodynamics. Another contributing factor is sea water intrusion associated with
 28 climate change.

29 Increased bromide concentrations would not be anticipated to occur in the SWP/CVP Export Service
 30 Areas south of the Delta due to greater source fraction of Sacramento River water on an annual
 31 average basis at the south Delta pumps under all action alternatives. Therefore, the cumulative
 32 condition for bromide in the SWP/CVP Export Service Areas with implementation of any of the
 33 alternatives is not expected to be adverse.

34 ***BDCP Alternatives***

35 Alternatives 1A–6C and 9, which include up to 65,000 acres of tidal restoration as part of
 36 conservation measures, would increase long-term average bromide concentrations at Barker Slough
 37 to levels substantially higher than those under Existing Conditions. Alternative 7 would not increase
 38 the long-term average bromide concentration at this location, and Alternative 8 would only increase
 39 it slightly. However, all alternatives would increase the drought period average bromide
 40 concentration at Barker Slough substantially, relative to concentrations during the drought period

1 analyzed under Existing Conditions (Appendix 8E, *Bromide*). Based on their causing substantially
2 increased average bromide concentrations at Barker Slough in the northwest Delta on a long-term
3 average basis and/or during drought periods, implementation of the BDCP alternatives would
4 contribute substantially to the adverse (significant) cumulative condition in the Delta for bromide.

5 Construction and implementation of the North Bay Aqueduct Alternative Intake Project would
6 provide water from the Sacramento River that is very low in bromide to the existing service area of
7 the North Bay Aqueduct, reducing the potential effects of cumulative bromide concentration
8 increases on water treatment facilities and end-users of water from the North Bay Aqueduct.

9 *Alternatives 4A, 2D, and 5A*

10 The amount of tidal habitat restoration assumed for Alternatives 4A, 2D, and 5A is substantially less
11 than assumed for the BDCP alternatives, such that these alternatives are not expected to
12 significantly affect Delta hydrodynamics and source water fractions. Modeling results (Appendix 8E,
13 *Bromide*) show that long-term and drought period average bromide concentrations with
14 implementation of Alternatives 4A, 2D, and 5A water conveyance facilities, and some assumed
15 habitat restoration, would be similar to or decrease relative to Existing Conditions. Thus,
16 Alternatives 4A, 2D, and 5A would not contribute substantially to the adverse (significant)
17 cumulative condition in the Delta for bromide.

18 **Chloride**

19 The cumulative condition for chloride is considered adverse in the Delta, because of marked
20 increases in chloride concentrations anticipated to occur in the western Delta and potentially Suisun
21 Marsh. One driver of the increased chloride concentrations is the amount and location of tidal
22 habitat restoration to be implemented and assumed as part of the cumulative condition. This tidal
23 habitat restoration would be implemented a component of the BDCP alternatives' conservation
24 measures, or as part of separate actions (e.g., the California Water Action Plan/EcoRestore) for
25 Alternatives 4A, 2D, and 5A, which will affect Delta hydrodynamics. Another contributing factor is
26 sea level rise and intrusion associated with climate change.

27 The cumulative condition for chloride would not be adverse in the SWP/CVP Export Service Areas
28 due to greater source fraction of Sacramento River water on an annual average basis at the south
29 Delta pumps under all action alternatives.

30 *BDCP Alternatives*

31 Regarding the frequency of exceeding the 150 mg/L Bay-Delta WQCP objective at Antioch and
32 Contra Costa Canal Pumping Plant #1, the modeling and assessment approach indicated that
33 Alternatives 1A–1C, 3, and 7–9 would result in a substantial increase in the frequency of objective
34 exceedance. Regarding the frequency of exceeding the 250 mg/l chloride objective at Antioch, the
35 modeling and assessment approach indicated that Alternatives 1A–1C, 3, and 5 would result in a
36 substantial increase in the frequency of exceeding this objective, relative to Existing Conditions,
37 whereas Alternative 9 would cause only a minor increase in frequency of exceedance and
38 Alternatives 6A–8 would result in a reduction in frequency of exceeding the 250 mg/L chloride
39 objective (Appendix 8G, *Chloride*). Regarding exceedance of Bay-Delta WQCP water quality
40 objectives for chloride, staff from DWR and Reclamation shall continue to monitor Delta water
41 quality conditions and adjust operations of the SWP and CVP in real time as necessary to meet water
42 quality objectives. These decisions take into account real-time conditions and are able to account for

1 many factors that the best available models cannot simulate. These water quality objectives are
2 legally enforceable means of protecting beneficial uses in the Delta, and are and will continue to be
3 included in the Bay-Delta WQCP. This ensures that these commitments are enforceable obligations
4 that will continue to affect operations and protect water quality. DWR and Reclamation have a good
5 history of compliance with water quality objectives (see Sections 8.1.3.4 and 8.1.3.7 for more detail).
6 Considering these real-time actions, the good history of compliance with objectives, and the
7 uncertainty inherent in the modeling approach (as discussed in Sections 8.3.1.1 and 8.3.1.3), it is
8 likely that any objective exceedance could be avoided through real-time operation of the SWP and
9 CVP. Nevertheless, water quality degradation could occur that may not be addressed through real-
10 time operations. Depending on siting and design of tidal restoration areas, the BDCP alternatives
11 could substantially increase chloride levels in some areas of Suisun Marsh relative to Existing
12 Conditions, primarily during the October through May period. Hence, based on their respective
13 effects on increased chloride levels in Suisun Marsh and the increased water quality degradation in
14 the western Delta, implementation of facilities operations and maintenance under the BDCP
15 alternatives would contribute substantially to this adverse (significant) cumulative condition for
16 chloride. Additionally, implementation of tidal habitat restoration would increase the tidal exchange
17 volume in the Delta, and thus may contribute to increased chloride concentrations in the Bay source
18 water as a result of increased salinity intrusion. As such, CM4 is expected to contribute to this
19 adverse (significant) cumulative condition. Implementation of CM2, CM3, and CM5–CM21 would not
20 contribute substantially to this adverse (significant) cumulative condition.

21 *Alternatives 4A, 2D, and 5A*

22 Implementation of facilities operations and maintenance under Alternatives 4A, 2D, and 5A would
23 not be expected to contribute substantially to the adverse (significant) cumulative condition for
24 chloride, as modeling results show that operations would not contribute to substantial adverse
25 changes in chloride concentrations at modeled Delta locations. Additionally, unlike the BDCP
26 alternatives, implementation of tidal habitat restoration would not be expected to contribute to
27 increased chloride concentrations, because the areal extent of the new restoration area would be a
28 relatively small portion of the existing and planned Delta tidal habitat areas and, thus, not expected
29 to measurably affect the Delta hydrodynamics. As such, implementation of Environmental
30 Commitments associated with these alternatives would not contribute substantially to this adverse
31 (significant) cumulative condition.

32 ***Electrical Conductivity***

33 The cumulative condition for EC is considered to be adverse, at various Delta locations and Suisun
34 Marsh, depending on action alternative implemented. One driver of the adverse EC conditions is the
35 amount and location of tidal habitat restoration to be implemented and assumed as part of the
36 cumulative condition. This tidal habitat restoration would be implemented a component of the BDCP
37 alternatives' conservation measures, or as part of separate actions (e.g., the California Water Action
38 Plan/EcoRestore) for Alternatives 4A, 2D, and 5A, which will affect Delta hydrodynamics. Another
39 contributing factor is sea level rise and intrusion associated with climate change.

40 EC levels at the south Delta export pumps would improve under all alternatives and thus the
41 cumulative EC condition at the export pumps would not be adverse. As such, cumulative EC levels in
42 the SWP/CVP Export Service Areas would not be adverse.

1 *BDCP Alternatives*

2 Alternatives 1A–3 and 5–9 are expected to result in more frequent exceedances of the Bay-Delta
3 WQCP EC objective in the Sacramento River at Emmaton, relative to Existing Conditions. This is due
4 in part to the definition of these alternatives, in which the compliance point is moved from Emmaton
5 to Threemile Slough. Although modeling of Alternative 4 indicated more frequent exceedance of the
6 Emmaton objective as well, these results were for modeling that was originally performed for
7 Alternative 4 assuming the Emmaton compliance point shifted to Threemile Slough, but Alternative
8 4 now does not include a change in compliance point from Emmaton to Threemile Slough.
9 Sensitivity analyses performed indicated that Alternative 4 is not expected to result in more
10 frequent exceedances of the Emmaton objective, but that water supply and water quality conditions
11 could be either under greater stress or under stress earlier in the year, and salinity EC levels at
12 Emmaton and in the western Delta may increase as a result, leading to EC water quality degradation
13 and increased possibility of impacts adverse effects to agricultural beneficial uses. Similarly, water
14 quality degradation is expected to occur at Emmaton and other areas of the western Delta under all
15 alternatives during parts of the summer, and on an annual average basis for Alternatives 1, 3, 4
16 Scenarios H1 and H2, and 9. To the extent that exceedances of this objective or substantial water
17 quality degradation is expected, these impacts could lead to effects on agricultural beneficial uses.
18 Increases in EC in the San Joaquin River at San Andreas Landing are expected for parts of the
19 summer under all alternatives, and depending on the nature of the increases, may result in water
20 quality degradation that could lead to effects on agricultural beneficial uses.

21 Moreover, in the central Delta at Prisoner’s Point, Alternatives 2A–C, 4 (Operational Scenarios H1
22 through H4), and 6A–8 would result in substantially increased frequency of exceedance of the EC
23 objective, whereas Alternative 5 would cause a lesser increase in frequency of exceedance, and
24 Alternatives 1A–C, 3, and 9 would have little to no effect on frequency of exceedance of the EC
25 objective at Prisoner’s Point (Appendix 8H). These exceedances could contribute to adverse effects
26 on fish and wildlife beneficial uses (specifically, indirect adverse effects on striped bass spawning),
27 though there is a high degree of uncertainty associated with this impact.

28 Alternatives 1A–5 and 9 could substantially increase EC levels in Suisun Marsh relative to Existing
29 Conditions, primarily during the October through May period, whereas Alternatives 6A–8 would
30 result in somewhat lesser (but still substantial) increases in Suisun Marsh.

31 Based on their adverse effects on EC levels in Suisun Marsh as well as the adverse effects in the
32 western and interior Delta, the BDCP alternatives would all contribute substantially to the adverse
33 (significant) cumulative conditions for EC in the Delta. Additionally, implementation of tidal habitat
34 restoration under CM4 would increase the tidal exchange volume in the Delta, and thus may
35 contribute to increased EC concentrations in the Bay source water as a result of increased salinity
36 intrusion. As such, CM4 is expected to contribute to this adverse (significant) cumulative condition.
37 Implementation of CM2, CM3, and CM5–CM21 would not contribute substantially to this adverse
38 (significant) cumulative condition.

39 *Alternatives 4A, 2D, and 5A*

40 Under Alternatives 4A, 2D, and 5A, the cumulative condition for EC is considered to be adverse in
41 the Delta due primarily to periodically high levels of EC in the western Delta associated with sea
42 water intrusion, and also in the south Delta. Implementation of facilities operations and
43 maintenance under these action alternatives, along with Mitigation Measure WQ-11, would not be
44 expected to contribute substantially to this adverse (significant) cumulative condition for EC,

1 because no additional exceedance of Bay-Delta WQCP EC objectives would be expected, and
2 substantial long-term degradation with respect to EC would be avoided. Additionally, unlike under
3 the BDCP alternatives, implementation of tidal habitat restoration would not be expected contribute
4 to increased EC levels, because the areal extent of the new restoration area would be a relatively
5 small portion of the existing and planned Delta tidal habitat areas and, thus, not expected to
6 measurably affect the Delta hydrodynamics. As such, implementation of Environmental
7 Commitments is not expected to contribute to this adverse (significant) cumulative condition.

8 ***Mercury***

9 Numerous regulatory efforts have been implemented or are under development to control and
10 reduce mercury loading to the Delta, Upstream of the Delta and in the SWP/CVP Export Service
11 Areas, which include a Delta mercury TMDL, methylmercury TMDL, and their implementation
12 strategies (e.g., methylmercury control studies), increased restrictions on point-source discharges
13 such as POTWs, greater restrictions on suction dredging in Delta tributary watersheds, and
14 continued clean-up actions on mine drainage in the upper watersheds. A key challenge surrounds
15 the pool of mercury deposited in the sediments of the Delta which cannot be readily or rapidly
16 reduced, despite efforts to reduce future loads in Delta tributaries, and serves as a source for
17 continued methylation and bioaccumulation of methylmercury by Delta biota. Consequently,
18 mercury levels in Delta waters are considered to be an adverse (significant) cumulative condition.

19 ***BDCP Alternatives***

20 Facilities operations and maintenance (CM1) of Alternatives 1A–5 would not be expected to
21 substantially alter the cumulative condition for mercury and the mercury impairment in the Delta or
22 contribute substantially to the adverse (significant) cumulative mercury condition in the SWP/CVP
23 Export Service Areas. Facilities operations and maintenance (CM1) of Alternatives 6A–9 would be
24 expected to contribute substantially to the adverse (significant) cumulative condition for mercury in
25 the Delta, since fish tissue concentrations are expected to increase measurably at several locations
26 throughout the Delta. Implementation of CM4 (tidal wetland habitat), CM5 (floodplain habitat),
27 CM10 (freshwater marsh habitat), and CM2 (Yolo Bypass fisheries enhancements) could create
28 conditions resulting in increased methylation of mercury within the Delta per unit time, increased
29 biotic exposure to and uptake of methylmercury, and resulting increased mercury bioaccumulation
30 in fish tissues. The methylation of mercury in these restored wetland habitats would contribute
31 substantially to the cumulative condition for mercury in the Delta.

32 ***Alternatives 4A, 2D, and 5A***

33 Facilities operations and maintenance of Alternatives 4A, 2D, and 5A would not be expected to
34 substantially alter the cumulative condition for mercury and the mercury impairment in the Delta or
35 contribute considerably to the adverse (significant) cumulative mercury condition in the SWP/CVP
36 Export Service Areas. Mercury and methylmercury concentrations in water are not expected to
37 change substantially under Alternatives 4A, 2D, and 5A. Fish tissue concentrations showed increases
38 at some locations, but because the increases would be relatively small, and it is not evident that
39 substantive increases are expected at numerous locations throughout the Delta, the changes were
40 considered to be within the uncertainty inherent in the modeling approach, and would likely not be
41 measurable in the environment.

42 The amount of new habitat restoration to be implemented for the Environmental Commitments of
43 Alternatives 4A, 2D, and 5A would be relatively small compared to the areal extent of the Delta, but

1 implementation would be expected to contribute considerably to certain localized areas (i.e., near
2 where the wetland restoration areas are planned) within the Delta through the potential for
3 increased mercury methylation in these restored wetland habitats. Design of restoration sites would
4 be guided by Environmental Commitment 12 of the action alternatives, which requires development
5 of site-specific mercury management plans as restoration actions are implemented. The
6 effectiveness of minimization and mitigation actions implemented according to the mercury
7 management plans is not known at this time, although the potential to reduce methylmercury
8 concentrations exists based on current research. Although Environmental Commitment 12 would be
9 implemented with the goal to reduce this potential effect, the uncertainties related to site-specific
10 restoration conditions and the potential for increases in methylmercury concentrations in the Delta
11 could contribute substantially to the cumulative condition for mercury in the Delta.

12 As such, conveyance facility operation and maintenance is not expected to contribute to the adverse
13 (significant) cumulative condition for mercury, but tidal habitat restoration Environmental
14 Commitments implemented under Alternatives 4A, 2D, and 5A could contribute to this adverse
15 condition in localized areas.

16 ***Microcystis Blooms***

17 The cumulative condition for *Microcystis* and, thus, microcystin concentrations is considered
18 adverse in the Delta due to conditions being more favorable for their production. This includes
19 future increased water temperatures associated with climate change and increased water residence
20 times associated with climate change/sea level rise and habitat restoration that will enhance
21 conditions for *Microcystis* blooms. *Microcystis* blooms can occur in the Delta during the June through
22 September period of the year.

23 Climate change is expected to cause an increase in average Delta water temperatures during the
24 summer and early fall months. Increased water temperatures could lead to earlier attainment of the
25 water temperature threshold of 19°C required to initiate *Microcystis* bloom in the Delta, and thus
26 earlier occurrences of *Microcystis* blooms, relative to Existing Conditions. Warmer water
27 temperatures could also increase bloom duration and magnitude, relative to Existing Conditions.
28 Nevertheless, it should be noted that projected Delta water temperature increases would be due
29 entirely to climate change, and not due to the implementation of the action alternatives. Because
30 climate change is assumed under the No Action Alternative, potential water temperature-driven
31 increases in *Microcystis* blooms in the Delta, relative to Existing Conditions, also would occur under
32 the No Action Alternative. Therefore, no water temperature-driven increases in *Microcystis* blooms
33 would occur in the Delta under the action alternatives, relative to the No Action Alternative.

34 An increase in residence time throughout the Delta is also expected due to climate change and sea
35 level rise, although this change is believed to be fairly small in most areas of the Delta. Restoration
36 areas, implemented either as part of the conservation measures of the BDCP alternatives, or
37 separate actions under Alternatives 4A, 2D, and 5A, could also contribute to increased residence
38 times.

39 ***BDCP Alternatives***

40 The BDCP alternatives, including the implementation of habitat restoration under CM2 and CM4,
41 would increase water residence times in the Delta during the summer period, relative to Existing
42 Conditions and the No Action Alternative. Longer residence times in portions of the Delta may
43 potentially increase the frequency, magnitude, and geographic extent of *Microcystis* blooms in Delta

1 waters, relative to Existing Conditions and the No Action Alternative. Siting and design of restoration
2 areas has substantial influence on the magnitude of residence time increases that would occur under
3 the BDCP alternatives. However, the expected residence time changes under the BDCP alternatives,
4 compared to Existing Conditions and the No Action Alternative, are in a direction and of magnitude
5 that could lead to an increase in Delta *Microcystis* blooms.

6 Water diverted from the Sacramento River in the North Delta is expected to be unaffected by
7 *Microcystis* and microcystins. However, the fraction of water flowing through the Delta that reaches
8 the existing south Delta intakes is expected to be influenced by an increase in the frequency,
9 magnitude, and geographic extent of *Microcystis* blooms as discussed above. Therefore, relative to
10 Existing Conditions and the No Action Alternative, the addition of Sacramento River water from the
11 North Delta under the BDCP alternatives serves to dilute *Microcystis* and microcystins in water
12 diverted from the South Delta with water that is not expected to contain them. Because the degree to
13 which *Microcystis* blooms, and thus microcystins concentrations, will increase in source water from
14 the South Delta is unknown, it cannot be determined whether the BDCP alternatives will result in
15 increased or decreased levels of microcystins in the mixture of source waters exported from Banks
16 and Jones pumping plants, relative to Existing Conditions and the No Action Alternative.

17 Implementation of the BDCP alternatives (including CM2 and CM4) would contribute substantially
18 to the adverse (significant) cumulative condition for *Microcystis* through their effects on residence
19 time. Conversely, because projected Delta water temperature increases are due entirely to climate
20 change, and are not due to the implementation of BDCP alternatives, implementation of the BDCP
21 alternatives would not contribute substantially to the adverse (significant) cumulative condition for
22 *Microcystis* via changes to Delta water temperature.

23 *Alternatives 4A, 2D, and 5A*

24 Change in flow paths of water through the Delta would occur under Alternatives 4A, 2D, and 5A,
25 which could result in localized increases in residence time in various Delta sub-regions, and
26 decreases in residence time in other areas. Implementation of the small amount of habitat
27 restoration within the Delta, associated with the alternatives' Environmental Commitments, also
28 could affect residence times at the affected areas. While there is uncertainty regarding the degree to
29 which the alternatives would affect water residence times in the Delta, it is anticipated that the
30 combined effects of restoration (to be implemented separate from the alternatives, e.g., EcoRestore),
31 sea level rise and climate change will drive the residence time changes and that the alternatives and
32 other cumulative projects would not contribute considerably to the adverse *Microcystis* and
33 microcystins condition in the Delta, in particular because the amount of habitat restoration by the
34 alternatives to be implemented would be so limited in area and location as it would not be able to
35 affect residence times Delta-wide.

36 As described for the BDCP alternatives, the water flowing through the Delta that would reach the
37 south Delta intakes is expected to be influenced by the increased frequency, magnitude, and
38 geographic extent of *Microcystis* blooms associated with restoration (to be implemented separate
39 from the alternatives, e.g., EcoRestore), sea level rise, and climate change. Water diverted from the
40 Sacramento River in the north Delta that would be conveyed to the south Delta intakes is expected
41 to be unaffected by *Microcystis* and microcystins. Therefore, the addition of Sacramento River water
42 from the north Delta under Alternatives 4A, 2D, and 5A at the south Delta intakes would serve to
43 dilute *Microcystis* and microcystins-containing water diverted from the south Delta with water that
44 is not expected to contain them. Because the degree to which *Microcystis* blooms, and thus

1 microcystins concentrations, will increase in source water from the south Delta is unknown, it
2 cannot be determined whether levels of microcystins in the mixture of source waters exported from
3 Banks and Jones pumping plants will be higher or lower, relative to Existing Conditions. However,
4 because the Sacramento River water contributed to the south Delta intakes will likely be unaffected
5 by *Microcystis* and microcystins, the alternatives would not contribute considerably to any future
6 adverse *Microcystis* and microcystins condition in the SWP/CVP Export Service Areas.

7 ***Organic Carbon***

8 Delta water quality conditions for DOC are anticipated to be adverse under the cumulative
9 condition.

10 ***BDCP Alternatives***

11 Facilities operations and maintenance (CM1) for Alternatives 1A–5 would not contribute
12 considerably to the adverse (significant) cumulative condition for DOC within Delta waters based on
13 modeling results showing little effect of these alternatives on long-term average concentrations.
14 Conversely, Alternatives 6A–9 would result in increased DOC levels at Franks Tract, Rock Slough and
15 Contra Costa PP No. 1. Under these alternatives, long-term average DOC concentration could
16 increase by up to 46%, relative to Existing Conditions. Thus, the DOC contributions from alternatives
17 6A–9 at Franks Tract, Rock Slough and Contra Costa PP No. 1 (i.e., interior Delta locations) are
18 determined to contribute considerably to the adverse (significant) cumulative condition for DOC in
19 the Delta. However, overall, modeling results for the south Delta pumps and thus the SWP/CVP
20 export service area predict a long-term improvement in export service area water quality, primarily
21 through a reduction in exports of water exceeding 4 mg/L. This is particularly true for Alternatives
22 6A–9 where notable improvements to DOC levels at the south Delta pumps would occur. Hence,
23 facilities operations and maintenance (CM1) for Alternatives 6A–9 would contribute substantially to
24 adverse (significant) cumulative conditions in the interior Delta, but would improve cumulative DOC
25 conditions at the south Delta pumps and thus in the SWP/CVP Export Service Areas.

26 In addition, implementation of CM4 (tidal wetland habitat), CM5 (floodplain habitat), and CM10
27 (freshwater marsh habitat) would create substantial new localized sources of DOC to Delta waters,
28 and in some circumstances would substitute for existing sources related to replaced agriculture. In
29 addition, CM2 would create greater localized source loading of DOC to Delta waters, to the degree
30 that the Yolo Bypass is inundated more frequently and/or to a greater geographic extent under the
31 alternatives, relative to Existing Conditions. Depending on localized hydrodynamics and proximity
32 to municipal drinking water intakes, such restoration activities could contribute substantial
33 amounts of DOC to municipal raw water supplies. The potential for substantial increases in long-
34 term average DOC concentrations related to the habitat restoration elements of CM4, CM5, and
35 CM10 could contribute to long-term water quality degradation with respect to DOC and, thus,
36 adversely affect the MUN beneficial use at various interior Delta locations. Hence, implementation of
37 CM2–CM21 would contribute substantially to the adverse (significant) cumulative condition for
38 DOC.

39 ***Alternatives 4A, 2D, and 5A***

40 Similar to Alternatives 1A–5, facilities operations and maintenance for Alternatives 4A, 2D, and 5A
41 would not contribute considerably to the adverse (significant) cumulative condition for DOC within
42 Delta waters based on modeling results showing little effect of these alternatives on long-term
43 average concentrations. However, there would not be expected to be substantial contributions of

1 DOC from habitat restoration areas under Alternatives 4A, 2D, and 5A, because the area to be
2 converted for new habitat would be small compared to areal extent of the Delta and existing habitat
3 areas and loading sources. As such, facilities operations and maintenance and Environmental
4 Commitments implemented under Alternatives 4A, 2D, and 5A would be minimal and are not
5 expected to considerably contribute to this adverse condition.

6 ***Pesticides and Herbicides***

7 Pesticide and herbicide use within and upstream of the Delta are changing continuously.
8 Historically, when society has substituted one class of pesticide for another without a corresponding
9 change in patterns of use (i.e., substitution of organochlorines with organophosphates), incidence of
10 non-target toxicity or environmental harm has changed and perhaps been lessened, but has
11 remained nevertheless. While factors such as TMDLs and future development of more target specific
12 and less toxic pesticides will ultimately influence the future cumulative condition for pesticides,
13 forecasting whether these various efforts will ultimately be successful at resolving current pesticide
14 related impairments requires considerable speculation. As such it is conservatively assumed that
15 the cumulative condition will be adverse with respect to pesticides and herbicides in the Delta. The
16 greater source fraction of Sacramento River water on an annual average basis at the south Delta
17 pumps under all action alternatives would be expected to result in the cumulative condition for
18 pesticides and herbicides in the SWP/CVP Export Service Areas to not be adverse.

19 ***BDCP Alternatives***

20 Alternatives 1A–5 are not expected to contribute considerably to the adverse (significant)
21 cumulative condition due to facilities operations and maintenance (CM1). However, implementation
22 of CM1 under Alternatives 6A–9 would result in long-term average San Joaquin River source water
23 fractions at Franks Tract, Rock Slough and Contra Costa PP No. 1 (interior Delta) increasing
24 considerably for some months such that the long-term risk of pesticide-related toxicity to aquatic
25 life could substantially increase at these locations. Additionally, the potential for increased incidence
26 of pesticide related toxicity could include pesticides such as chlorpyrifos and diazinon for which
27 existing Clean Water Act Section 303(d) listings exist for the Delta, and thus existing beneficial use
28 impairment could be made discernibly worse. In addition, implementation of CM13 (nonnative
29 aquatic vegetation control) under the BDCP alternatives would be expected to contribute
30 substantially to the adverse (significant) cumulative condition for pesticides and herbicides in the
31 Delta.

32 ***Alternatives 4A, 2D, and 5A***

33 Alternatives 4A, 2D, and 5A are not expected to contribute considerably to the adverse (significant)
34 cumulative condition due to facilities operations and maintenance, because the changes in the
35 source water fractions of Sacramento River, San Joaquin River, and Delta agriculture water due to
36 these alternatives would not be expected to be of sufficient magnitude to substantially alter the
37 long-term risk of pesticide-related toxicity to aquatic life, nor adversely affect other beneficial uses
38 of the Delta.

39 ***Selenium***

40 The lower San Joaquin River and the western Delta are listed as impaired in accordance with Section
41 303(d) of the Clean Water Act for exceeding selenium water quality objectives or bioaccumulation in
42 biota. The San Joaquin River impairment is listed as extending from the Mud Slough confluence to

1 the Airport Way Bridge near Vernalis, a reach distance of about 43 river miles. Selenium occurs
2 naturally throughout the lower San Joaquin River watershed, with elevated concentrations of
3 selenium occurring in the shallow groundwater within the Grassland Watershed. Subsurface
4 agricultural drainage discharges from this area are the major source of selenium to the San Joaquin
5 River and Delta. Load allocations for agricultural subsurface drainage discharges from the Grassland
6 Drainage Area have been developed through completion of the lower San Joaquin River selenium
7 TMDL and the Grassland Bypass Project. The Grassland Bypass Project prevents discharge of
8 subsurface agricultural drainage water into wildlife refuges and wetlands. The Grassland Area
9 Farmers have been successful in meeting TMDL wasteload allocations and continue to utilize and
10 expand the San Joaquin River Water Quality Improvement Project. Moreover, the Grassland Area
11 Farmers continue to work closely with the Central Valley Water Board and U.S. Bureau of
12 Reclamation to further develop and improve their drainage solutions for the Grassland Drainage
13 Area. Despite these improvements in reducing selenium loading to the San Joaquin River and Delta,
14 it is anticipated that the cumulative condition for selenium in the lower San Joaquin River and Delta
15 will remain adverse.

16 While there have been improvements to selenium concentrations in San Francisco Bay, due in part
17 to the petroleum refineries implementing controls that have decreased selenium in their discharges,
18 the bay is currently CWA Section 303(d) listed as impaired for elevated selenium. TMDLs that will
19 be developed to address the impairment would be expected to contribute to some reduction in
20 selenium in the bay, including the North Bay, which is partially influenced by Delta outflow. Thus, it
21 is anticipated that the future cumulative condition would be no worse, and possibly better than,
22 existing conditions, but will remain adverse.

23 *BDCP Alternatives*

24 Facilities operations and maintenance (CM1) of Alternatives 1A–5 would not be expected to
25 substantially alter the cumulative condition for selenium and selenium impairment in the Delta.
26 Modeled selenium concentrations in sturgeon in the western Delta, in the San Joaquin River at
27 Antioch and the Sacramento River at Mallard Island would increase under Alternatives 6A–9 by 17–
28 42%, which may represent a measurable increase in the environment. These increases would
29 contribute to low toxicity benchmarks being exceeded on average, in all years, and to high toxicity
30 benchmarks being approached or exceeded during drought years. These increases would further
31 degrade water quality by measurable levels, on a long-term basis, for selenium and, thus, cause the
32 CWA Section 303(d)-listed impairment of beneficial uses to be made discernibly worse. These
33 potentially measurable increases would contribute substantially to the adverse (significant)
34 cumulative condition for selenium in the Delta. However, the greater Sacramento River flow fraction
35 at the south Delta pumps under all BDCP alternatives would be expected to result in reduced
36 selenium concentrations in the SWP/CVP Export Service Areas and thus would not contribute to the
37 adverse (significant) cumulative condition. Implementation of CM4 (tidal wetland habitat), CM5
38 (floodplain habitat), and CM10 (freshwater marsh habitat) could create conditions resulting in
39 increased flow residence time at the restored Delta locations, which could increase biotic exposure
40 to and uptake of selenium, potentially resulting in increased selenium bioaccumulation in fish
41 tissues. The potential for increased biotic exposure in and near these restored wetland habitats
42 would contribute substantially to the adverse (significant) cumulative condition for selenium in the
43 Delta. However, *AMM27 Selenium Management*, which affords for site-specific measures to reduce
44 effects, would be available to reduce BDCP-related effects associated with selenium.

1 *Alternatives 4A, 2D, and 5A*

2 Facilities operations and maintenance of Alternatives 4A, 2D, and 5A would not be expected to
3 substantially alter the cumulative condition for selenium and selenium impairment in the Delta.
4 Modeling estimates indicate these alternatives would result in essentially no change in selenium
5 concentrations in water or most biota throughout the Delta, with no exceedances of benchmarks for
6 biological effects. Concentrations of selenium in sturgeon would exceed only the lower benchmark,
7 indicating a low potential for effects. Overall, these alternatives would not be expected to
8 substantially increase the frequency with which applicable benchmarks would be exceeded in the
9 Delta (there being only a small increase for sturgeon exceedance relative to the low benchmark for
10 sturgeon and no exceedance of the high benchmark) or substantially degrade the quality of water in
11 the Delta, with regard to selenium. The greater Sacramento River flow fraction at the south Delta
12 pumps under Alternatives 4A, 2D, and 5A would result in reduced selenium concentrations in the
13 SWP/CVP Export Service Areas and thus would not contribute to the adverse (significant)
14 cumulative condition.

15 While the implementation of Environmental Commitment 4: Tidal Natural Communities Restoration
16 would create shallow backwater areas that could result in local increased water residence times, the
17 extent of these areas would be minimal relative to the area of the Delta, and environmental changes
18 associated with their development are unlikely to be of magnitude that would measurably change
19 selenium concentrations in water or biota, relative to Existing Conditions. Further, although water
20 residence times associated with restoration could increase, they are not expected to increase
21 without bound, and selenium concentrations in the water column would not continue to build up
22 and be recycled in sediments and organisms as may be the case within a closed water system.
23 Further, proposed avoidance and minimization measures (AMMs) would require evaluating risks of
24 selenium exposure at a project level for each restoration area, minimizing to the extent practicable
25 potential risk of additional bioaccumulation, and monitoring selenium levels in fish and/or wildlife
26 to establish whether, or to what extent, additional bioaccumulation is occurring. See BDCP Appendix
27 3.C, *Avoidance and Minimization Measures*, for additional detail on AMM27. Because selenium
28 concentrations are not expected to build up in these areas and because *AMM27 Selenium*
29 *Management*, which affords for site-specific measures to reduce effects, would be available to reduce
30 effects associated with selenium, the restored habitats are not expected to contribute considerably
31 to the adverse (significant) cumulative condition.

32 Facilities operations and maintenance of Alternatives 4A, 2D, and 5A would not be expected to
33 substantially alter the cumulative condition for the selenium impairment in the Delta or contribute
34 considerably to the cumulative selenium condition in North Bay. Selenium concentrations in water
35 in the Delta are not expected to change substantially under Alternatives 4A, 2D, and 5A, and thus
36 these alternatives would not be expected to contribute considerable additional loading to the North
37 Bay that would worsen the impairment.

38 **NEPA Effects:** The cumulative water quality conditions are considered to be adverse for bromide,
39 chloride, electrical conductivity, mercury, *Microcystis* blooms, organic carbon, pesticides and
40 herbicides, and selenium in areas of the Delta, and thus may adversely affect beneficial uses of the
41 Delta such as domestic, agricultural, municipal and industrial water supply and recreation, aesthetic,
42 and fish and wildlife resources.

1 *BDCP Alternatives*

2 The implementation of the BDCP alternatives would contribute substantially to these adverse
3 (significant) cumulative water quality conditions. With respect to bromide, chloride, and electrical
4 conductivity, implementation of the BDCP alternatives would improve water quality conditions for
5 these constituents at the Banks and Jones pumping plants in the south Delta and thus in the
6 SWP/CVP Export Service Areas. Mitigation measures, conservation measures, and environmental
7 commitments have been developed to mitigate the contributions of the BDCP alternatives to the
8 adverse (significant) cumulative water quality conditions elsewhere in the Delta for bromide (WQ-
9 5), chloride (WQ-7), electrical conductivity (WQ-11), mercury (CM12), *Microcystis* blooms (WQ-32a
10 and WQ-32b), organic carbon (WQ-17 and WQ-18), pesticides and herbicides (WQ-21 and WQ-22)
11 and selenium (*AMM27 Selenium Management*).

12 *Alternatives 4A, 2D, and 5A*

13 The implementation of the water conveyance facilities operations and maintenance component of
14 Alternatives 4A, 2D, and 5A, including Mitigation Measure WQ-11 proposed for EC, would not
15 contribute considerably to adverse (significant) cumulative water quality conditions for these
16 constituents. With respect to chloride and EC, implementation of Alternatives 4A, 2D, and 5A would
17 improve water quality conditions for these constituents at the Banks and Jones pumping plants in
18 the south Delta and thus in the SWP/CVP Export Service Areas. The implementation of habitat
19 restoration Environmental Commitments could contribute considerably to the adverse (significant)
20 cumulative water quality condition for mercury. Environmental Commitment 12 would be
21 implemented to minimize conditions that promote the production of methylmercury.

22 **CEQA Conclusion:** Separate conclusions are provided for the BDCP alternatives and Alternatives 4A,
23 2D, and 5A.

24 *BDCP Alternatives*

25 The cumulative Delta water quality conditions are anticipated to be significant for bromide, chloride,
26 electrical conductivity, mercury, *Microcystis* blooms, organic carbon, pesticides and herbicides, and
27 selenium.

28 The incremental effects of the BDCP alternatives would be cumulatively considerable with respect to
29 significant cumulative bromide, chloride, *Microcystis*, and electrical conductivity conditions at
30 various western and interior Delta locations. However, implementation of the BDCP alternatives
31 would not contribute considerably, and would, in fact, improve conditions for these constituents
32 (except *Microcystis*) at the Banks and Jones pumping plants in the south Delta and thus in the
33 SWP/CVP Export Service Areas. It cannot be determined whether the BDCP alternatives will result
34 in increased or decreased levels of microcystins in the mixture of source waters exported from
35 Banks and Jones pumping plants, relative to Existing Conditions.

36 Implementation of WQ-5 may reduce impacts on bromide relative to municipal and industrial
37 beneficial uses in Barker Slough, but it is not known whether actions to reduce this impact under the
38 mitigation measures are feasible. Implementation of Mitigation Measures WQ-7a, WQ-7b, WQ-11a,
39 and WQ-11b may reduce impacts on chloride relative to municipal and industrial beneficial uses and
40 EC relative to agricultural beneficial uses in the western Delta, but it is not known whether actions
41 to reduce this impact under the mitigation measures are feasible. Implementation of Mitigation
42 measure WQ-11c may reduce potential impacts of EC on fish and wildlife beneficial uses in the
43 interior Delta, but it is not known whether actions to reduce this impact under the mitigation

1 measure are feasible. Thus, for these impacts, the contribution to the adverse (significant)
2 cumulative condition is expected to remain significant. Implementation of Mitigation Measures WQ-
3 7d and WQ-11d is expected to reduce the contribution of impacts on chloride and EC water quality
4 degradation in Suisun Marsh to a less-than-significant level. Implementation of WQ-32 may reduce
5 potential impacts on *Microcystis* in the Delta, but it is not known whether actions to reduce this
6 impact under the mitigation measure are feasible; thus, the contribution to the adverse (significant)
7 cumulative condition is expected to remain significant.

8 Regarding mercury and selenium, facilities operations and maintenance (CM1) would not be
9 expected to contribute considerably to the significant cumulative mercury and selenium conditions
10 in the Delta for Alternatives 1A–5, but would be expected to contribute to these conditions for
11 Alternatives 6A–9. Implementation of CM4, CM5, and CM10 would be expected to contribute
12 considerably to certain localized areas (i.e., near where the wetland restoration areas are planned)
13 within the Delta through the potential for increased mercury methylation and selenium
14 bioaccumulation in these restored wetland habitats. Although CM12 is designed to reduce these
15 effects for mercury, it is not known if these actions would be feasible and could effectively reduce
16 the incremental contribution to the adverse (significant) cumulative condition to a less-than-
17 significant level. However, with implementation of *AMM27 Selenium Management*, which affords for
18 site-specific measures to reduce effects, the incremental effects of these CMs on selenium would not
19 be expected to be cumulatively considerable. Likewise, CM2 would create greater localized source
20 loading of methylmercury to Delta waters, to the degree that the Yolo Bypass would be inundated
21 more frequently and/or to a greater geographic extent under the alternatives, relative to Existing
22 Conditions. Conversely, CM2 is not expected to contribute considerably to future Delta selenium
23 levels and thus would not be expected to affect future bioaccumulation of selenium in Delta fish
24 tissues.

25 For organic carbon, implementation of facilities operations and maintenance (CM1) for Alternatives
26 6A–9 would contribute considerably to the significant cumulative organic carbon condition in the
27 Delta, but Alternatives 1A–C, 2A–C, 3, 4 and 5 would not contribute considerably to this cumulative
28 condition. Conservation Measures 4, 5, and 10, through the ability of these new wetlands to load
29 additional organic carbon to Delta waters, would contribute considerably to the significant adverse
30 (significant) cumulative organic carbon condition in the Delta. In addition, CM2 would create greater
31 localized source loading of DOC to Delta waters for all BDCP alternatives, to the degree that the Yolo
32 Bypass would be inundated more frequently and/or to a greater geographic extent under the
33 alternatives, relative to Existing Conditions. Implementation of Mitigation Measure WQ-17 and WQ-
34 18 may reduce these contributions, but it is unknown whether these actions would be feasible and
35 would effectively reduce the incremental contribution to the adverse (significant) cumulative
36 condition to a less-than-significant level. These cumulative effects are not expected to extend to the
37 south Delta pumps or the SWP/CVP Export Service Areas.

38 Implementation of facilities operations and maintenance (CM1) for Alternatives 6A–9 would
39 contribute considerably to the adverse (significant) cumulative pesticide and herbicide condition in
40 the Delta, but Alternatives 1A–5 would not contribute considerably to this significant cumulative
41 condition. Also, implementation of CM13 (nonnative aquatic vegetation control) is the only
42 conservation measure identified that would contribute considerably to the cumulative pesticide and
43 herbicide condition in the Delta. However, with implementation of Mitigation Measure WQ-22, the
44 contribution to the cumulative condition of CM13 is expected to be less than significant. The
45 cumulative effects for pesticides and herbicides are not expected to extend to the SWP/CVP Export
46 Service Areas due to the increases in Sacramento River source fraction at Banks and Jones pumping

1 plants under all BDCP alternatives and its generally lower levels of pesticides relative to the San
2 Joaquin River source water.

3 *Alternatives 4A, 2D, and 5A*

4 The incremental effects of the water conveyance facilities operations and maintenance component
5 of Alternatives 4A, 2D, and 5A, including Mitigation Measure WQ-11 proposed for EC, would not be
6 expected to be cumulatively considerable for chloride and EC conditions in the Delta.

7 Implementation of Alternatives 4A, 2D, and 5A would, in fact, improve conditions for these
8 constituents at the Banks and Jones pumping plants in the south Delta and thus in the SWP/CVP
9 Export Service Areas.

10 Facilities operations and maintenance under Alternatives 4A, 2D, and 5A would not be expected to
11 contribute considerably to the significant cumulative *Microcystis* condition in the Delta through
12 increased residence times in the Delta during the summer period. Similarly, Environmental
13 Commitments are not expected to contribute to this significant cumulative condition, because the
14 area of restoration would be so small as to have no net effect on through-Delta residence time.

15 Facilities operations and maintenance would not be expected to contribute considerably to the
16 significant cumulative mercury and selenium conditions in the Delta. Implementation of habitat
17 restoration Environmental Commitments could contribute considerably to the significant
18 cumulative mercury condition at certain localized areas within the Delta (i.e., near where the
19 wetland restoration areas are planned) through the potential for increased mercury methylation in
20 these restored wetland habitats. Although Environmental Commitment 12 is designed to reduce
21 these effects for mercury, it is not known if these actions would be feasible and could effectively
22 reduce the incremental contribution to the adverse (significant) cumulative condition to a less-than-
23 significant level. With implementation of *AMM27 Selenium Management*, which affords for site-
24 specific measures to reduce effects, the incremental effects of habitat restoration on selenium would
25 not be expected to be cumulatively considerable.

26 Implementation of facilities operations and maintenance for Alternatives 4A, 2D, and 5A would not
27 contribute considerably to the significant cumulative organic carbon condition in the Delta. Habitat
28 restoration Environmental Commitments would potentially load additional organic carbon to Delta
29 waters, but contributions are not expected to be cumulatively considerable, because the land area
30 proposed for restoration would be relatively small compared to existing land area and sources of
31 DOC as to not have an effect on DOC concentrations.

32 Implementation of facilities operations and maintenance for Alternatives 4A, 2D, and 5A would not
33 contribute considerably to the adverse (significant) cumulative pesticide and herbicide condition in
34 the Delta, because the changes in the source water fractions of Sacramento River, San Joaquin River,
35 and Delta agriculture water, due to the alternatives, would not be expected to be of sufficient
36 magnitude to substantially alter the long-term risk of pesticide-related toxicity to aquatic life, nor
37 adversely affect other beneficial uses of the Delta. Further, the Environmental Commitments would
38 not involve actions that would contribute to additional pesticide loading, and thus would not
39 contribute considerably to the significant cumulative pesticide condition in the Delta.

1 Mitigation Measures

2 *BDCP Alternatives*

3 The following conservation measure mitigation measures, and environmental commitment have
 4 been developed to mitigate the contributions of the BDCP alternatives to the adverse (significant)
 5 cumulative water quality conditions described above for bromide (Mitigation Measure WQ-5),
 6 chloride (Mitigation Measure WQ-7), electrical conductivity (Mitigation Measures WQ-11a, 11b, 11c,
 7 and 11d), mercury (CM12), organic carbon (Mitigation Measures WQ-17 and WQ-18), pesticides and
 8 herbicides (Mitigation Measure WQ-22) and selenium (*AMM27 Selenium Management*). As noted for
 9 the BDCP alternatives in Section 8.3.3, it is expected that the impacts on these constituents would
 10 remain significant and unavoidable with mitigation.

11 *Alternatives 4A, 2D, and 5A*

12 The following mitigation measures and Environmental Commitment have been developed to
 13 mitigate the contributions of Alternatives 4A, 2D, and 5A to the adverse (significant) cumulative
 14 water quality conditions described above for electrical conductivity (Mitigation Measures WQ-11e
 15 and 11f) and mercury (Environmental Commitment 12). As noted for these alternatives in Section
 16 8.3.4, it is expected that the impacts on mercury would remain significant and unavoidable with
 17 mitigation; however, impacts on EC would be reduced to a less-than-significant level.

18 8.4 References Cited

- 19 Agency for Toxic Substances and Disease Registry. 1995. *Toxicological Profile for Polycyclic Aromatic*
 20 *Hydrocarbons*. U.S. Department of Health and Human Services.
- 21 ———. 2007. *Toxicological Profile for Boron*. U.S. Department of Health and Human Services, Public
 22 Health Service. Agency for Toxic Substances and Disease Registry, Division of Toxicology and
 23 Environmental Medicine. Atlanta, GA.
- 24 Alpers, C., R. Antweiler, H. Taylor, P. Dileanis, and J. Domagalski. 2000. *Metals Transport in the*
 25 *Sacramento River, California, 1996–1997*. Volume 1: Methods and Data. U.S. Geological Survey–
 26 Water Resources Investigations Report 99-4286. Sacramento, CA.
- 27 Alpers, C. N., C. Eagles-Smith, C. Foe, S. Klasing, M. C. Marvin-DiPasquale, D. G. Slotton, and
 28 L. Windham-Meyers. 2008. *Sacramento-San Joaquin Delta Regional Ecosystem Restoration*
 29 *Implementation Plan*. Ecosystem Conceptual Model. Mercury.
- 30 Amy, G., R. Bull, K. Kerri, S. Regli, and P. Singer. 1998. *Bay-Delta Drinking Water Quality: Bromide Ion*
 31 *(Br-) and Formation of Brominated Disinfection By-Products (DBPs)*. Appendix E to July 2000
 32 CALFED Bay-Delta Program Water Quality Program Plan. Sacramento, CA.
- 33 Anderson, B., J. Hunt, B. Phillips, B. Thompson, S. Lowe, K. Taberski, and R. Scott Carr. 2007. Patterns
 34 and Trends in Sediment Toxicity in the San Francisco Estuary. *Environmental*
 35 *Research* 105(2007):145–155.
- 36 Archibald Consulting, Palencia Consulting Engineers, and Starr Consulting. 2012. *California State*
 37 *Water Project Watershed Sanitary Survey 2011 Update*. Prepared for State Water Project
 38 Contractors Authority and the California Department of Water Resources. June.

- 1 Aquatic Science Center. 2012. *The Pulse of the Delta: Linking Science & Management through Regional*
2 *Monitoring*. Contribution No. 673. Aquatic Science Center, Richmond, CA.
- 3 Ayers, R., and D. Westcot. 1994. *Water Quality for Agriculture*. FOA Irrigation and Drainage Paper.
- 4 Ballard, A., R. Breuer, F. Brewster, C. Dahm, C. Irvine, K. Larsen, A. Mueller-Solger, and A. Vargas.
5 2009. *Background/Summary of Ammonia Investigations in the Sacramento-San Joaquin Delta and*
6 *Suisun Bay*. March 2, 2009. Available: <[http://www.waterboards.ca.gov/centralvalley/](http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/ambient_ammonia_concentrations/02mar09_ammonia_invest_summ.pdf)
7 [water_issues/delta_water_quality/ambient_ammonia_concentrations/02mar09_ammonia_](http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/ambient_ammonia_concentrations/02mar09_ammonia_invest_summ.pdf)
8 [invest_summ.pdf](http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/ambient_ammonia_concentrations/02mar09_ammonia_invest_summ.pdf)>. Accessed January 19, 2012.
- 9 Baxa, D. V., T. Kurobe, K. A. Ger, P. W. Lehmen, and S. J. Teh. 2010. Estimating the Abundance of Toxic
10 *Microcystis* in the San Francisco Estuary Using Quantitative Real-Time PCR. *Harmful Algae*
11 9:342–349.
- 12 Bay Delta and Tributaries Project. 2009. *Bay Delta and Tributaries Project*.
13 Available: <<http://bdat.ca.gov/index.html>>. Accessed: March 2, 2009.
- 14 ———. 2010. *Bay Delta and Tributaries Project*. Available: <<http://bdat.ca.gov/index.html>>.
15 Accessed: April 14, 2010.
- 16 Beckon, W. N., M. C. S. Eacock, and A. G. Gordus. 2008. Biological Effects of the Grassland Bypass
17 Project. In San Francisco Estuary Institute for the Grassland Bypass Project Oversight
18 Committee, *Grassland Bypass Project 2004-2005*. San Francisco, CA. Chapter 7, pages 93–167.
- 19 Bennett, J., J. Hofius, C. Johnson, and T. Maurer. 2001. *Tissue Residues and Hazards of Water-Borne*
20 *Pesticides for Federally Listed and Candidate Fishes of the Sacramento–San Joaquin River Delta,*
21 *California: 1993–1995*. Department of the Interior, U.S. Fish and Wildlife Service.
- 22 Benotti, M., R. Trenholm, B. Vanderford, J. Holady, B. Stanford, and S. Snyder. 2009. Pharmaceuticals
23 and Endocrine Disrupting Compounds in U.S. Drinking Water. *Environmental Science &*
24 *Technology* 43(3):597–603.
- 25 Black, K., M. Yilmaz, and E. J. Phillips. 2011. Growth and Toxin Production by *Microcystis Aeruginosa*
26 PCC 7806 (Kutzling) Lemmerman at Elevated Salt Concentrations. *Journal of Environmental*
27 *Protection* 2: 669–674.
- 28 Bradley, P., L. Barber, F. Chapelle, J. Gray, D. Kolpin, and P. McMahon. 2009. Biodegradation of
29 17-estradiol, Estrone and Testosterone in Stream Sediments. *Env. Sci. Tech.* 43:1902–1910.
- 30 Brinkmann, U., and A. de Kok. 1980. Production, Properties, and Usage. In R. Kimbrough (ed.),
31 *Halogenated Biphenyls, Terphenyls, Naphthalenes, Dibenzodioxins and Related Products, Topics in*
32 *Environmental Health, Volume 4*. Amsterdam, Netherlands: Elsevier/North Holland Biomedical
33 Press.
- 34 Brown, F., J. Winkler, P. Visita, J. Dhaliwal, and M. Petreas. 2006. Levels of PBDEs, PCDFs, and
35 Coplanar PCBs in Edible Fish from California Coastal Waters. *Chemosphere* 64:276–286.
- 36 Buck, K., J. Ross, A. Flegal, and K. Bruland. 2006. A Review of Total Dissolved Copper and Its Chemical
37 Speciation in San Francisco Bay, California. *Environmental Research* 105(2007):5–19.

- 1 Bureau of Reclamation. 2004. *Long-Term Central Valley Project and State Water Project Operating*
2 *Criteria and Plan*. Biological Assessment for ESA Section 7(a)(2) Consultation. Mid-Pacific
3 Region. Sacramento, CA.
- 4 ———. 2006. *San Luis Drainage Feature Re-evaluation Final Environmental Impact Statement,*
5 *Section 5*. Mid-Pacific Region, Sacramento, CA. Available:
6 <http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=61>
- 7 ———. 2009a. *Central Valley Project–Delta Division*. Accessed: March 12, 2009. Available:
8 <http://www.usbr.gov/projects/Project.jsp?proj_Name=Delta+Division+Project>
- 9 ———. 2009b. *Central Valley Project–General Overview*. Accessed: March 12, 2009. Available:
10 <http://www.usbr.gov/projects/Project.jsp?proj_Name=Central+Valley+Project>
- 11 ———. 2009c. *Record of Decision Grassland Bypass Project, 2010–2019*. ROD-07-141. South-Central
12 California Area Office, Fresno, CA.
- 13 ———. 2009d. Data received February 9, 2009, via e-mail from Michael C. S. Eacock, Project
14 Manager/Soil Scientist, South-Central California Area Office, Fresno, CA.
- 15 Bureau of Reclamation, U.S. Fish and Wildlife Service, and California Department of Fish and Game.
16 2011. *Suisun Marsh Habitat Management, Preservation, and Restoration Plan. Final EIS-EIR*.
17 Available: <http://www.usbr.gov/mp/nepa/nepa_projdetails.cfm?Project_ID=781>.
- 18 Butterwick, L., N. de Oude, and K. Raymond. 1989. Safety Assessment of Boron in Aquatic and
19 Terrestrial Environments. *Ecotoxicology and Environmental Safety* 17:339–371.
- 20 CALFED Bay-Delta Program. 2000. *CALFED Bay-Delta Program Final Programmatic Environmental*
21 *Impact Statement/Environmental Impact Report*. Prepared by the CALFED Bay-Delta Program
22 for the U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries
23 Service, U.S. Environmental Protection Agency, Natural Resources Conservation Service, U.S.
24 Army Corps of Engineers, and California Resources Agency. Available:
25 <http://www.calwater.ca.gov/calfed/library/Archive_EIS.html>. Accessed March 9, 2009.
- 26 ———. 2003. *Drinking Water Quality: Bromide*. Available: <[http://www.science.calwater.ca.gov/](http://www.science.calwater.ca.gov/pdf/water_quality_bromide.pdf)
27 [pdf/water_quality_bromide.pdf](http://www.science.calwater.ca.gov/pdf/water_quality_bromide.pdf)>. Accessed: February 17, 2009.
- 28 ———. 2007a. *Conceptual Model for Salinity in the Central Valley and Sacramento–San Joaquin Delta*.
29 CALFED Bay-Delta Program, Sacramento, CA.
- 30 ———. 2007b. *Final Draft CALFED Water Quality Program Stage 1 Final Assessment*. CALFED Water
31 Quality Program.
- 32 ———. 2008a. *The State of Bay-Delta Science, 2008*. CALFED Science Program.
- 33 ———. 2008b. *CALFED Water Quality Program, Program Plan Year 9*.
- 34 California Department of Boating and Waterways. 2006. *Egeria densa Control Program, Second*
35 *Addendum to 2001 Environmental Impact Report with Five-Year Program Review and Future*
36 *Operations Plan*. December 8.
- 37 California Department of Water Resources. 1981. Contract between the State of California
38 Department of Water Resources and the North Delta Water Agency for the assurance of a
39 dependable water supply of suitable quality. January 28.

- 1 ———. 1995. *Sacramento–San Joaquin Delta Atlas*. The Resources Agency, Sacramento, CA.
- 2 ———. 1997. Chapter 2: DSM2 MODEL DEVELOPMENT. Methodology for Flow and Salinity
3 Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. *18th Annual Progress Report*
4 *to the State Water Resources Control Board*. Sacramento, CA
- 5 ———. 2005. *California Water Plan Update 2005* (Bulletin 160-05).
- 6 ———. 2009a. *California State Water Project Today*. Last updated 2009. Available:
7 <<http://www.publicaffairs.water.ca.gov/swp/swptoday.cfm>>. Accessed March 12, 2009
- 8 ———. 2009b. *Water Data Library*. Available: <www.wdl.water.ca.gov/>. Accessed March 3, 2009.
- 9 ———. 2010. *The State Water Project Delivery Reliability Report 2009*. Available:
10 <<http://baydeltaoffice.water.ca.gov/swpreliability/>>.
- 11 California Office of Environmental Health Hazard Assessment. 2008. *Development of Fish*
12 *Contaminant Goals and Advisory Tissue Levels for Common Contaminants in California Sport Fish:*
13 *Chlordane, DDTs, Dieldrin, Methylmercury, PCBs, Selenium, and Toxaphene*. Sacramento, CA. June.
- 14 ———. 2010. *Announcement of Publication of the Final Public Health Goal for Selenium in Drinking*
15 *Water*. Available: <<http://oehha.ca.gov/water/phg/121010phg.html>>. Accessed: July 30, 2012.
- 16 California Urban Water Agencies. 1998. *Bay-Delta Water Quality Evaluation Draft Final Report*.
17 Expert Panel: D. Owen, P. Daniel, R. Summers.
- 18 Centers for Disease Control. 2005. *Third National Report on Human Exposure to Environmental*
19 *Chemicals*. NCEH Pub. No. 05-0570, Atlanta, Georgia. Available:
20 <<http://www.cdc.gov/exposurereport/>>.
- 21 Central Coast Regional Water Quality Control Board. 2011. *Water Quality Control Plan for the Central*
22 *Coastal Basin. San Luis Obispo, California*. Available: <[http://www.swrcb.ca.gov/rwqcb3/](http://www.swrcb.ca.gov/rwqcb3/publications_forms/publications/basin_plan/index.shtml)
23 [publications_forms/publications/basin_plan/index.shtml](http://www.swrcb.ca.gov/rwqcb3/publications_forms/publications/basin_plan/index.shtml)>. Accessed July 13, 2010.
- 24 Central Valley Regional Water Quality Control Board. 2001. *Total Maximum Daily Load for Selenium*
25 *in the Lower San Joaquin River*. Staff Report. Sacramento, CA.
- 26 ———. 2002. *Amendment to the Water Quality Control Plan for the Sacramento River and San*
27 *Joaquin River Basins*. Staff Report and Functional Equivalent Document.
- 28 ———. 2004. *Amendments to the Water Quality Control Plan for the Sacramento River and San*
29 *Joaquin River Basins for The Control of Salt and Boron into the Lower San Joaquin River*. Final Staff
30 Report.
- 31 ———. 2005. *Amendments to the Water quality Control Plan for the Sacramento River and San*
32 *Joaquin River Basins for The Control Program for Factors Contributing to the Dissolved Oxygen*
33 *Impairment in the Stockton Deep Water Ship Channel*. Final Staff Report.
- 34 ———. 2006. *Amendments to the Water Quality Control Plan for the Sacramento River and San*
35 *Joaquin River Basins for the Control of Diazinon and Chlorpyrifos Runoff into the Sacramento-San*
36 *Joaquin Delta*. Final Staff Report. June.
- 37 ———. 2007. *Water Quality Control Plan (Basin Plan) for the Sacramento River Basin and the San*
38 *Joaquin River Basin. Fourth Edition Revised October 2007 (with Amendments)*. Sacramento, CA.

- 1 ———. 2008a. *Sacramento–San Joaquin Delta Estuary TMDL for Methylmercury*. Staff Report.
2 February.
- 3 ———. 2008b. *Amendments to the Water Quality Control Plan for the Sacramento River and San*
4 *Joaquin River Basins for the Control of Methylmercury and Total Mercury in the Sacramento–San*
5 *Joaquin Delta Estuary*. Staff Report. February.
- 6 ———. 2009a. *Water Quality Control Plan (Basin Plan) for Sacramento River Basin and San Joaquin*
7 *River Basin*. Revised September 2009 (with Approved Amendments). Rancho Cordova, CA.
8 Available: <http://www.swrcb.ca.gov/centralvalley/water_issues/basin_plans/index.shtml>.
- 9 ———. 2009b. *TMDL and 303(d) List–TMDL Projects in the Central Valley Region*. Available:
10 <[http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/index.sht](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/index.shtml)
11 [ml](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/index.shtml)>. Accessed: May 19, 2009.
- 12 ———. 2009c. *San Joaquin River Selenium TMDL*. Sacramento, California. Accessed: March 12, 2009.
13 Available: <[http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/san_joaquin_se/)
14 [central_valley_projects/san_joaquin_se/](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/san_joaquin_se/)>
- 15 ———. 2009d. *Relative-Risk Evaluation for Pesticides Used in the Central Valley Pesticide Basin Plan*
16 *Amendment Project Area*. Final Staff Report. February.
- 17 ———. 2010a. *2010 Ammonia Update*. Memo from C. Foe to J. Bruns, Central Valley Water Board.
- 18 ———. 2010b. Order No. R5-2010-0114, NPDES No. CA0077682, Waste Discharge Requirements
19 for the Sacramento Regional County Sanitation District, Sacramento Regional Wastewater
20 Treatment Plant, Sacramento County.
- 21 ———. 2010c. *Central Valley Pesticide TMDL and Basin Plan Amendment–Water Quality Criteria*
22 *Method Development; Phase III Reports*. Available: <[http://www.waterboards.ca.gov/](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/criteria_method/index.shtml)
23 [centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/criteria_method/index.shtml)
24 [criteria_method/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/central_valley_pesticides/criteria_method/index.shtml)>. Accessed: April 2010.
- 25 ———. 2010d. *Resolution No. R5-2010-0046 Amending the Water Quality Control Plan for the*
26 *Sacramento River and San Joaquin River Basins for the Control of Selenium in the Lower San*
27 *Joaquin River Basin*. Adopted May 27. Available: <[http://www.waterboards.ca.gov/](http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0046_res.pdf)
28 [centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0046_res.pdf](http://www.waterboards.ca.gov/centralvalley/board_decisions/adopted_orders/resolutions/r5-2010-0046_res.pdf)>.
- 29 ———. 2010e. *Aquatic Issue Paper. NPDES Permit Renewal Issues Aquatic Life and Wildlife*
30 *Preservation*.
- 31 ———. 2011a. *Drinking Water Policy for Surface Waters Outline (October)*. Available:
32 <http://www.swrcb.ca.gov/centralvalley/water_issues/drinking_water_policy/>.
- 33 ———. 2011b. *Sacramento–San Joaquin Delta Estuary TMDL for Methylmercury*. Final EPA
34 Approval of Basin Plan Amendment, Oct. 20, 2011.
- 35 ———. 2011c. *Cache Creek, Bear Creek, Sulfur Creek, and Harley Gulch TMDL for Mercury*. Available:
36 <[http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/cac](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/cache_sulphur_creek/index.shtml)
37 [he_sulphur_creek/index.shtml](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/cache_sulphur_creek/index.shtml)>.

- 1 ———. 2011d. *American River Mercury TMDL July 28 CEQA scoping meeting cancellation letter*. July
 2 15. Available: <[http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/
 3 central_valley_projects/american_river_hg/2011jul28_ceqa_scop_mtg/2011jul28_mtg_](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/american_river_hg/2011jul28_ceqa_scop_mtg/2011jul28_mtg_cancel.pdf)
 4 [cancel.pdf](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/american_river_hg/2011jul28_ceqa_scop_mtg/2011jul28_mtg_cancel.pdf)>. Accessed: October 10, 2013.
- 5 ———. 2015. *San Joaquin River Dissolved Oxygen Control Program Implementation Draft Staff Report*.
 6 January. Available: <[http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/
 7 central_valley_projects/san_joaquin_oxygen/required_studies/2014nov_staffrpt_draft.pdf](http://www.waterboards.ca.gov/centralvalley/water_issues/tmdl/central_valley_projects/san_joaquin_oxygen/required_studies/2014nov_staffrpt_draft.pdf)>.
 8 Accessed: May 15, 2015.
- 9 CH2M HILL. 2009. *DSM2 Recalibration*. Prepared for California Department of Water Resources.
 10 October.
- 11 Chauhan, R. P. S., and S. L. Powar. 1978. Tolerance of Wheat and Pea to Boron in Irrigation Water.
 12 *Plant Soil* 50:145–149.
- 13 Chen, W-H, K. Haunschild, J. Lund, and W. E. Fleenor. 2010. Current and Long-Term Effects of Delta
 14 Water Quality on Drinking Water Treatment Costs from Disinfection Byproduct Formation. *San*
 15 *Francisco Estuary and Watershed Science* 8(3). Available:
 16 <<http://escholarship.org/uc/item/0qf4072h>>.
- 17 Chow, A., R. Dahlgren, and J. Harrison. 2007. Watershed Sources of Disinfection Byproduct
 18 Precursors in the Sacramento and San Joaquin Rivers, California. *Environmental Science and*
 19 *Technology* 41:7645–7652.
- 20 Cloern, J., D. Jassby, J. Carstensen, W. Bennett, W. Kimmerer, R. Mac Nally, D. Schoellhamer, and M.
 21 Winder. 2012. Perils of Correlating CUSUM-Transformed Variables to Infer Ecological
 22 Relationships. *Limn. Oceanogr.* 57(2): 665-668.
- 23 Contra Costa Water District. 1997. *Conversions between EC, TDS, Chlorides, Bromide and Sodium*.
 24 Prepared by Richard A. Denton. January.
- 25 ———. 2009. *FAQs on Pharmaceuticals and Personal Care Products in CCWD Water*. Accessed:
 26 March 2009. Available: <<http://www.ccwater.com/waterquality/Endocrine.asp>
- 27 Cutter, G. A., and L. S. Cutter. 2004. Selenium Biogeochemistry in the San Francisco Bay Estuary:
 28 Changes in Water Column Behavior. *Estuarine Coastal and Shelf Science* 61:463–476.
- 29 David, N., L. J. McKee, F. J. Black, A. R. Flegal, C. H. Conaway, D. H. Schoellhamer, and N. K. Ganju.
 30 2009. Mercury Concentrations and Loads in a Large River System Tributary to San Francisco
 31 Bay, California, USA. *Environmental Toxicology and Chemistry* 28(10): 2091–2100.
- 32 Davis, J., L. McKee, J. Leatherbarrow, and T. Daum. 2000. *Contaminant Loads: From Stormwater to*
 33 *Coastal Waters in the San Francisco Bay Region*. San Francisco Estuary Institute.
- 34 Davis, J., F. Hetzel, J. Oram, and L. McKee. 2007. Polychlorinated Biphenyls (PCBs) in San Francisco
 35 Bay. *Environmental Research* 105:67–86.
- 36 Davis, J. A., B. K. Greenfield, G. Ichikawa, and M. Stephenson. 2008. Mercury in Sport Fish from the
 37 Sacramento–San Joaquin Delta Region, California, USA. *Science of the Total Environment* 391:66–
 38 75.

- 1 Davis, J. A., R. E. Looker, D. Yee, M. Marvin-Di Pasquale, J. L. Grenier, C. M. Austin, L. J. McKee, B. K.
2 Greenfield, R. Brodberg, and J. D. Blum. 2012. Reducing Methylmercury Accumulation in the
3 Food Webs of San Francisco Bay and its Local Watersheds. *Environmental Research* 119:3–26.
- 4 Davis, T. W., D. L. Berry, G. L. Boyer, and C. J. Gobler. 2009. The Effects of Temperature and Nutrients
5 on the Growth and Dynamics of Toxic and Non-toxic Strains of *Microcystis* during Cyanobacteria
6 Blooms. *Harmful Algae* 8:715–725.
- 7 Dawson, B. 2001. *Ground-Water Quality in the Southeastern Sacramento Valley Aquifer, California*.
8 U.S. Geological Survey Water-Resources Investigations Report 01-4125.
- 9 Deng, D.-F., S. S. O. Hung, and S. J. Teh. 2007. Selenium Depuration: Residual Effects of Dietary
10 Selenium on Sacramento Splittail (*Pogonichthys macrolepidotus*). *Science of the Total*
11 *Environment* 377:224–232.
- 12 Deng, D.-F., F.-C. Teh, and S. J. Teh. 2008. Effect of Dietary Methylmercury and Seleno-Methionine on
13 Sacramento Splittail Larvae. *Science of the Total Environment* 407:197–203.
- 14 Desmarais, T., H. Solo-Gabriele, and C. Palmer. 2001. Influence of Soil on Fecal Indicator Organisms
15 in a Tidally Influenced Subtropical Environment. *Applied and Environmental Microbiology*
16 68(3):1165–1172
- 17 Deverel, S., D. Leighton, and M. Finlay. 2007. Processes Affecting Agricultural Drainwater Quality and
18 Organic Carbon Loads in California’s Sacramento–San Joaquin Delta. *San Francisco Estuary and*
19 *Watershed Science* 5(2). May, Article 2.
- 20 DiGiorgio, C., S. W. Krasner, C. Guo, M. Dale, and M. Scimenti. 2009. *Sources, Fate, and Transport of*
21 *NDMA, Pharmaceuticals and Personal Care Products (PPCPs) in Water*. Proceedings of
22 presentation given at April 21, 2009 face to face meeting of Municipal Water Quality
23 Investigation and contractor. Available: <[http://www.water.ca.gov/waterquality/
24 drinkingwater/docs/NDMA-DiGiorgio.pdf](http://www.water.ca.gov/waterquality/drinkingwater/docs/NDMA-DiGiorgio.pdf)>. Accessed July 31, 2013.
- 25 Dortch, Q. 1990. The Interaction Between Ammonium and Nitrate Uptake in Phytoplankton. *Mar.*
26 *Ecol. Prog. Ser.* 61: 183-201.
- 27 Drexler, J., C. de Fontaine, and S. Deverel. 2009a. The Legacy of Wetland Drainage on the Remaining
28 Peat in the Sacramento-San Joaquin Delta, California, USA. *Wetlands* 29(1):372–386.
- 29 Drexler, J., C. de Fontaine, and T. Brown. 2009b. Peat Accretion Histories During the Past 6000 Years
30 in Marshes of the Sacramento-San Joaquin Delta, California, USA. *Estuaries and Coasts*.
31 32:871–892.
- 32 DSM2PWT. 2001. *Enhanced Calibration and Validation of DSM2 HYDRO and QUAL, Draft Final Report*.
33 Interagency Ecological Program for the Sacramento-San Joaquin Estuary. November.
- 34 Dugdale, R., F. Wilkerson, V. Hogue, and A. Marchi. 2007. The Role of Ammonium and Nitrate in
35 Spring Bloom Development in San Francisco Bay. *Estuarine Coastal and Shelf Science* 73:17–29.
- 36 Dugdale, R. C., F. P. Wilkerson, A. E. Parker, A. Marchi and K. Taberski. 2012. River Flow and
37 Ammonium Discharge Determine Spring Phytoplankton Blooms in an Urbanized Estuary.
38 *Estuarine Coastal and Shelf Science* 115:187-199.

- 1 Eckard, R. S., P. J. Hernes, B. A. Bergamaschi, R. Stepanauskas, and C. Kendall. 2007. Landscape Scale
2 Controls on the Vascular Plant Component of Organic Matter in the Sacramento–San Joaquin
3 Delta. *Geochimica et Cosmochimica Acta* 71:5968–5984.
- 4 Eisler, R. 1987. *Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: A*
5 *Synoptic Review*. U.S. Fish and Wildlife Service Biological Report 85(1.11).
- 6 Engle, Diana, and Claus Suverkropp. 2010. Memorandum, Comments for Consideration by the State
7 Water Resources Control Board Regarding the Scientific Article *Long-term Changes in Nutrient*
8 *Loading and Stoichiometry and their Relationships with Changes in the Food Web and Dominant*
9 *Pelagic Fish Species in the San Francisco Estuary, California*. Memorandum, 29 July 2010, Larry
10 Walker Associates.
- 11 Entrix. 2008. *Grassland Bypass Project, 2010–2019 Environmental Impact Statement and*
12 *Environmental Impact Report*. Draft, December. Prepared for U.S. Bureau of Reclamation and San
13 Luis & Delta-Mendota Water Authority. Concord, CA.
- 14 Evanson, M., and R. Ambrose. 2006. Sources and Growth Dynamics of fecal Indicator Bacteria in a
15 Coastal Wetland System and Potential Impacts to Adjacent Waters. Science Direct. *Water*
16 *Research* 40:475–486
- 17 Fleck, J., M. Fram, and R. Fujii. 2007. Organic Carbon and Disinfection Byproduct Precursor Loads
18 from a Constructed, Non-Tidal Wetland in California’s Sacramento–San Joaquin Delta. *San*
19 *Francisco Estuary and Watershed Science* 5(2):1–24
- 20 Flegal, A., C. Brown, S. Squire, J. Ross, G. Scelfo, and S. Hibdon. 2007. Spatial and Temporal Variations
21 in Silver Contamination and Toxicity in San Francisco Bay. *Environmental Research* 105:34–52.
- 22 Foe, C. 2010. *Selenium Concentrations in Largemouth Bass in the Sacramento–San Joaquin Delta*.
23 Central Valley Regional Water Quality Control Board, Sacramento, CA. June.
- 24 Foe, C., S. Louie and D. Bosworth. 2008. *Methylmercury Concentrations and Loads in the Central*
25 *Valley and Freshwater Delta*. Final Report submitted to the CALFED Bay-Delta Program for the
26 project “Transport, Cycling and Fate of Mercury and Methylmercury in the San Francisco
27 Delta and Tributaries” Task 2. Central Valley Regional Water Quality Control Board. Available:
28 <<http://mercury.mlml.calstate.edu/reports/reports/>>.
- 29 Fox, J., and E. Archibald. 1997. *Aquatic Toxicity and Pesticides in Surface Waters of the Central Valley*.
30 Prepared for California Urban Water Agencies.
- 31 Gilmour, C., E. Henry, and R. Mitchell. 1992. Sulfate Stimulation of Mercury Methylation in
32 Freshwater Sediments. *Environmental Science and Technology* 26:2281–2287.
- 33 Gilbert, P. M. 2010. Long-Term Changes in Nutrient Loading and Stoichiometry and their
34 Relationships with Changes in the Food Web and Dominant Pelagic Fish Species in the San
35 Francisco Estuary, California. *Reviews in Fish Science* 18:211–232,
36 doi:10.1080/10641262.2010.492059
- 37 Gilbert, P. M., C. A. Heil, D. Hollander, M. Revilla, A. Hoare, J. Alexander, and S. Murasko. 2004.
38 Evidence for Dissolved Organic Nitrogen and Phosphorus Uptake During A Cyanobacterial
39 Bloom in Florida Bay. *Mar. Ecol. Prog. Ser.* 280: 73-83.

- 1 Gilbert, P. M., J. Harrison, C. A. Heil, and S. Seitzinger. 2006. Escalating Worldwide Use of Urea – A
2 Global Change Contributing to Coastal Eutrophication. *Biogeochem.* 77: 441-463.
- 3 Gilbert, P. M., D. Fullerton, J. M. Burkholder, J. C. Cornwell and T. M. Kana. 2011. Ecological
4 Stoichiometry, Biogeochemical Cycling, Invasive Species, and Aquatic Food Webs: San Francisco
5 Estuary and Comparative Systems. *Reviews in Fisheries Science* 19(4):358–417.
- 6 Gorski, P. R., D. E. Armstrong, J. P. Hurley, and D. P. Krabbenhoft. 2008. Influence of Natural
7 Dissolved Organic Carbon on the Bioavailability of Mercury to a Freshwater Alga. *Environmental*
8 *Pollution* 154:116–123.
- 9 Grant, S., B. Sanders, A. Beohm, J. Redman, J. Kim, R. Mrse, A. Chu, M. Gouldin, C. McGee, N. Gardiner,
10 B. Jones, J. Svejksky, G. Leipzig, and A. Brown. 2001. Generation of Enterococci Bacteria in a
11 Coastal Saltwater Marsh and its Impact on Surf Zone Water Quality. *Environmental Science and*
12 *Technology* 35(12):2407–2416.
- 13 Green, P., and T. Young. 2006. Loading of the Herbicide Diuron into the California Water System.
14 *Environmental Engineering Science* 23(3):545–551
- 15 Greenfield, B., and J. Davis. 2005. A PAH Fate Model for San Francisco Bay. *Chemosphere* 60:515–530.
- 16 Greenfield, B., G. Siemering, J. Andrews, M. Rajan, S. Andrews, Jr., and D. Spencer. 2007. Mechanical
17 Shredding of Water Hyacinth (*Eichhornia crassipes*): Effects on Water Quality in the
18 Sacramento–San Joaquin River Delta, California. *Estuaries and Coasts* 30(4):627–640.
- 19 Greenfield, B. K., S. J. Teh, J. R. M. Ross, J. Hunt, G. H. Zhang, J. A. Davis, G. Ichikawa, D. Crane, S. S. O.
20 Hung, D. F. Deng, F-C. Teh, and P. G. Green. 2008. Contaminant Concentrations and
21 Histopathological Effects in Sacramento Splittail. *Archives of Environmental Contamination and*
22 *Toxicology* 55:270–281. Supplemental electronic information provided by author.
- 23 Gullett, B., A. Touati, and M. Hays. 2003. PCDD/F, PCB, HxBz, PAH, and PM Emission Factors for
24 Fireplace and Woodstove Combustion in the San Francisco Bay Region. *Environmental Science &*
25 *Technology* 37:1758–1765.
- 26 Guo, L., C. Nordmark, F. Sprulock, B. Johnson, L. Li, J. Lee, and K. Goh. 2004. Characterizing
27 Dependence of Pesticide Load in Surface Water on Precipitation and Pesticide Use for the
28 Sacramento Watershed. *Environmental Science & Technology* 38:3842–3852
- 29 Guo, Y. C., S. W. Krasner, S. Fitzsimmons, G. Woodside, and N. Yamachika. 2010. *Source, Fate, and*
30 *Transport of Endocrine Disruptors, Pharmaceuticals, and Personal Care Products in Drinking*
31 *Water Sources in California*. Prepared for the National Water Research Institute. Fountain Valley,
32 CA. Available: <<http://www.nwri-usa.org/CECs.htm>>.
- 33 Han, S., A. Obraztsova, P. Pretto, K. Choe, J. Gieskes, D. Deheyn, and B. Tebo. 2007. Biogeochemical
34 Factors Affecting Mercury Methylation in Sediments of the Venice Lagoon, Italy. *Environmental*
35 *Toxicology and Chemistry* 26:665–663.
- 36 Hayward, D., M. Petreas, J. Visita, M. McKinney, and R. Stephens. 1996. Investigation of a Wood
37 Treatment Facility: Impact on an Aquatic Ecosystem in the San Joaquin River, Stockton,
38 California. *Archives of Environmental Contaminant Toxicology* 30:30–39.

- 1 Heim, W. A., K. H. Coale, M. Stephenson, K. Choe, G. A. Gill, and C. Foe. 2007. Spatial and Habitat-
2 Based Variations in Total and Methyl Mercury Concentrations in Surficial Sediments in the San
3 Francisco Bay-Delta. *Environmental Science Technology* 41:3501–3507.
- 4 Hem, J. 1985. *Study and Interpretation of the Chemical Characteristics of Natural Water*. Third
5 Edition. United States Geological Survey Water-Supply Paper 2254. Reprinted in 1986 and 1989.
- 6 Hessen, D. O. 1997. Stoichiometry in Food Webs—Lotka Revisited. *Oikos* 79:195–200.
- 7 Hestir, E., D. Schoellamer, T. Morgan-King, and S. Ustin. 2013. A Step Decrease in Sediment
8 Concentration in a Highly Modified Tidal River Delta Following the 1983 E Niño Floods. *Marine*
9 *Geology* [in press].
- 10 Hodgkiss I. J., and K. C. Ho, 1997. Are Changes in N:P Ratios in Coastal Waters the Key to Increased
11 Red Tide Blooms? *Hydrobiologia* 352(1-3):141–147.
- 12 Hoenicke, R., D. Orosa, J. Orama, and K. Taberski. 2007. Adapting an Ambient Monitoring Program to
13 the Challenge of Managing Emerging Pollutants in the San Francisco Estuary. *Environmental*
14 *Research* 105:132–144.
- 15 Huisman, J., J. Sharples, J. M. Stroom, P. M. Visser, W. E. A. Kardinaal, J. M. H. Verspagen, and B.
16 Sommeijer. 2004. Changes in Turbulent Mixing Shift Competition for Light between
17 Phytoplankton Species. *Ecology* 85(11):2960–2970.
- 18 Ibanez, C., N. Prat, C. Duran, M. Pardos, A. Munn´e, R. Andreu, N. Caiola, N. Cid, H. Hampel, R.
19 S´anchez, and R. Trobajo. 2008. Changes in Dissolved Nutrients in the Lower Ebro River: Causes
20 and Consequences. *Limnetica* 27:131–142.
- 21 ICF International. 2010. *Stockton Deep Water Ship Channel Demonstration Dissolved Oxygen Aeration*
22 *Facility Project*. Final Report. December. (ICF 00508.10). Sacramento, CA. Prepared for:
23 California Department of Water Resources, Sacramento, CA. Available:
24 <http://baydeltaoffice.water.ca.gov/sdb/af/index_af.cfm>.
- 25 ———. 2016. *Draft Biological Assessment for the California WaterFix*. January. (ICF 0023.15).
26 Sacramento, CA. Prepared for U.S. Department of the Interior, Bureau of Reclamation,
27 Sacramento, CA.
- 28 Jassby, A. 2005. Phytoplankton Regulation in a Eutrophic Tidal River (San Joaquin River, California).
29 *San Francisco Estuary and Watershed Science* 3(1): Article 3.
- 30 ———. 2008. Phytoplankton in the Upper San Francisco Estuary: Recent Biomass Trends, Their
31 Causes and Their Trophic Significance. *San Francisco Estuary and Watershed Science* 6(1):
32 Article 2.
- 33 Jassby, A., and E. Van Nieuwenhuysse. 2005. Low Dissolved Oxygen in an Estuarine Channel (San
34 Joaquin River, California): Mechanisms and Models Based on Long-Term Time Series. *San*
35 *Francisco Estuary and Watershed Science* 3(2).
- 36 Jassby, A., J. Cloern, and B. Cole. 2002. Annual Primary Production: Patterns and Mechanisms of
37 Change in a Nutrient-Rich Tidal Ecosystem. *Limnology and Oceanography* 47:698–712.

- 1 Jassby, A. D., W. J. Kimmerer, S. G. Monismith, C. Armor, J. E. Cloern, T. M. Powell, J. R. Schubel, and T.
2 J. Vendlinski. 1995. Isohaline Position as a Habitat Indicator for Estuarine Populations.
3 *Ecological Applications* 5: 272-289.
- 4 Johnson, M., I. Werner, S. Teh, and F. Loge. 2010. *Evaluation of Chemical, Toxicological, and*
5 *Histopathologic Data to Determine Their Role in the Pelagic Organism Decline*. Synthesis Report
6 by UC Davis, submitted to the State Water Resources Control Board.
- 7 Johnson, N. W. and B. F. Beck 2012. *Sulfur and Carbon Controls on Methyl Mercury in St. Louis River*
8 *Estuary Sediment*. Phase II. Research Report. U. of Minnesota, Duluth.
- 9 Jones-Lee, A. 2008. *Stormwater Runoff Water Quality Newsletter, Devoted to Urban/Rural Stormwater*
10 *Runoff Water Quality Management Issues*. Volume 11, No. 5. (May 8) El Macero, CA.
- 11 Juttner, F. and S. B. Watson. 2007. Biochemical and Ecological Control of Geosmin and
12 2-Methylisoborneol in Source Waters. *Appl. Env. Microbiol.* 73(14):4395-4406.
- 13 Kidd, K., P. Blanchfield, K. Mills, V. Palace, R. Evans, J. Lazorchak, and R. Flick. 2007. Collapse of a Fish
14 Population After Exposure to a Synthetic Estrogen. *Proceedings of the National Academy of*
15 *Sciences* 104(21):8897-8901.
- 16 Kim, D., and T. Young. 2009. Significance of Indirect Deposition on Wintertime PAH Concentrations
17 in an Urban Northern California Creek. *Environmental Engineering Science* 26(2):269-277.
- 18 Kimmerer, W. J. and J. K. Thompson. 2014. Phytoplankton Growth Balanced by Clam and
19 Zooplankton Grazing and Net Transport into the Low-Salinity Zone of the San Francisco Estuary.
20 *Estuaries and Coasts*, Pre-print published online: January 7.
- 21 Kolpin, D., E. Furlong, M. Meyer, E. Thurman, S. Zaugg, L. Barber, and H. Buxton. 2002.
22 Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams,
23 1999-2000: A National Reconnaissance. *Environmental Science and Technology* 36(6):1202-
24 1211.
- 25 Kratzer, C., P. Dileanis, C. Zamora, S. Silva, C. Kendall, B. Bergamaschi, and R. Dahlgren. 2004. *Sources*
26 *and Transport of Nutrients, Organic Carbon, and Chlorophyll-A in the San Joaquin River Upstream*
27 *of Vernalis, California, during Summer and Fall, 2000 and 2001*. USGS Water-Resources
28 Investigations Report 03-4127.
- 29 Kraus, T. E. C., B. A. Bergamaschi, P. J. Hernes, R. G. M. Spencer, R. Stepanauskas, C. Kendall,
30 R. F. Losee, and R. Fujii. 2008. Assessing the Contribution of Wetlands and Subsided Islands to
31 Dissolved Organic Matter and Disinfection Byproduct Precursors in the Sacramento-San Joaquin
32 River Delta: A Geochemical Approach. *Organic Geochemistry* 39(9):1302-1318.
- 33 Kuivila, K. M., and C. G. Foe. 1995. Concentrations, Transport, and Biological Effects of Dormant
34 Spray Pesticides in the San Francisco Estuary, California. *International Journal of Environmental*
35 *Analytical Chemistry* 14(7):1141-1150
- 36 Kuivila, K. M., and B. E. Jennings. 2007. Input, Flux, and Persistence of Six Select Pesticides in San
37 Francisco Bay. *Internal Journal of Environmental and Analytical Chemistry* 87 (13 & 14):897-911.
- 38 Lancelot, C., P. Grosjean, V. Rousseau, E. Breton, and P. M. Gilbert. 2012. Rejoinder to "Perils of
39 correlating CUSUM-transformed variables to infer ecological relationships (Breton et al. 2006;
40 Gilbert 2010)." *Limnology and Oceanography* 57(2):669-670.

- 1 Lee, B. G., J. S. Lee, and S. N. Luoma. 2006. Comparison of Selenium Bioaccumulation in the Clams
2 *Corbicula fluminea* and *Potamocorbula amurensis*: A Bioenergetic Modeling Approach.
3 *Environmental Toxicology and Chemistry* 25(7):1933-1940.
- 4 Lehman, P. 2000. The Influence of Climate on Phytoplankton Community Biomass in San Francisco
5 Bay Estuary. *Limnology and Oceanography* 45(3):580–590.
- 6 Lehman, P., S. Teh, G. Boyer, M. Nobriga, E. Bass, and C. Gogle. 2010. Initial Impacts of *Microcystis*
7 *aeruginosa* Blooms on the Aquatic Food Web in the San Francisco Estuary. *Hydrobiologia*
8 637:229–248.
- 9 Lehman, P. W., G. Boyer, C. Hall, S. Waller and K. Gehrts. 2005. Distribution and Toxicity of a New
10 Colonial *Microcystis aeruginosa* Bloom in the San Francisco Bay Estuary, California.
11 *Hydrobiologia* 541:87–99.
- 12 Lehman, P. W., G. Boyer, M. Satchwell, and S. Waller. 2008. The Influence of Environmental
13 Conditions on the Seasonal Variation of *Microcystis* Cell Density and Microcystins Concentration
14 in San Francisco Estuary. *Hydrobiologia* 600:187–204.
- 15 Lehman, P. W., K. Marr, G. L. Boyer, S. Acuna, and S. J. Teh. 2013. Long-Term Trends and Causal
16 Factors Associated with *Microcystis* Abundance and Toxicity in San Francisco Estuary and
17 Implications for Climate Change Impacts. *Hydrobiologia* 718: 141–158.
- 18 Lehman, P. W., C. Kendall, M. A. Guerin, M. B. Young, S. R. Silva, G. L. Boyer, and S. J. Teh. 2015.
19 Characterization of *Microcystis* Bloom and Its Nitrogen Supply in San Francisco Estuary Using
20 Stable Isotopes. *Estuaries and Coasts* 38:165–178.
- 21 Li, F., H. Zhang, Y. Zhu, Z. Yihua, and C. Ling. 2013. Effect of Flow Velocity on Phytoplankton Biomass
22 and Composition in a Freshwater Lake. *Science of the Total Environment*. 447:64–71.
- 23 Linville, R. G., S. N. Luoma, L. Cutter, and G. A. Cutter. 2002. Increased Selenium Threat as a Result of
24 Invasion of the Exotic Bivalve *Potamocorbula amurensis* into the San Francisco Bay-Delta.
25 *Aquatic Toxicology* 57:51–64.
- 26 Liu, S. and B. Suits. 2012. Estimating Delta-wide Bromide Using DSM2- Simulated EC Fingerprints. In
27 *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun*
28 *Marsh, 33rd Annual Progress Report, June 2012*. Delta Modeling Section, Bay-Delta Office,
29 California Department of Water Resources.
- 30 Lomas, M. W. and P. M. Gilbert. 1999. Temperature Regulation of Nitrate Uptake: A Novel Hypothesis
31 About Nitrate Uptake and Reduction in Cool Water Diatoms. *Limn. Oceanogr.* 44:556–572.
- 32 Loraine, G., and M. Pettigrove. 2006. Seasonal Variations in Concentrations of Pharmaceuticals and
33 Personal Care Products in Drinking Water and Reclaimed Wastewater in Southern California.
34 *Environmental Science and Technology* 40(3):687–695.
- 35 Los Angeles Regional Water Quality Control Board. 1994. *Water Quality Control Plan, Los Angeles*
36 *Region. Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties*. Los Angeles,
37 California. Available: <[http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/
38 basin_plan/](http://www.swrcb.ca.gov/rwqcb4/water_issues/programs/basin_plan/)>. Accessed: July 13, 2010.

- 1 Lucas, L., and R. Stewart. 2007. *Transport, Transformation, and Effects of Selenium and Carbon in the*
2 *Delta of the Sacramento–San Joaquin Rivers: Implications for Ecosystem Restoration*. Ecosystem
3 Restoration Program Project No. ERP-01-C07. U.S. Geological Survey. Menlo Park, CA.
- 4 Lund, J., E. Hanak, W. Fleenor, R. Howitt, J. Mount, and P. Moyle. 2007. *Envisioning Futures for the*
5 *Sacramento–San Joaquin Delta*. San Francisco, CA: Public Policy Institute of California.
- 6 MacDonald, D. D., C. G. Ingersoll, and T. A. Berger. 2000. Development and Evaluation of Consensus-
7 Based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environmental*
8 *Contamination and Toxicology* 39:20–21.
- 9 Madsen, J. D., P. A. Chambers, W. F. James, E. W. Koch and D. F. Westlake. 2001. The Interaction
10 Between Water Movement, Sediment Dynamics and Submersed Macrophytes. *Hydrobiologia*
11 444(1-3):71–84.
- 12 Mahler, B., P. Van Metre, T. Bashara, J. Wilson, and D. Johns. 2005. Parking Lot Sealcoat: An
13 Unrecognized Source of Urban Polycyclic Aromatic Hydrocarbons. *Environmental Science and*
14 *Technology* 39:5560–5566.
- 15 Marmen, S., D. Aharonovich, M. Grossowicz, L. Blank, Y. Z. Yacobi, and D. J. Sher. 2016. Distribution
16 and Habitat Specificity of Potentially Toxic *Microcystis* across Climate, Land, and Water Use
17 Gradients. *Frontiers in Microbiology*. doi: 10.3389/fmicb.2016.00271.
- 18 McKee, L., N. Ganju, and D. Schoellhamer. 2006. Estimates of Suspended Sediment Entering San
19 Francisco Bay from the Sacramento and San Joaquin Delta, San Francisco Bay, California. *Journal*
20 *of Hydrology* 323:335–352.
- 21 Melwani, A., S. Bezalel, J. Hunt, L. Grenier, J. Davis, G. Ichikawa, B. Jakl, W. Heim, A. Bonnema, and
22 M. Gassel. 2007. *California Bay-Delta Authority Fish Mercury Project. Year 2 Annual Report Sport*
23 *Fish Sampling and Analysis*. San Francisco Estuary Institute. Contr. No. 535.
- 24 Melwani, A., S. Bezalel, J. Hunt, J. Grenier, G. Ichikawa, W. Heim, A. Bonnema, C. Foe, and J. Davis.
25 2009. Spatial Trends and Impairment Assessment of Mercury in Sport Fish in the Sacramento–
26 San Joaquin Delta Watershed. *Environ. Pollut.* 157(11):3137-49.
- 27 Meyer, J. S., and W. J. Adams. 2010. Relationship Between Biotic Ligand Model Based Water Quality
28 Criteria and Avoidance and Olfactory Responses to Copper by Fish. *Env. Tox. Chem.* 29(9):2096–
29 2103.
- 30 Miège, C., J. M. Choubert, L. Ribeiro, M. Eusèbe, and M. Coquery. 2009. Fate of Pharmaceuticals and
31 Personal Care Products in Wastewater Treatment Plants—Conception of a Database and First
32 Results. *Environmental Pollution* 157:1721–1726.
- 33 Mierzwa, M., and B. Suits. 2005. Jones Tract. 2004. Levee Break DSM2 Simulation. In *Methodology for*
34 *Flow and Salinity Estimates in the Sacramento–San Joaquin Delta and Suisun Marsh 26th Annual*
35 *Progress Report*. Available: <[http://modeling.water.ca.gov/delta/reports/annrpt/2005/](http://modeling.water.ca.gov/delta/reports/annrpt/2005/2005Ch3.pdf)
36 [2005Ch3.pdf](http://modeling.water.ca.gov/delta/reports/annrpt/2005/2005Ch3.pdf)>. Accessed: July 8, 2009.
- 37 Mission, B. and D. Latour. 2012. Influence of Light, Sediment Mixing, Temperature and Duration of
38 the Benthic Life Phase on the Benthic Recruitment of *Microcystis*. *Journal of Plankton Research*
39 34(2):113–119.

- 1 Moore, D. R. J., A. Pawlisz, R. Teed, G. M. Richardson, H. E. Allen, S. Thakali, J. Gibson, B. C. Hickey, J. R.
2 Hill, J. Holmes, J. J. Ridal, D. Lean, J. Crow, D. Eskew, G. Holdsworth, and J. Little. 2003. *Developing*
3 *Ambient Water Quality Criteria for Mercury: A Probabilistic Site-Specific Approach*. Water
4 Environment Research Foundation. 99-ECO-2. London: IWA Publishing.
- 5 Morris, A. W., and J. P. Riley. 1966. The Bromide/Chlorinity and Sulphate/Chlorinity Ratio in Sea
6 Water. *Deep-Sea Research* 13:699–705
- 7 Municipal Water Quality Investigations. 2003a. *The Municipal Water Quality Investigations Program*
8 *Summary and Findings from Data Collected August 1998 through September 2001*. State of
9 California, The Natural Resources Agency, Department of Water Resources, Division of
10 Environmental Services. Sacramento, CA.
- 11 ———. 2003b. *Water Quality Investigations of the Barker Slough Watershed, 1997–2001, North Bay*
12 *Aqueduct Summary*. Available: <[http://www.water.ca.gov/waterquality/drinkingwater/
13 mwqi_reports.cfm](http://www.water.ca.gov/waterquality/drinkingwater/mwqi_reports.cfm)>.
- 14 ———. 2005. *The Municipal Water Quality Investigations Program Summary and Findings from Data*
15 *Collected October 2001 through September 2003*. State of California, The Natural Resources
16 Agency, Department of Water Resources. Sacramento, CA.
- 17 ———. 2006. *The Municipal Water Quality Investigations Program Summary and Findings of Data*
18 *Collected from the Sacramento–San Joaquin Delta Region, October 2003 through September 2005*.
19 State of California, The Natural Resources Agency, Department of Water Resources, Division of
20 Environmental Services. Sacramento, CA.
- 21 ———. 2008. *The Municipal Water Quality Investigations Program Summary and Findings of Data*
22 *Collected from the Sacramento–San Joaquin Delta Region, October 2005 through September 2007*.
23 State of California, The Natural Resources Agency, Department of Water Resources, Division of
24 Environmental Services. Sacramento, CA.
- 25 ———. 2009. *Jones Tract Flood Water Quality Investigations*. State of California, The Natural
26 Resources Agency, Department of Water Resources, Division of Environmental Services.
27 Sacramento, CA.
- 28 MWH. 2011. *Validation of DSM2 QUAL for Simulation of Various Cations and Anions, Final Report*.
29 Prepared for Metropolitan Water District of Southern California. June.
- 30 Nable, R. O., G. S. Bañuelos, and J. G. Paull. 1997. Boron Toxicity. *Plant Soil* 193:181–198.
- 31 Najm, I., and R. Rhodes Trussell. 2001. NDMA Formation in Water and Wastewater. *Journal AWWA*
32 93(2):92–99.
- 33 National Marine Fisheries Service. 2009. *Biological Opinion and Conference Opinion on the Long-*
34 *Term Operations of the Central Valley Project and State Water Project*. June 4. Long Beach, CA.
35 Available: <[http://swr.nmfs.noaa.gov/ocap/NMFS_Biological_and_Conference_Opinion_
36 on_the_Long-Term_Operations_of_the_CVP_and_SWP.pdf](http://swr.nmfs.noaa.gov/ocap/NMFS_Biological_and_Conference_Opinion_on_the_Long-Term_Operations_of_the_CVP_and_SWP.pdf)>. Accessed March, 23, 2012.
- 37 National Research Council. 2006. *Health Risks from Dioxin and Related Compounds: Evaluation of the*
38 *EPA Reassessment*. Committee on EPA's Exposure and Human Health Reassessment of TCDD and
39 Related Compounds. Washington, D.C.: National Academies Press.

- 1 National Toxicology Program. 2011. *Report on Carcinogens*. Twelfth Edition. U.S. Department of
2 Health and Human Services Public Health Service.
- 3 Newhart, K. 2002. *Rice Pesticide Use and Surface Water Monitoring 2002*. Report to the California
4 Regional Water Quality Control Board.
- 5 Ohlendorf, H. M. 2003. Ecotoxicology of Selenium. Pages 465–500 in D. J. Hoffman, B. A. Rattner, G. A.
6 Burton Jr., and J. C. Cairns Jr., Lewis (eds.), *Handbook of Ecotoxicology*, Second Edition. Boca
7 Raton, FL: CRC Press.
- 8 Oppenheimer, J., and R. Stephenson. 2006. Characterizing the Passage of Personal Care Products
9 through Wastewater Treatment Processes. *Water Environment & Technology* 18(12):1521–
10 1542.
- 11 Oros, D., J. Ross, R. Spies, and T. Mumley. 2007. Polycyclic Aromatic Hydrocarbon (PAH)
12 Contamination in San Francisco Bay: A 10-year Retrospective of Monitoring in an Urbanized
13 Estuary. *Environmental Research* 105:101–118.
- 14 Paerl, H. W. 1988. Nuisance Phytoplankton Blooms in Coastal, Estuarine, and Inland Waters. *Limnol.*
15 *Oceanogr.* 33(4, part 2):823–847.
- 16 Paerl, H. W., R. S. Fulton, P. H. Moisaner, and J. Dyble. 2001. Harmful Freshwater Algal Blooms, with
17 an Emphasis on Cyanobacteria. *The Scientific World* 1:76–113.
- 18 Paerl, H. W., H. Xu, N. S. Hall, G. Zhu, B. Qin, Y. Wu, K. L. Rossignol, L. Dong, M. J. McCarthy, and A. R.
19 Joyner. 2014. Controlling Cyanobacterial Blooms in Hypereutrophic Lake Taihu, China: Will
20 Nitrogen Reductions Cause Replacement of Non-N₂ Fixing by N₂ Fixing Taxa. *PlosONE*. Available:
21 <<http://dx.doi.org/10.1371/journal.pone.0113123>>.
- 22 Pandey, G. 2001. Chapter 3: Simulation of Historical DOC and UVA Conditions in the Delta.
23 Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun
24 Marsh. *22nd Annual Progress Report to the State Water Resources Control Board*. Sacramento, CA.
- 25 Parker, Alexander E., Richard C. Dugdale, and Frances P. Wilkerson. 2012. Elevated Ammonium
26 Concentrations from Wastewater Discharge Depress Primary Productivity in the Sacramento
27 River and the Northern San Francisco Estuary. *Marine Pollution Bulletin* 64:574–586.
- 28 Paulsen, S. C. and J. List. 1997. A Study of Transport and Mixing in Natural Waters Using ICP-MS:
29 Water-Particle Interactions. *Water, Air and Soil Poll.* 99:149–156.
- 30 Pickhardt, P. C., M. Stepanova, and N. S. Fisher. 2006. Contrasting Uptake Routes and Tissue
31 Distributions of Inorganic and Methylmercury in Mosquitofish (*Gambusia affinis*) and Redear
32 Sunfish (*Lepomis microlophus*). *Environmental Toxicology and Chemistry* 25:2132–2142.
- 33 Presser, T. S., and S. N. Luoma. 2006. Forecasting Selenium Discharges to the San Francisco Bay-
34 Delta Estuary: Ecological Effects of a Proposed San Luis Drain Extension. Professional Paper
35 1646. U.S. Geological Survey, Reston, VA.
- 36 ———. 2009. *Modeling of Selenium for the San Diego Creek Watershed and Newport Bay, California*.
37 U.S. Geological Survey Open-File Report 2009-1114. Available:
38 <<http://pubs.usgs.gov/of/2009/1114/>>. Accessed: June 7, 2010.

- 1 ———. 2010a. A Methodology for Ecosystem-scale Modeling of Selenium. *Integrated Environmental*
2 *Assessment and Management* 6:685-710.
- 3 ———. 2010b. *Ecosystem-scale Selenium Modeling in Support of Fish and Wildlife Criteria*
4 *Development for the San Francisco Bay-Delta Estuary, California*. Administrative Report.
5 December. U.S. Geological Survey, Reston, VA.
- 6 ———. 2013. Ecosystem-scale selenium model for the San Francisco Bay-Delta Regional Ecosystem
7 Restoration Implementation Plan. *San Francisco Estuary and Watershed Science*, 11(1).
8 Available: <<http://escholarship.org/uc/item/2td0b99t#page-1>>.
- 9 Presser, T. S., and D. Z. Piper. 1998. Mass Balance Approach to Selenium Cycling through the San
10 Joaquin Valley: From Source to River to Bay. Pages 153–182 in W. T. Frankenberger, Jr., and R. A.
11 Engberg (eds.), *Environmental Chemistry of Selenium*. New York: Marcel Dekker, Inc.
- 12 Public Policy Institute of California. 2008. *Delta Drinking Water Quality and Treatment Costs*
13 *Technical Appendix H*. San Francisco, CA.
- 14 Ross, J., and D. Oros. 2004. Polycyclic Aromatic Hydrocarbons in the San Francisco Estuary Water
15 Column: Sources, Spatial Distributions, and Temporal Trends (1993–2001). *Chemosphere*
16 57:909–920.
- 17 Ruhl, H. A. and N. B. Rybicki. 2010. Long-term Reductions in Anthropogenic Nutrients Link to
18 Improvements in Chesapeake Bay Habitat. *Proceedings of the National Academy of Sciences*
19 107(38):16566–16570.
- 20 Sacramento Regional County Sanitation District. 2004. *Coordinated Monitoring Program 2003–2004*
21 *Annual Report*. September.
- 22 ———. 2005. *Coordinated Monitoring Program 2004–2005 Annual Report*. September.
- 23 ———. 2006. *Coordinated Monitoring Program 2005–2006 Annual Report*. September.
- 24 ———. 2007. *Coordinated Monitoring Program 2006–2007 Annual Report*. September.
- 25 ———. 2008. *Coordinated Monitoring Program 2007–2008 Annual Report*. September.
- 26 ———. 2009. *Coordinated Monitoring Program 2008–2009 Annual Report*. September.
- 27 ———. 2014. *Draft Environmental Impact Report for the Sacramento Regional County Sanitation*
28 *District EchoWater Project*. Control Number 2012-70044, State Clearinghouse #2012052017.
29 Prepared by Ascent Environmental, Sacramento, CA. March.
- 30 Sadiq, R., and M. J. Rodriguez. 2004. *Disinfection By-Products (DBPs) in Drinking Water and Predictive*
31 *Models for their Occurrence: A Review* (NRCC-44499). Prepared for the Canada National Research
32 Council. Available: <<http://irc.nrc-cnrc.gc.ca/ircpubs>>.
- 33 Saiki, M. K., D. T. Castleberry, T. W. May, B. A. Martin, and F. N. Bullard. 1995. Copper, Cadmium, and
34 Zinc Concentrations in Aquatic Food Chains from the Upper Sacramento River (California) and
35 Selected Tributaries. *Archives of Environmental Contamination and Toxicology* 29(4).
- 36 Saleh, D., J. Domagalski, C. Kratzer, and D. Knifong. 2007. *Organic Carbon Trends, Loads, and Yields to*
37 *the Sacramento-San Joaquin Delta, California, Water Years 1980 to 2000*. U.S. Geological Survey
38 Water Resources Investigation Report 03-4070, Second Edition. Sacramento, CA.

- 1 San Diego Regional Water Quality Control Board. 2007. *Water Quality Control Plan for the San Diego*
 2 *Basin (9)* (with amendments prior to April 25, 2007). San Diego, CA. Available:
 3 <http://www.swrcb.ca.gov/rwqcb9/water_issues/programs/basin_plan/index.shtml>.
 4 Accessed: July 13, 2010.
- 5 San Francisco Bay Regional Water Quality Control Board. 2006. *Mercury in San Francisco Bay.*
 6 *Proposed Basin Plan Amendment and Staff Report for Revised Total Maximum Daily Load (TMDL)*
 7 *and Proposed Mercury Water Quality Objectives.* Oakland, CA.
- 8 ———. 2007. *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan).* California
 9 Regional Water Quality Control Board, San Francisco Bay Region. Available:
 10 <http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml>. Accessed:
 11 February 17, 2009.
- 12 ———. 2011. *Preliminary Project Report Total Maximum Daily Load Selenium in North San Francisco*
 13 *Bay.* January.
- 14 ———. 2012. *Suisun Marsh TMDL for Methylmercury, Dissolved Oxygen and Nutrient Biostimulation,*
 15 *Part 1: Project Definition and Part 2: Project Plan.* (September). Available:
 16 <http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/TMDLs/suisunmarsh/SM_P
 17 [roject%20Definition&Plan_Sep'12.pdf](http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/TMDLs/suisunmarsh/SM_P)>. Accessed: August 6, 2013.
- 18 ———. 2013. *San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan).* June 29.
- 19 San Francisco Estuary Institute. 2010. CD3 Contaminant Data, Regional Monitoring Program for
 20 Water Quality. Available: <<http://www.sfei.org/tools/wqt>>. Accessed: April 13, 2010.
- 21 ———. 2014. Available: <http://cd3.sfei.org/>. Site accessed on September 30, 2014.
- 22 ———. 2015. CD3 Contaminant Data, Regional Monitoring Program for Water Quality. Available:
 23 <<http://cd3.sfei.org/>>. Accessed: February 17, 2015.
- 24 Sandhu, N. and D. Wilson, R. Finch, and F. Chung. 1999. *Modeling Flow-Salinity Relationships in the*
 25 *Sacramento-San Joaquin Delta Using Artificial Neural Networks.* Technical Information Record
 26 OSP-99-1. California Department of Water Resources, Sacramento, CA. San Joaquin County. 1992.
 27 *San Joaquin County General Plan.* July. Stockton, CA. Available: <<http://www.sjgov.org/>
 28 [commdev/cgi-bin/cdyn.exe?grp=planning&htm=generalplan](http://www.sjgov.org/)>. Accessed August 2, 2013.
- 29 Santa Ana Regional Water Quality Control Board. 2008. *Water Quality Control Plan for the Santa Ana*
 30 *River Basin (Region 8).* February. Riverside, CA. Available:
 31 <http://www.swrcb.ca.gov/rwqcb8/water_issues/programs/basin_plan/index.shtml
 32 <http://www.bdcpeireis.com/section.do?action=display&file=35713>>. Accessed: July 13, 2010.
- 33 Saracino-Kirby, Inc. 2000. *Arsenic Occurrence and Conjunctive Management in California.* Prepared
 34 for the Association of California Water Agencies.
- 35 Schmieder, P., D. Ho, P. Schlosser, J. Clark, and G. Schladow. 2008. An SF6 Tracer Study of the Flow
 36 Dynamics in the Stockton Deep Water Ship Channel: Implications for Dissolved Oxygen
 37 Dynamics. *Estuaries and Coasts* 31:1038–1051.
- 38 Schoellhamer, D., T. Mumley, and J. Leatherbarrow. 2007a. Suspended Sediment and Sediment-
 39 Associated Contaminants in San Francisco Bay. *Environmental Research* 105:119–131.

- 1 Schoellhamer, D., S. Wright, J. Drexler, and M. Stacy. 2007b. *Sedimentation Conceptual Model*. Delta
2 Regional Ecosystem Restoration Implementation Plan. Sacramento, CA.
- 3 Seneviratne, S., and S. Wu. 2007. Chapter 3 – Enhanced Development of Flow-Salinity Relationships
4 in the Delta Using Artificial Neural Networks: Incorporating Tidal Influence. Methodology for
5 Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. *28th Annual*
6 *Progress Report to the State Water Resources Control Board*. Sacramento, CA.
- 7 Senn, D. B., and E. Novick. 2013. *San Francisco Bay Nutrient Conceptual Model*. Draft. May 1. San
8 Francisco Estuary Institute, Richmond, CA.
- 9 ———. 2014. *Suisun Bay Ammonium Synthesis Report*. Contribution No. 706. San Francisco Estuary
10 Institute, Richmond, CA.
- 11 Shao, D., Y. Kang, S. Wu, and M. Wong. 2012. Effects of Sulfate Reducing Bacteria and Sulfate
12 Concentrations on Mercury Methylation in Freshwater Sediments. *Science of the Total*
13 *Environment* 424:331–336.
- 14 Sickman, J. O., M. J. Zanoli, and H. L. Mann. 2007. Effects of Urbanization on Organic Carbon Loads in
15 the Sacramento River, California. *Water Resources Research* 43.
- 16 Siemering, G., J. Hayworth, and B. Greenfield. 2008. Assessment of Potential Aquatic Herbicide
17 Impacts to California Aquatic Ecosystems. *Archives of Environmental Contamination and*
18 *Toxicology* 55(3):415–431.
- 19 Skorupa, J. P., and H. M. Ohlendorf. 1991. Contaminants in Drainage Water and Avian Risk
20 Thresholds. Pages 345–368 in A. Dinar and D. Zilberman (eds.), *The Economics and Management*
21 *of Water and Drainage in Agriculture*. Norwell, MA: Kluwer Academic Publishers.
- 22 Slotton, D. G., S. M. Ayers, and R. D. Weyand. 2007. *CBDA Biosentinel Mercury Monitoring Program*.
23 *Second Year Draft Data Report. February through December, 2006*. Department of Environmental
24 Science and Policy, University of California, Davis.
- 25 Snyder, S. 2003. Endocrine Disruptors as Water Contaminants: Toxicological Implications for
26 Humans and Wildlife. *Southwest Hydrology* Nov/Dec:14–16.
- 27 ———. 2008. Occurrence and Impact of Endocrine Disrupting Chemicals in Water and Wastewater.
28 In *Carollo Engineers Research Solutions*, 6–9. Sacramento, CA.
- 29 Sohn, J. G. Amy, J. Cho, Y. Lee, and Y. Too. 2004. Disinfectant Decay and Disinfection By-Products
30 Formation Model Development: Chlorination and Ozonation By-Products. *Water Research*
31 38:2461–2478.
- 32 Southern California Coastal Water Research Project. 2009. *Workshop Report, Managing*
33 *Contaminants of Emerging Concern in California: Developing Processes for Prioritizing,*
34 *Monitoring, and Determining Thresholds of Concern*. Costa Mesa, CA. April 28–29, 2009.
- 35 Spencer, R. G. M., B. A. Pellerin, B. A. Bergamaschi, B. D. Downing, T. E. C. Kraus, D. R. Smart,
36 R. A. Dahlgren, and P. J. Hernes. 2007. Diurnal Variability in Riverine Dissolved Organic Matter
37 Composition Determined by In Situ Optical Measurement in the San Joaquin River, CA.
38 *Hydrological Processes* 21:3181–3189.

- 1 State Water Project Contractors Authority. 2007. *California State Water Project Watershed Sanitary*
 2 *Survey*. 2006 Update. Prepared by Archibald Consulting, Richard Woodard Water Quality
 3 Consultants, and Palencia Consulting Engineers.
- 4 State Water Resources Control Board. 2003. *Clear Lake Mercury TMDL. Basin Plan Amendment*.
 5 <[http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2003/](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2003/rs2003-0040.pdf)
 6 [rs2003-0040.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2003/rs2003-0040.pdf)>.
- 7 ———. 2006. *Water Quality Control Plan for the San Francisco Bay/Sacramento San Joaquin Delta*
 8 *Estuary*. Available: <[http://www.waterboards.ca.gov/waterrights/water_issues/programs/](http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf)
 9 [bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf](http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/wq_control_plans/2006wqcp/docs/2006_plan_final.pdf)>. Accessed: July 7, 2009.
- 10 ———. 2007. *Bioaccumulation of Pollutants in California Waters*. Surface Water Ambient Monitoring
 11 Program.
- 12 ———. 2008. *Strategic Workplan for Activities in the San Francisco Bay/Sacramento–San Joaquin*
 13 *Delta Estuary*. Central Valley Regional Water Quality Control Board and San Francisco Bay
 14 Regional Water Quality Control Board.
- 15 ———. 2010a. *A Compilation of Water Quality Goals*. Available: <[http://www.waterboards.ca.gov/](http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/)
 16 [water_issues/programs/water_quality_goals/](http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/)>. Accessed: April 13, 2010.
- 17 ———. 2010b. Resolution No. 2010-0046 Approving Amendments to the Water Quality Control
 18 Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) to Address Selenium
 19 Control in the San Joaquin River Basin. Adopted October 5. Available:
 20 <[http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/rs2010_0046.pdf)
 21 [rs2010_0046.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/rs2010_0046.pdf)>.
- 22 ———. 2010c. 10/05/10 Bd Meeting–Item #5; Staff Change #1(Circulated 09/30/10) for
 23 Resolution No. 2010-0046 Approving Amendments to the Water Quality Control Plan for the
 24 Sacramento River and San Joaquin River Basins (Basin Plan) to Address Selenium Control in the
 25 San Joaquin River Basin. Adopted October 5. Available:<[http://www.waterboards.ca.gov/](http://www.waterboards.ca.gov/board_info/agendas/2010/oct/100510_5changesheet1.pdf)
 26 [board_info/agendas/2010/oct/100510_5changesheet1.pdf](http://www.waterboards.ca.gov/board_info/agendas/2010/oct/100510_5changesheet1.pdf)>.
- 27 ———. 2010d. Resolution No. 2010-0046 Approving Amendments to the Water Quality Control
 28 Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) to Address Selenium
 29 Control in the San Joaquin River Basin. Adopted October 5. Available:
 30 <[http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/rs2010_0046.pdf)
 31 [rs2010_0046.pdf](http://www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2010/rs2010_0046.pdf)>.
- 32 ———. 2010e. 10/05/10 Bd Meeting–Item #5; Staff Change #1 (Circulated 09/30/10) for
 33 Resolution No. 2010-0046 Approving Amendments to the Water Quality Control Plan for the
 34 Sacramento River and San Joaquin River Basins (Basin Plan) to Address Selenium Control in the
 35 San Joaquin River Basin. Adopted October 5. Available:<[http://www.waterboards.ca.gov/](http://www.waterboards.ca.gov/board_info/agendas/2010/oct/100510_5changesheet1.pdf)
 36 [board_info/agendas/2010/oct/100510_5changesheet1.pdf](http://www.waterboards.ca.gov/board_info/agendas/2010/oct/100510_5changesheet1.pdf)>.
- 37 ———. 2011. *2010 CWA Section 303(d) List of Water Quality Limited Segments*. Approved by U.S.
 38 EPA on December 23, 2011. Available: <[http://www.swrcb.ca.gov/centralvalley/water_issues/](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/index.shtml#currentrpt)
 39 [tmdl/impaired_waters_list/index.shtml#currentrpt](http://www.swrcb.ca.gov/centralvalley/water_issues/tmdl/impaired_waters_list/index.shtml#currentrpt)>.

- 1 ———. 2012. Order WQ 2012-0013 In the Matter of Own Motion Review of Waste Discharge
2 Requirements Order No. R5-2010-0114 [NPDES No. CA0077682] for Sacramento Regional
3 Wastewater Treatment Plant. Adopted December 4. Available: <[http://www.swrcb.ca.gov/
4 board_decisions/adopted_orders/water_quality/2012/wqo2012_0013.pdf](http://www.swrcb.ca.gov/board_decisions/adopted_orders/water_quality/2012/wqo2012_0013.pdf)>.
- 5 ———. 2013. *Fact Sheet, Bay Delta Planning Efforts*. Available: <[http://www.waterboards.ca.gov/
6 publications_forms/publications/factsheets/docs/bd_plneff_fs.pdf](http://www.waterboards.ca.gov/publications_forms/publications/factsheets/docs/bd_plneff_fs.pdf)>. Accessed July 30, 2013.
- 7 Stepanauskas, R., M. A. Moran, B. A. Bergamashi, and J. T. Hollibaugh. 2005. Sources, Bioavailability,
8 and Photoreactivity of Dissolved Organic Carbon in the Sacramento–San Joaquin River Delta.
9 *Biogeochemistry* 74:131–149.
- 10 Sterner, R. W. and J. J. Elser. 2002. *Ecological Stoichiometry: The Biology of Elements from Molecules*
11 *to the Biosphere*. Princeton, NJ: Princeton University Press.
- 12 Stewart, A. R., S. N. Luoma, C. E. Schlekat, M. A. Doblin, and K. A. Hieb. 2004. Food Web Pathway
13 Determines How Selenium Affects Aquatic Ecosystems: A San Francisco Bay Case Study.
14 *Environmental Science and Technology* 38:4519–4526.
- 15 Stewart, A. R., S. N. Luoma, K. A. Elrick, J. L. Carter, M. van der Wegen. 2013. Influence of Estuarine
16 Processes on Spatiotemporal Variation in Bioavailable Selenium. *Marine Ecology Progress Series*
17 492:41–56.
- 18 Surface Water Ambient Monitoring Program. 2009. *Surface Water Ambient Monitoring Program,*
19 *Central Valley Regional Water Quality Control Board*. Available: <[http://www.swrcb.ca.gov/
20 centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/index.sh
21 tml](http://www.swrcb.ca.gov/centralvalley/water_issues/water_quality_studies/surface_water_ambient_monitoring/index.shtml)>. Accessed: March 6, 2009.
- 22 Taylor, W. D., R. F. Losee, M. Torobin. 2006. *Early Warning and Management of Surface Water Taste-*
23 *and-Odor Events*. Denver, CO: American Water Works Association Research Foundation Reports.
- 24 Tchobanoglous, G., and E. Schroeder. 1987. *Water Quality Characteristics, Modeling, Modification*.
25 Boston, MA: Addison-Wesley Publishing Company.
- 26 TDC Environmental. 2008. *Pesticides of Interest for Urban Surface Water Quality: Urban Pesticides*
27 *Use Trends Report 2008*. Prepared for the San Francisco Estuary Project.
- 28 ———. 2010. *Pesticides in Urban Runoff, Wastewater, and Surface Water: Annual Review of New*
29 *Scientific Findings 2010*. Prepared for the San Francisco Estuary Partnership.
- 30 Teh, S. J., X. Deng, D.-F. Deng, F.-C. Teh, S. S. O. Hung, T. W.-M. Fan, J. Liu, and R. M. Higashi. 2004.
31 Chronic Effects of Dietary Selenium on Juvenile Sacramento Splittail (*Pogonichthys*
32 *macrolepidotus*). *Environmental Science and Technology* 38:6085–6093.
- 33 Teh, S., I. Flores, M. Kawaguchi, S. Lesmeister, and C. Teh. 2011. *Final Report. Full Life-Cycle Bioassay*
34 *Approach to Assess Chronic Exposure of Pseudodiaptomus forbesi to Ammonia/Ammonium*.
35 Submitted to: Chris Foe and Mark Gowdy, State Water Board. UC Davis Agreement No. 06-447-
36 300. SUBTASK No. 14. University of California, Davis.
- 37 Tetra Tech. 2006a. *Conceptual Model for Nutrients in the Central Valley and Sacramento–San Joaquin*
38 *River Delta*. Prepared for the Central Valley Drinking Water Policy Workgroup.

- 1 ———. 2006b. *Conceptual Model for Organic Carbon in the Central Valley and Sacramento–San*
 2 *Joaquin Delta*. Final Report prepared for USEPA Region IX and Central Valley Drinking Water
 3 Policy Workgroup. April 16. Available: <[http://www.swrcb.ca.gov/rwqcb5/water_issues/
 4 drinking_water_policy/oc_model_final.pdf](http://www.swrcb.ca.gov/rwqcb5/water_issues/drinking_water_policy/oc_model_final.pdf)>.
- 5 ———. 2007. *Conceptual Model for Pathogens and Pathogen Indicators in the Central Valley and*
 6 *Sacramento–San Joaquin Delta*. Prepared for the Central Valley Drinking Water Policy Group.
- 7 ———. 2008. *Technical Memorandum 2: North San Francisco Bay Selenium Data Summary and*
 8 *Source Analysis*. Prepared for San Francisco Bay Regional Water Quality Control Board.
 9 Lafayette, CA.
- 10 ———. 2014. *Calculating Dissolved Selenium Loads from the Delta to San Francisco Bay Using DSM2*.
 11 May.
- 12 Tonk, L., K. Bosch, P. M. Visser, and J. Huisman. 2007. Salt Tolerance of the Harmful Cyanobacterium
 13 *Microcystis aeruginosa*. *Aquatic Microbial Ecology* 46:117–123.
- 14 U.S. Department of the Interior. 1998. *Guidelines for Interpretation of the Biological Effects of Selected*
 15 *Constituents in Biota, Water, and Sediment*. National Irrigation Water Quality Program
 16 Information Report No. 3. DOI, Denver, CO. Available:
 17 <<http://www.usbr.gov/niwqp/guidelines/pdf/Selenium.pdf>>. Accessed: March 2, 2009.
- 18 U.S. Environmental Protection Agency. 1992. *Water Quality Standards; Establishment of Numeric*
 19 *Criteria for Priority Toxic Pollutants; State’s Compliances*. Available:
 20 <<http://water.epa.gov/lawsregs/rulesregs/ntr/ntr.cfm>>. Accessed: July 30, 2012.
- 21 ———. 1999a. *1999 Update of Ambient Water Quality Criteria for Ammonia*. EPA-822-R-99-014.
 22 Office of Water. December. Washington, D.C.
- 23 ———. 1999b. *Cryptosporidiosis: Guidance for People with Severely Weakened Immune Systems*. EPA
 24 Document 816-F-99-005.
- 25 ———. 2000. 40 CFR Part 131–Water Quality Standards; Establishment of Numeric Criteria for
 26 Priority Toxic Pollutants for the State of California; Rule. Vol. 65, No. 97.
- 27 ———. 2001. *Water Quality Criterion for the Protection of Human Health, Methylmercury*. EPA-823-
 28 R-01-001, Office of Water, Washington, D.C.
- 29 ———. 2006a. *National Primary Drinking Water Regulations*. Available:
 30 <<http://www.epa.gov/safewater/contaminants/index.html>>. Accessed: February 23, 2009.
- 31 ———. 2006b. *An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the*
 32 *United States for the Years 1987, 1995, and 2000*. National Center for Environmental Assessment,
 33 EPA/600/P-03/002F. Washington, D.C. Available: <[http://cfpub.epa.gov/ncea/cfm/
 34 recordisplay.cfm?deid=159286](http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=159286)>. Accessed: March 5, 2009.
- 35 ———. 2008a. *Regulatory Determinations Support Document for Selected Contaminants from the*
 36 *Second Drinking Water Contaminant List*. Office of Water. June.
- 37 ———. 2008b. *Drinking Water Health Advisory for Boron and Compounds*. Prepared by Health and
 38 Ecological Criteria Division, Office of Science and Technology, Office of Water, for Office of
 39 Groundwater/Drinking Water.

- 1 ———. 2008c. *Drinking Water Contaminants Overview*. Available:
2 <<http://www.epa.gov/safewater/contaminants/index.html>>. Accessed: February 19, 2009.
- 3 ———. 2008d. *U.S. EPA Pesticides Program Overview*. Available: <<http://www.epa.gov/pesticides/>>.
4 Accessed: February 17, 2009.
- 5 ———. 2009a. *Draft 2009 Update Aquatic Life Ambient Water Quality Criteria for Ammonia –*
6 *Freshwater* (Supersedes 1999 update). EPA-822-D-09-001. December. Office of Water.
7 Washington, D.C.
- 8 ———. 2009b. *Endocrine Disruptor Screening Program*. Available:
9 <<http://www.epa.gov/endo/pubs/edspoverview/whatare.htm>>. Accessed: February 23, 2009.
- 10 ———. 2009c. *Pharmaceuticals and Personal Care Products*. Available:
11 <<http://www.epa.gov/ppcp/>>. Accessed: February 23, 2009.
- 12 ———. 2009d. *National Primary Drinking Water Regulations–Microorganisms*. Available:
13 <<http://www.epa.gov/OGWDW/contaminants/index.html#1>>. Accessed: March 9, 2009.
- 14 ———. 2009e. *Technical Factsheet on: Polycyclic Aromatic Hydrocarbons (PAHs)*. Available:
15 <<http://www.epa.gov/safewater/contaminants/basicinformation/benzo-a-pyrene.html>>.
16 Accessed: February 24, 2009.
- 17 ———. 2009f. *Consumer Factsheet on Selenium*. Office of Ground Water and Drinking Water.
18 Available: <http://www.epa.gov/OGWDW/contaminants/dw_contamfs/selenium.html>.
19 Accessed: March 5, 2009.
- 20 ———. 2009g. *Aquatic Life Criteria for Selenium*. Available:
21 <<http://www.epa.gov/waterscience/criteria/selenium/>>. Accessed: March 11, 2009.
- 22 ———. 2009h. *Arsenic in Drinking Water*. Available:
23 <<http://www.epa.gov/safewater/arsenic/index.html>>. Accessed: March 5, 2009.
- 24 ———. 2009i. *Consumer Fact Sheet on Cadmium*. Available:
25 <<http://www.epa.gov/OGWDW//dwh/c-ioc/cadmium.html>>. Accessed: March 5, 2009.
- 26 ———. 2009j. *Consumer Fact Sheet on Copper*. Available: <[http://www.epa.gov/OGWDW//](http://www.epa.gov/OGWDW//dwh/c-ioc/copper.html)
27 [dwh/c-ioc/copper.html](http://www.epa.gov/OGWDW//dwh/c-ioc/copper.html)>. Accessed: March 5, 2009.
- 28 ———. 2009k. *Consumer Fact Sheet on Lead*. Available: <[http://www.epa.gov/OGWDW//](http://www.epa.gov/OGWDW//dwh/c-ioc/lead.html)
29 [dwh/c-ioc/lead.html](http://www.epa.gov/OGWDW//dwh/c-ioc/lead.html)>. Accessed: March 5, 2009.
- 30 ———. 2010. *Disinfection Byproduct Health Effects*. Available:
31 <http://www.epa.gov/enviro/html/icr/dbp_health.html>. Accessed: May 20, 2010.
- 32 ———. 2011. *Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta*
33 *Estuary*. Unabridged Advance Notice of Proposed Rulemaking. (February).
- 34 ———. 2012a. *Water Quality Challenges in the San Francisco Bay/Sacramento-San Joaquin Delta*
35 *Estuary. EPA's Action Plan*. Unabridged Advance Notice of Proposed Rulemaking. (August).
- 36 ———. 2012b. *National Recommended Water Quality Criteria*. Available: <[http://water.epa.gov/](http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm)
37 [scitech/swguidance/standards/criteria/current/index.cfm](http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm)>. Accessed: July 30, 2012.

- 1 ———. 2014. *External Peer Review Draft: Aquatic Life Ambient Water Quality Criterion for Selenium –*
2 *Freshwater*. Washington, D.C.
- 3 ———. 2015. *Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins*. EPA-
4 820R15100. Office of Water. Washington, D.C. June.
- 5 U.S. Fish and Wildlife Service. 2008a. *Species at Risk from Selenium Exposure in the San Francisco*
6 *Estuary*. Sacramento Fish and Wildlife Office, Environmental Contaminants Division.
7 Sacramento, CA.
- 8 ———. 2008b. *Biological Opinion on the Effects of the Proposed Coordinated Operations of the CVP*
9 *and SWP to the Threatened Delta Smelt (Hypomesus transpacificus) and its Designated Critical*
10 *Habitat*. Reference 81420-2008-F-1481-5.
- 11 U.S. Food and Drug Administration. 2009. *Questions and Answers about Dioxins*. Center for Food
12 Safety and Applied Nutrition. Available: <[http://www.fda.gov/Food/FoodSafety/
13 FoodContaminantsAdulteration/ChemicalContaminants/DioxinsPCBs/ucm077524.htm](http://www.fda.gov/Food/FoodSafety/FoodContaminantsAdulteration/ChemicalContaminants/DioxinsPCBs/ucm077524.htm)>.
14 Accessed: March 5, 2009.
- 15 U.S. Geological Survey. 2002. *Water-Quality Data for Pharmaceuticals, Hormones, and Other Organic*
16 *Wastewater Contaminants in U.S. Streams, 1999–2000*. Open File Report 02-94.
- 17 ———. 2003. *Organic Carbon Trends, Loads, and Yields to Sacramento–San Joaquin Delta, California*
18 *Water Years 1980 to 2000*.
- 19 ———. 2009. USGS Water-Quality Daily Data for California. Available:
20 <http://waterdata.usgs.gov/ca/nwis/dv/?referred_module=qw>. Accessed: March 6, 2009.
- 21 ———. 2010. USGS Water-Quality Daily Data for California. Available:
22 <http://waterdata.usgs.gov/ca/nwis/dv/?referred_module=qw>. Accessed: April 14, 2010.
- 23 ———. 2014. USGS Water-Quality Daily Data for California. Available:
24 <[http://nwis.waterdata.usgs.gov/nwis/qwdata?search_criteria=search_station_nm&submitted_
25 form=introduction](http://nwis.waterdata.usgs.gov/nwis/qwdata?search_criteria=search_station_nm&submitted_form=introduction)>. Accessed: September 26, 2014.
- 26 Van Geen, A., and S. Luoma. 1999a. A Record of Estuarine Water Contamination from the Cd Content
27 of Foraminiferal Tests in San Francisco Bay, California. *Marine Chemistry* 64(1999):57–69.
- 28 ———. 1999b. The Impact of Human Activities on Sediments of San Francisco Bay, California: An
29 Overview. *Marine Chemistry* 64(1999):1–6.
- 30 Verspagen, J. M. H. 2004. Recruitment of Benthic *Microcystis* (cyanophyceae) to the Water Column:
31 Internal Buoyancy Changes or Resuspension? *Journal of Phycology* 40:260–270.
- 32 Visser, P. M., B. W. Ibelings, B. Van der Veer, J. Koedoods, and L. R. Mur. 1996. Artificial Mixing
33 Prevents Nuisance Blooms of the Cyanobacterium *Microcystis* in Lake Nieuwe Meer, the
34 Netherlands. *Freshwater Biology* 36:435–450.
- 35 de Vlaming, V., L. Deanovic, and S. Fong. 2005. *Investigation of Water Quality in Agricultural Drains in*
36 *the California Central Valley*. Aquatic Toxicology Laboratory, University of California, Davis.
37 Prepared for the State Water Resources Control Board. Davis, CA.

- 1 de Vlaming, V., A. Biales, D. Riordan, D. Markiewicz, R. Holmes, P. Otis, C. Leutenegger, R. Zander, and
2 J. Lazorchak. 2006. *Screening California Surface Waters for Estrogenic Endocrine Disrupting*
3 *Chemicals (EEDC) with a Juvenile Rainbow Trout Liver Vitellogenin mRNA Procedure*. Report
4 Submitted to the Surface Water Ambient Monitoring Program (SWAMP), State Water Resources
5 Control Board.
- 6 de Voogt, P., M.-L. Janex-Habibi, F. Sacher, L. Puijker, and M. Mons. 2009. Development of a Common
7 Priority List of Pharmaceuticals Relevant for the Water Cycle. *Water Science and*
8 *Technology* 59(1):39–46.
- 9 Waggott, A. 1969. An Investigation of the Potential Problem of Increasing Boron Concentrations in
10 Rivers and Water Courses. *Water Research* 3:749–765.
- 11 Water Education Foundation. 2002. *Layperson's Guide to the Central Valley Project*. Sacramento, CA.
12 ———. 2004. *Layperson's Guide to the State Water Project*. Sacramento, CA.
- 13 Wenning, R., D. Mathur, D. Paustenbach, M. Stephenson, S. Folwarkow, and W. Luksemburg. 1999.
14 Polychlorinated Dibenzo-p-dioxins and Dibenzofurans in Stormwater Outfalls Adjacent to Urban
15 Areas and Petroleum Refineries in San Francisco Bay, California. *Archives of Environmental*
16 *Contamination and Toxicology* 37:290–301.
- 17 Werner, I., S. Anderson, K. Larsen, and J. Oram. 2008. *Chemical Stressors in the Sacramento-San*
18 *Joaquin Delta*. Ecosystem Conceptual Model. Delta Regional Ecosystem Restoration
19 Implementation Plan. Sacramento, CA.
- 20 Werner, I., L. Deanoic, V. Connor, V. de Vlaming, H. Bailey, and D. Hinton. 2000. Insecticide-caused
21 Toxicity to *Ceriodaphnia dubia* (Cladocera) in the Sacramento–San Joaquin River Delta,
22 California, USA. *Environmental Toxicology and Chemistry* 19(1):215–227.
- 23 Werner I., Deanovic L. A., Markiewicz D., Khamphanh J., Reece C. K., Stillway M., Reece C. 2010.
24 Monitoring Acute and Chronic Water Column Toxicity in the Northern Sacramento–San Joaquin
25 Estuary, California, USA, using the Euryhaline Amphipod, *Hyaella azteca*: 2006–2007. *Environ.*
26 *Toxicol Chem.* 29:2190–2199.
- 27 Werner, I., and J. Oram. 2008. *Pyrethroid Insecticides*. Ecosystem Conceptual Model. Sacramento-San
28 Joaquin Delta Regional Ecosystem Restoration Implementation Plan. Sacramento, CA.
- 29 Weston, D., and M. Lydy. 2010. Urban and Agricultural Sources of Pyrethroid Insecticides to the
30 Sacramento–San Joaquin Delta of California. *Environmental Science and Technology* 44(5):1833–
31 1840.
- 32 Wetzel, R. 2001. *Limnology*. San Diego, CA: Academic Press.
- 33 Wiener, J. G., C. C. Gilmour, and D. P. Krabbenhoft. 2003. *Mercury Strategy for the Bay-Delta*
34 *Ecosystem: A Unifying Framework for Science, Adaptive Management, and Ecological Restoration*.
35 Final Report to the California Bay-Delta Authority.
- 36 Wilbur, R. and A. Munévar, 2001. Chapter 7 – Integration of CALSIM and Artificial Neural Networks
37 Models for Sacramento-San Joaquin Delta Flow-Salinity Relationships. *Methodology for Flow and*
38 *Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh*. 22nd Annual Progress
39 Report to the State Water Resources Control Board. Sacramento, CA.

- 1 Wilkerson, F., R. Dugdale, V. Hogue, and A. Marchi. 2006. Phytoplankton Blooms and Nitrogen
2 Productivity in San Francisco Bay. *Estuaries and Coasts* 29(3):401–416.
- 3 Wilson, A. E., W. A. Wilson, and M. E. Hay. 2006. Intraspecific Variation in Growth and Morphology of
4 the Bloom-Forming Cyanobacterium *Microcystis aeruginosa*. *Applied and Environmental*
5 *Microbiology* 72(11):7386–7389.
- 6 World Health Organization. 2002. *Global Assessment of the State of the Science of Endocrine*
7 *Disruptors*. International Programme on Chemical Safety. WHO/PCS/EDC/02.2.
- 8 ———.2003. *Chloride in Drinking-Water*. Background document for development WHO Guidelines
9 for Drinking-water Quality. WHO/SDE/WSH/03.04/03.
- 10 Wright, S., and D. Schoellhamer. 2005. Estimating Sediment Budgets at the Interface Between Rivers
11 and Estuaries with Application to the Sacramento–San Joaquin River Delta. *Water Resources*
12 *Research* 41:1–17.
- 13 Yee, D., T. Grieb, W. Mills, and M. Sedlak. 2007. Synthesis of Long-Term Nickel Monitoring in San
14 Francisco Bay. *Environmental Research* 105:20–33.
- 15 Yee, D., L. J. McKee, and J. J. Oram. 2011. A Regional Mass Balance of Methylmercury in San Francisco
16 Bay, California, USA. *Environmental Toxicology and Chemistry* 30:88–96.