Appendix H1

Modeling for the Revised Proposed Plan Amendments

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Appendix H1a
Sacramento Water Allocation Model Methods

H1a.1 Introduction

This appendix summarizes Sacramento Water Allocation Model (SacWAM) modeling methods SacWAM version 2025.08.28 for the Existing, VA, 55, and 55 WSA scenarios. The methods for Existing, VA, and 55 WSA scenarios are described in this appendix because they are relevant to the analysis in Chapter 13. The 55 scenario is included in this appendix for context because it includes the model updates described below and provides a point of comparison for the 55 WSA scenario. Please see Chapter 6, *Changes in Hydrology and Water Supply*, and Appendix A1, *Sacramento Water Allocation Model Methods and Results*, for a general description of SacWAM modeling methods for Existing and percent unimpaired flow scenarios. See Chapter 9.5, *Changes in Hydrology and Water Supply*, and Appendix G3a, *Sacramento Water Allocation Model Methods and Results for the Proposed Voluntary Agreements*, for a description of SacWAM modeling methods for the VA scenario absent the refinements described in the current appendix.

Within the current appendix, model scenarios are referred to according to the names assigned to them within SacWAM. Elsewhere in the Staff Report, Existing is referred to as "baseline" and 55 WSA is referred to as "55 percent unimpaired flow with water supply adjustments" or "55 w/WSAs." Results from model scenarios documented here and discussed in Chapter 13 are summarized in greater detail in Appendix H1a2, *Sacramento Water Allocation Model Results for Revised Proposed Plan Amendments*, Appendix H1a3, *Sacramento Water Allocation Model Results for Updated Unimpaired Flow Scenarios*, Appendix H1a4, *Sacramento Water Allocation Model Results for CVP Export Constraint Sensitivity Analysis*, and Appendix H1a5, *Sacramento Water Allocation Model Results for Export Constraint Sensitivity Analysis*.

Since the release of SacWAM version 2023.06.12 to support the 2023 Draft Staff Report, many minor refinements have been made to SacWAM as part of SacWAM version 2025.08.28 based on input from stakeholders during the public comment period. Model changes include extension of period of simulation through 2021, changes to priorities of CVP contractors, minor changes to operations of Contra Costa Water District, Oroville Reservoir, Folsom Reservoir, and Delta depletions. Additionally, refinements were made to the VA scenario and a new scenario was developed to represent the water supply adjustments. Each of the sections below presents more detail on each of the model changes.

H1a.2 SacWAM General Updates

This section summarizes general updates included in SacWAM 2025.08.28 that affect all modeled scenarios.

H1a.2.1 Extension of Period of Simulation

The period of simulation has been extended to include water years 2016-2021 resulting in a full period of simulation of water years 1922–2021 (note, however, that water year 1922, the "Current Accounts" year in SacWAM is identical across all scenarios, and is thus excluded from analysis). This update allows for the simulation of recent dry periods and simulates more years that are within the recent regulatory environment.

H1a.2.2 Change in Priorities for CVP Contractors and Refuge Supplies

CVP north-of-Delta (NOD) and CVP south-of-Delta (SOD) demand priorities were adjusted to separate delivery priorities between contract types and to more accurately represent the way that the U.S. Bureau of Reclamation (Reclamation) allocates water between contract types south-of-Delta. Additionally, refuge priorities were increased relative to other senior demands to reflect provisions of the December 2025 revised draft Bay-Delta Plan intended to prioritize refuge water supplies.

Previously, Sacramento River Settlement Contract (SRSC) demands were the same priority (45) as NOD refuge demands, which is also the priority assigned to the buffer pool of Shasta Reservoir in the percent unimpaired flow scenarios. The priority for refuge demands was increased to 44 (lower numerical values reflect higher priorities in SacWAM), which results in water being delivered to refuge demands before settlement contract demands when deliveries are shorted by low reservoir storage conditions using the reservoir buffers.

Previously, all SOD CVP demands had a priority of 73 which required a postprocessing exercise to redistribute SOD CVP supplies. Reclamation contracts are written such that SOD refuges and Exchange Contractors receive 100% or Shasta critical year allocations before SOD water service contractors receive water. In this update of SacWAM, the priorities have been updated to reflect the contract priorities, negating the need for a postprocessing step, and to prioritize refuge deliveries over Exchange Contractor deliveries consistent with the change described above for SRSC and NOD refuge demands. The new CVP demand priorities are shown in Table H1a-1. One refuge demand site, R_17_PR2, has lower demand priorities due to its physical location and the presence of a transmission link to it from the Sutter Bypass. High priority demands with transmission links from flood bypasses can cause unrealistic operations of upstream reservoirs. Accordingly, as modeled, water supplies to refuges in water budget area 17 show reductions of up to five percent, larger than elsewhere in the model domain (Appendix H1a3). This effect is largely a modeling artifact and does not necessarily reflect an actual shortage in refuge supply under the modeled scenarios.

For all flow scenarios with requirements less than 65 percent of unimpaired flow, the reductions in deliveries to refuges supplied by the CVP described in the 2023 Draft Staff Report were the result of the demand priorities discussed above as opposed to allocations *per se*. This effect was particularly strong for deliveries to NOD refuges, which were frequently shorted by reservoir storage conditions.

Table H1a-1. Updated CVP Demand Priorities

CVP Contract Type	SacWAM Demand Priority
CVP SRSC	45
CVP NOD Refuge	44
CVP SOD Agricultural	76
CVP SOD Urban	76
CVP Exchange	75
CVP SOD Refuge	74

NOD = north-of-Delta; SOD = south-of-Delta; SRSC = Sacramento River Settlement Contract

H1a.2.3 Contra Costa Water District Diversions

Contra Costa Water District (CCWD) diverts water at multiple locations in the Delta under various water rights, contracts, and transfer agreements. Based on comments by CCWD, SacWAM has been updated to more explicitly reflect each of these diversion types separately. SacWAM now contains three transmission links for the Old River (Old River and Victoria Canal) diversion and two transmission links for the Rock Slough diversion. The CVP transmission links are limited based on the CVP allocation. The transfer transmission links are limited based on transfer water supply. Diversion through the water right transmission link is only allowed when the Delta is in excess conditions. The total diversions through all of the transmission links to the Old River and Victoria Canal diversion is limited to no more than 250 cubic feet per second (cfs) and the total diversion through all of the Rock Slough transmission links is limited to 350 cfs. The CCWD WRIMS model was also updated to accommodate the updated transmission links and to limit transfer supplies in the 55 WSA and other percent unimpaired scenarios to those modeled in the Existing scenario.

H1a.2.4 Delta Depletions

There were two changes made to Delta depletions. First the accretions from and diversions to Byron Bethany Irrigation District were added to the depletion arc Delta Depletion 7. Second, the seepage to the Delta islands is now represented as a separate arc from each Delta depletion arc. This reduces the postprocessing required to summarize the water supplied to Delta users.

H1a.2.5 Folsom and Oroville Operations

The expressions for the top-of-conservation (TOC) for Folsom and Oroville Reservoirs have been updated based on updates made to CalSim 3 which provide a better representation of current operations of these reservoirs. The Folsom Reservoir TOC was previously calculated dynamically based on available upstream storage capacity. Now the Folsom Reservoir TOC is a static curve that ranges from 567 thousand acre-feet (TAF) in the winter to 967 TAF in the summer. Based on information provided by the California Department of Water Resources (DWR), the Oroville Reservoir TOC has been refined and now ranges from 2,787 TAF in some winters to 3,538 TAF in the summer. In addition to the TOC for Oroville Reservoir, the end of September carryover target was updated in the SWP allocation logic from 1.3 million acre-feet (MAF) to 1.6 MAF to reflect DWR’s updated operational targets.

H1a.2.6 Other Minor Changes

Two minor changes were made that have minimal effects on the simulation as a whole, however they infrequently have large local effects.

H1a.2.6.1 Knights Landing Ridge Cut

The Knights Landing Ridge Cut connects the Colusa Basin Drain to the Yolo Bypass. Previously, the operations of the outfall gates led to model instability because the model was inconsistent in portraying whether the water in the Colusa Basin Drain would flow to the Sacramento River or to the Yolo Bypass when the outflow gates were open. A new operational flow requirement was added on the Colusa Basin Drain outflow with a priority of 42. Now when the outfall gates are open, the model will prefer to route water back to the Sacramento River.

H1a.2.6.2 Limits in diversions from Mill, Deer, and Antelope Creeks

The SacWAM demand site A_05_NA represents Los Molinos Mutal Water Company and other non-district diverters and SRSCs in water budget area 05. This demand site draws water from Mill Creek, Deer Creek, Antelope Creek, the Sacramento River, and groundwater. Previously in SacWAM there were no constraints on the transmission links from each of the surface water sources, so modeled diversions did not necessarily reflect the availability of surface water to the lands irrigated from a particular tributary. Expressions for maximum flow volume and maximum flow percent of demand were added to constrain diversions from each surface water source to better reflect the land use associated with each tributary.

H1a.3 Voluntary Agreements Scenario

Since the release of the 2023 Draft Staff Report, VA participants and other members of the public have provided comments that resulted in minor updates to the modeling assumptions for the VA scenario. These changes are discussed in Section H1a.3.1, *Updates to the Voluntary Agreements Scenario*.

Additionally, through the development of accounting the procedures for the VA pathway reflected in the December 2025 revised draft Bay-Delta Plan and Appendix B.1 thereto, the VA proposal has been modified to build flows upon the 2024 Long-Term Operations (LTO) of the CVP and SWP Record of Decision (ROD) (Reclamation 2024) with modifications to remove actions to protect longfin smelt, which was not federally listed at the adoption of the 2020 ROD (Reclamation 2020). VA modeling methods were not updated to reflect changes between the 2020 ROD (as represented by the 2019 BiOps scenario described in Appendix G3a, *Sacramento Water Allocation Model Methods and Results for the Proposed Voluntary Agreements*) and 2024 ROD. Accordingly, Section H1a.3.2, *Sensitivity to LTO of the CVP and* SWP, describes a comparison of modeled operations under the 2020 ROD versus the 2024 ROD, as modified for the purposes of VA accounting, based on model results from CalSim 3. At the time of this writing, CalSim 3 is the best available model to compare the scenarios of interest.

H1a.3.1 Updates to the Voluntary Agreements Scenario

Based on public comments by VA participants and others, changes were made to Mokelumne, American, and Trinity Rivers, as well as summer Suisun Marsh Salinity Control Gate (SMSCG) operations in the VA scenario.

On the Mokelumne River, VA flows are now required in addition to the existing flow requirements below Woodbridge, as well as below Camanche Reservoir. Previously VA flows were only required to be in addition to the existing flow requirement below Camanche Reservoir. The monthly distribution of VA flows on the Mokelumne River has also been updated to reflect the default monthly distribution in the VA proposal.

On the American River, VA flows are now required in up to 6 out of every 8 years instead of 3 out of every 8 years previously. This change is based on clarification of the VA proposal by American River parties. Additionally, Hell Hole Reservoir has been reoperated in the VA scenario to replenish the 10 TAF of spring releases from Folsom Reservoir potentially attributable to upstream reservoir reoperation. This assumption is meant to model the aggregate effect of upstream reoperation within the American River watershed, with the understanding that in implementation this effect may be distributed among multiple reservoirs.

Imports from the Trinity River through the Clear Creek Tunnel are now limited to be no more than the existing conditions scenario similar to the unimpaired flow scenarios. This modeling assumption reflects new provisions included in Section 4.4.10.1 in the December 2025 revised draft Bay-Delta Plan.

The SMSCG has been updated in the VA scenario by adding the summer actions for habitat. The modeling assumptions for SMSCG operation in the VA scenario are now the same as the Existing scenario.

H1a.3.2 Sensitivity to LTO of the CVP and SWP

At the request of State Water Board staff, DWR prepared CalSim 3 models representing 2020 ROD and 2024 ROD, as modified to exclude actions to protect longfin smelt (DWR 2025). In the discussion that follows, the 2020 ROD scenario is referred to as the "2019 BiOps" model, while the 2024 ROD scenario is referred to as the "2024 BiOps" model. Both models use historical hydrology for a period of record of 1922 through 2021 for greatest comparability to the SacWAM hydrology used in Chapter 13. The two models were built upon the CalSim 3 modeling framework used in the 2024 Final Environmental Impact Report for the Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta, Suisun Marsh, and Suisun Bay (LTO FEIR) (DWR 2024). The 2019 BiOps and 2024 BiOps models were based on the Baseline Conditions (Study 1) and Cumulative Projects (Study 12av2) model simulations, respectively, as described in Appendix 4A and Appendix 4G to the LTO FEIR (DWR 2024). Specifically, Appendix 4A, Attachment 6: *Scenario Related Changes to CalSim 3 and DSM2*, describes the formulation of Old and Middle River (OMR) reverse flow limits and modifications to Suisun Marsh Salinity Control Gate (SMSCG) operations; Appendix 4G, Attachment 1: *CalSim 3 Model Assumptions Callouts*, describes model assumptions for the Baseline Conditions and Cumulative Projects model. Each model was modified as described in DWR 2025 and below to represent the scenario of interest.

H1a.3.2.1 2019 BiOps Model

The 2019 BiOps model was derived from the LTO FEIR (DWR 2024) Baseline Conditions model (Study 1), with modifications to use historical hydrology and remove actions associated with the 2020 Incidental Take Permit (2020 ITP, Permit No. 2081-2019-066-00) previously issued to DWR by the California Department of Fish and Wildlife, as well as the Interim Operations Plan (IOP) that had applied to operations of the CVP during litigation of the 2019 BiOps. Specifically, the following actions were excluded:

1. 2020 ITP requirements for increased Delta outflow during summer months; see "Additional 100 TAF for Delta Outflow under ITP" (DWR 2024).
2. 2020 ITP Spring Outflow during April and May; see "Spring Outflow Requirement" (DWR 2024).
3. 2020 ITP dry years following below normal years SMSCG operations; see "Summer/Fall Habitat (SMSCG)" (DWR 2024).
4. IOP export constraints on CVP; see "Interim Operations Plan (IOP)" (DWR 2024).

OMR reverse flow limits were modeled as the percentage of days within each month for which a limit of -3,500 cfs OMR applies. Table H1a-2 shows the assumed percentages by month and water year type for the 2019 BiOps model (see also DWR 2024, Table 4A-6-11).

Table H1a-2. OMR Percentage by Water Year Type for Input into CalSim 3 in 2019 BiOps Model

Water Year Type	Jan Avg	Feb Avg	Mar Avg	Apr Avg	May Avg	Jun Avg
Critical	0%	0%	20%	19%	13%	0%
Dry	0%	0%	48%	31%	50%	0%
Below Normal	0%	11%	100%	88%	81%	0%
Above Normal	0%	14%	99%	77%	74%	0%
Wet	0%	0%	99%	67%	67%	0%

H1a.3.2.2 2024 BiOps Model

The 2024 BiOps model was derived from LTO FEIR (DWR 2024) Cumulative Project model (Study 12av2) with modifications to use historical hydrology and remove actions associated with proposed VAs and OMR reverse flow limits associated with protection of longfin smelt. Excluded VA actions are listed in the LTO FEIR (DWR 2024) at p. 4G-1-14 and pp. 4G-1-17 through 4G-1-19. OMR reverse flow limits were modified by combining estimates of species-specific action thresholds following the same procedure described in Section 4A-6.3.2.12 of the LTO FEIR (DWR 2024) but excluding thresholds for longfin smelt. OMR reverse flow limits were modeled as the percentage of days within each month for which a limit of -3,500 cfs OMR applies. For the 2024 BiOps model, separate lookup tables are used depending upon the status of a "highflow offramp" when either Sacramento River flows at Rio Vista exceed 55,000 cfs or San Joaquin River flows at Vernalis exceed 8,000 cfs (see DWR 2024, Appendix 4A, Attachment 6). Table H1a-3 and Table H1a-4 show the percentages for the two conditions. Table H1a-3 can be compared with LTO FEIR Table 4A-6-23 (DWR 2024) to see the effect of removing longfin smelt triggers. The largest effects are generally seen in January through March of drier water year types. Table H1a-4 contains identical values to those in LTO FEIR Table 4A-6-24 (DWR 2024).

Table H1a-3. OMR Percentage by Water Year Type for Input into CalSim 3, No Highflow Offramp in 2024 BiOps

Water Year Type	Jan Avg	Feb Avg	Mar Avg	Apr Avg	May Avg	Jun Avg
Critical	0%	0%	20%	21%	21%	10%
Dry	4%	15%	63%	88%	63%	40%
Below Normal	5%	31%	100%	79%	67%	46%
Above Normal	32%	54%	95%	83%	69%	53%
Wet	0%	0%	90%	87%	70%	59%

Table H1a-4. OMR Percentage by Water Year Type for Input into CalSim 3, With Highflow Offramp (Rio Vista Flows>55,000 cfs or Vernalis Flows>8,000 cfs) in 2024 BiOps

Water Year Type	Jan Avg	Feb Avg	Mar Avg	Apr Avg	May Avg	Jun Avg
Critical	0%	0%	0%	3%	9%	0%
Dry	4%	15%	49%	79%	39%	0%
Below Normal	5%	31%	100%	41%	11%	21%
Above Normal	32%	54%	67%	47%	24%	24%
Wet	0%	0%	34%	54%	37%	26%

Changes to OMR reverse flow limits between the 2019 BiOps and 2024 BiOps models reflect the following actions:

1. The adult Delta smelt turbidity bridge action is changed from -2,000 cfs for 5 days to -3,500 cfs for 12 days; a high flow offramp is assumed to occur when San Joaquin River flows at Vernalis exceed 10,000 cfs.
2. A high flow offramp applies to larval and juvenile Delta smelt actions when Sacramento River flows at Rio Vista exceed 55,000 cfs or San Joaquin River flows at Vernalis exceed 8,000 cfs.
3. Spring-run Chinook salmon actions are included.
4. The QWest flow threshold for OMR “storm flex” operations is increased from 1,000 cfs to 1,500 cfs.

Additional changes to the 2024 BiOps model relative to the 2019 BiOps model include:

1. SMSCG operations changed from 60 days of continuous operation during June through August to 7 days on, 7 days off operations during June through October.
2. Added limitation to North Bay Aqueduct diversions: maximum seven-day average diversion rate of 100 cfs in January through March of dry and critical water years according to the Sacramento 40-30-30 water year type.
3. Permitted capacity of SWP Banks Pumping Plant up to 10,300 cfs during December 1 through March 31, depending upon San Joaquin River flow at Vernalis; this is an expansion of a similar assumption in the 2019 BiOps model that applies during December 15 through March 15.
4. Changes to Shasta Reservoir carryover storage targets and CVP water allocation procedures to reflect updated temperature operations for the Sacramento River downstream of Keswick Reservoir.

H1a.3.2.3 CalSim 3 Model Results Comparison:

Table H1a-5, Table H1a-6, and Table H1a-7 summarize long-term average monthly values for total Delta inflow and Delta outflow in TAF and combined export rate, OMR flows, and OMR limits in cfs in the 2019 BiOps and 2024 BiOps models, and the average changes in monthly values in 2024 from 2019 BiOps from January through June for 1922-2021 model simulation period (DWR 2025). More detailed results are available in DWR 2025.

Table H1a-5. Total Delta Inflow, Total Delta Outflow, Average Combined CVP and SWP Export Rate, Average OMR Flows and Average OMR Requirement by Month and for January through June in 2019 BiOps

	Jan	Feb	Mar	Apr	May	Jun	Jan-Jun
Total Delta Inflow (TAF)	2,745	3,243	3,019	2,042	1,769	1,375	14,193
Delta Outflow (TAF)	2,417	2,898	2,655	1,667	1,276	796	11,709
Total Exports (CFS)	6,518	7,722	6,512	5,362	5,723	5,799	6,273
OMR Flows (CFS)	-3,772	-3,977	-2,996	-1,850	-2,942	-4,259	-3,299
OMR Requirement (CFS)	-4,487	-4,540	-3,857	-4,133	-4,125	-5,000	-4,357

CFS = cubic feet per second; OMR = Old and Middle River; TAF = thousand acre-feet

Table H1a-6. Total Delta Inflow, Total Delta Outflow, Average Combined CVP and SWP Export Rate, Average OMR Flows and Average OMR Requirement by Month and for January through June in 2024 BiOps

	Jan	Feb	Mar	Apr	May	Jun	Jan-Jun
Total Delta Inflow (TAF)	2,753	3,245	3,021	2,043	1,771	1,356	14,187
Delta Outflow (TAF)	2,431	2,915	2,649	1,669	1,274	810	11,748
Total Exports (CFS)	6,414	7,441	6,640	5,339	5,790	5,225	6,141
OMR Flows (CFS)	-3,678	-3,739	-3,121	-1,834	-3004	-3,728	-3,184
OMR Requirement (CFS)	-4,425	-4,322	-4,005	-3,966	-4,180	-4,414	-4,219

CFS = cubic feet per second; OMR = Old and Middle River; TAF = thousand acre-feet

Table H1a-7 shows the changes most relevant to Delta operations, and accordingly, the main incremental effects of LTO of the CVP and SWP on modeled VA outcomes. Overall, there is slight increase in Delta outflow in 2024 BiOps model from January through June. Combined exports during this period decrease since modeled OMR flows are less negative. For example, Combined exports decrease in June because the percentage of monthly OMR limits at -3,500 cfs is higher (Table H1a-3 and Table H1a-4 versus Table H1a-2) in the 2024 BiOps than in the 2019 BiOps model. The largest single-month change is observed in June, when combined exports are reduced by 574 cfs (34 TAF), and offset by an increase of 14 TAF in Delta outflow and a decrease of 20 TAF in Delta inflow. Figure H1a-1 and Figure H1a-2 show that the OMR limit and modeled OMR flows in June are less negative in 2024 BiOps relative to the 2019 BiOps. Similar patterns of smaller magnitude can be seen in comparisons of modeled OMR flows in January and February (DWR 2025). Summer/Fall SMSCG operation, Noth Bay Aqueduct and SWP South Delta Pumping Plant assumption changes have less effect on Delta outflow and combined exports.

Table H1a-7. Changes in Total Delta Inflow, Total Delta Outflow, Average Combined CVP and SWP Export Rate, Average OMR Flows and Average OMR Requirement by Month and for January through June for the 2024 BiOps Relative to 2019 BiOps

	Jan	Feb	Mar	Apr	May	Jun	Jan-Jun
Total Delta Inflow (TAF)	7	2	2	1	2	-20	-6
Delta Outflow (TAF)	14	17	-6	2	-2	14	39
Total Exports (CFS)	-104	-281	128	-23	66	-574	-131
OMR Flows (CFS)	93	238	-125	16	-62	531	115
OMR Requirement (CFS)	62	218	-147	167	-54	586	138

CFS = cubic feet per second; OMR = Old and Middle River; TAF = thousand acre-feet

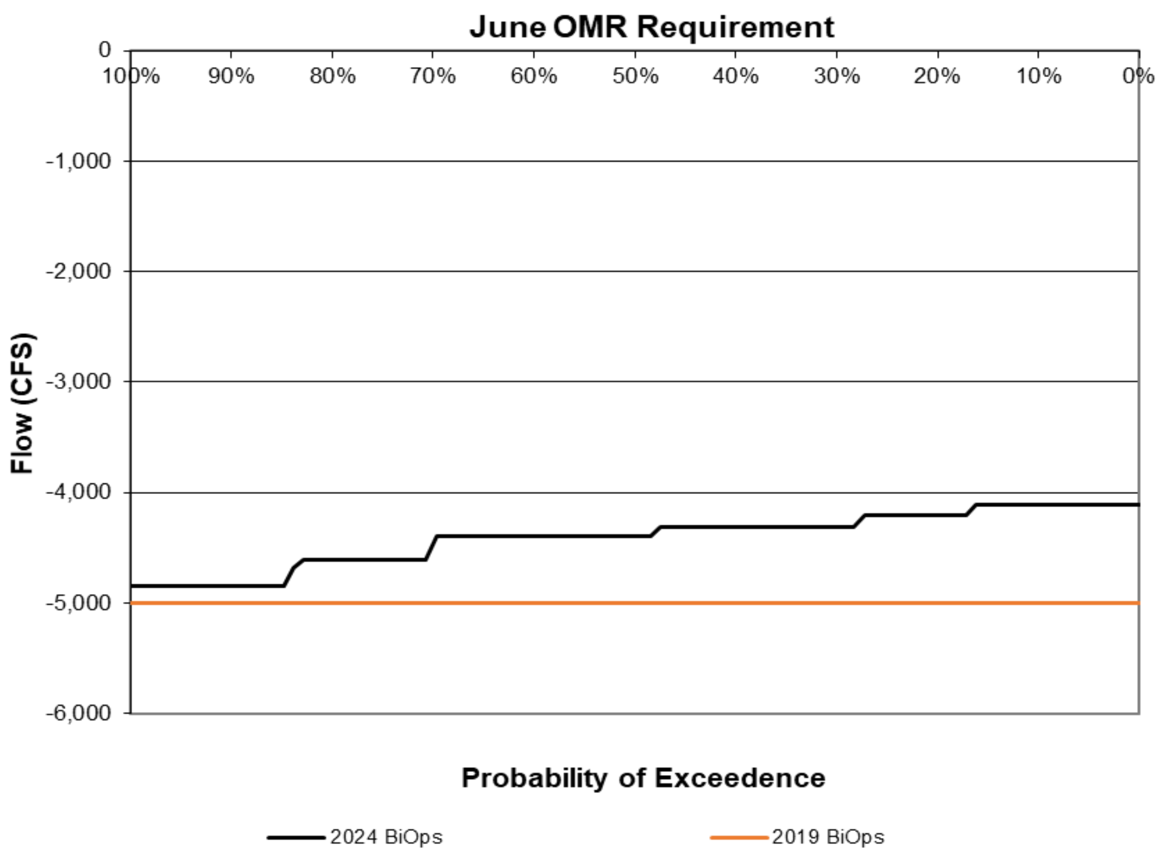

Figure H1a-1. Old and Middle River Flow Requirement in June

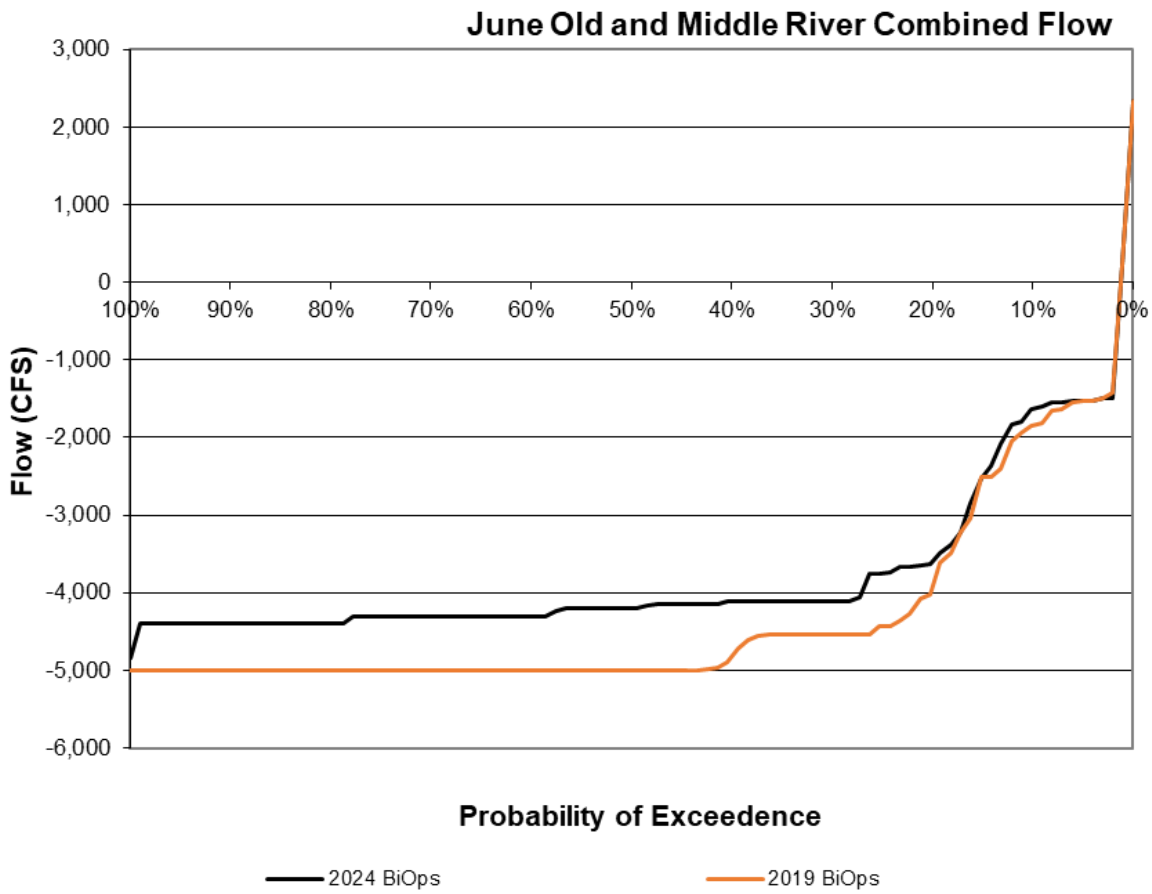

Figure H1a-2. Old and Middle River Combined Flow in June

Based on the model results presented here, updating SacWAM assumptions associated with LTO of the CVP and SWP using the available information would be expected to have minor effects on the modeled comparison of the VA scenario to the Existing (baseline) scenario, and would not change the conclusions of the impact and benefit analyses presented in Chapter 13, *Revised Proposed Plan Amendments*.

H1a.4 55 with Water Supply Adjustments (55 WSA) Scenario

The starting point for the inflow and inflow-based outflow requirements is reduced below 55 percent of unimpaired flow by the WSAs. WSAs apply at the watershed-wide scale and, where applicable, at the tributary scale as described below. The following sections outline the rules that were used to model 55 WSA scenario.

H1a.4.1 Watershed-Wide WSAs

The watershed-wide WSAs apply based on the cumulative sum of the prior 12 months of the Sacramento Valley Four River Index (four river index)[1] during October through May. The requirement for May applies for June through September. Under the watershed-wide WSAs, 55 percent of unimpaired flow is required in the wettest 1/3 of years, 45 percent of unimpaired flow in the middle 1/3 of years, and 35 percent of unimpaired flow in the driest 1/3 of years. Thresholds of the four river index that would trigger the watershed-wide WSAs were calculated as the 0.67 and 0.33 quantiles of historical values of the 12 month four river index from water years 1992 through 2021, rounded to the nearest 0.1 MAF. The years 1992 through 2021 were used to represent current climate and hydrological conditions, based on the contemporary reference period used by the DWR to calculate adjusted historical hydrology for CalSim 3 (Schwarz et al. 2025).

During October through May, when the 12-month four river index is below 20.2 MAF, the flow requirement is reduced to 45 percent of unimpaired flow watershed-wide and when the 12-month four river index is below 13.2 MAF, the flow requirement is reduced to 35 percent of unimpaired flow watershed-wide. The requirement for May applies for June through September. Water supply adjustments are applied to all unimpaired flow requirement compliance locations throughout the Sacramento/Delta which are listed in Table A1-2 of Appendix A1.

H1a.4.2 Tributary-Specific WSAs

In addition to watershed-wide WSAs described above, additional tributary-specific WSAs apply for specified rainfall dominated and municipal supply dominated tributaries, including the Mokelumne River, Calaveras River, and Putah Creek. The tributary-specific WSAs allow for the requirements to be further reduced, and at times provide for no new inflow requirements under the December 2025 revised draft Bay-Delta Plan (this does not affect other regulatory requirements, including existing Decision 1641 requirements). The tributary-specific WSAs were developed to apply in conjunction with the watershed-wide WSAs to further reduce impacts to municipal water supplies and reservoir carryover storage levels in these three watersheds that are highly impaired and are also either municipal water supply dominated or are flashy rainfall dominated systems that cause significant challenges managing carryover storage, or both. These tributary-specific WSAs are based on local storage conditions as defined in Table H1a-8 which reduce or remove the flow requirements during low storage conditions. If the previous month's storage is below the fraction of TOC listed in Table H1a-8, the applicable flow requirement is the lower of the flow requirement listed or the watershed-wide WSA described above.

[1] The four river index refers to the sum of the unimpaired runoff as published in the DWR Bulletin 120 for the following locations: Sacramento River flow at Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River flow at Smartville; American River, total inflow to Folsom Reservoir.

Table H1a-8. Tributary-Specific WSAs

Tributary	Reservoir	Fraction of Top of Conservation	Required Percent of Unimpaired Flow
Mokelumne River	Camanche Reservoir	<0.72	35%
		<0.53	0%
Putah Creek	Lake Berryessa	<0.9	35%
		<0.57	0%
Calaveras River	New Hogan Reservoir	<0.72	35%
		<0.42	0%

When the unimpaired flow requirement for an individual tributary is reduced, the reduction in required flow is translated to all unimpaired flow requirements within the watershed and is translated to downstream flow requirements as well. For example, if the storage is low in Camanche Reservoir in one month, then all unimpaired flow requirements are reduced on the Mokelumne River the following month. Additionally, the reduction in flow requirement at the Delta outflow location is reduced by the volume reduced at the mouth of the tributary. This ensures that when the required flow is reduced on one tributary, it does not need to be made up from another tributary. Table H1a-9 shows how flow requirement reductions are translated within each watershed and downstream.

Table H1a-9. Flow Requirements Modified by each Tributary-Specific WSA.

Tributary	TOC of Reservoir	UF Compliance Location
Mokelumne River	Camanche Reservoir	SWRCB Pardee Inflow SWRCB Camanche Inflow SWRCB Camanche SWRCB Mokelumne River SWRCB Delta
Putah Creek	Lake Berryessa	SWRCB Lake Berryessa SWRCB Putah Creek SWRCB Delta
Calaveras River	New Hogan Reservoir	SWRCB New Hogan SWRCB Calaveras River SWRCB Delta

SWRCB = State Water Resources Control Board; TOC = top of conservation; UF = unimpaired flow

H1a.4.3 Reservoir Buffer Pool

The top of buffer values were adjusted in the 55 WSA scenario based on comments and based on updated carryover storage target ranges presented in Appendix H1a1. As discussed in Appendix A1, the carryover storage targets presented in Appendix A1c and H1a1 do not directly translate to the end of September buffer pool level because the water in the buffer pool can be released based on downstream demand priorities. The storage in the buffer pool has a higher priority than the storage when the reservoir is full, therefore the reservoir will continue to release water when the storage drops below the buffer pool, but only for higher priority demands (including instream flow requirements). To meet an end of season target such as those listed in Appendix H1a1, in some cases the buffer pool level needs to be higher than the target because water will continue to be released throughout the season once storage drops below the below the buffer pool. Table H1a-10 shows the previous end of September buffer pool values for the 55 scenario and the updated values for the 55 WSA scenario.

Table H1a-10. End of September Buffer Pool Levels for Reservoirs that have Changed between the 55 Scenario and the 55 WSA Scenario

Reservoir	55 Scenario	55 WSA Scenario
Camanche	169 TAF	139 to 179 TAF [1]
Folsom	TOC to 750 TAF [2]	550 TAF
New Bullards Bar	750 TAF	650 TAF
Oroville	1,638 TAF	1,388 TAF
Pardee	189 TAF	129 to 169 TAF [3]
Shasta	1,850 TAF	1,300 TAF

TAF = thousand acre-feet; TOC = top of conservation
[1] The EOS buffer for Camanche is 179 TAF except in critical years according to the Sacramento water year type when it is reduced to 139 TAF.
[2] The EOS buffer for Folsom was previously the minimum of the TOC or 750 TAF
[3] The EOS buffer for Pardee is 169 TAF except in critical years according to the Sacramento water year type when it is reduced to 129 TAF

H1a.4.4 Solano Project Allocation and Berryessa Operations

The maximum allocation for the Solano Project in the 55 scenario described in SacWAM version 2023.06.12 was incorrectly set at 50 percent. The maximum allocation was updated to 100 percent to be consistent with the other scenarios. Additionally, new expressions were developed to limit the maximum required release from Lake Berryessa to meet the SWRCB Berryessa requirement, reflecting infrastructure limitations. The downstream requirement SWRCB Putah Creek is also adjusted to reflect the reduced release requirement. For the 55 WSA scenario, the maximum release is assumed to be 750 cfs.

H1a.4.5 CVP and SWP Allocations

The 55 WSA scenario includes modification to the CVP and SWP allocation logic to better reflect availability of water supply to each Project with the new flow requirements and carryover storage targets. For the CVP, this is accomplished by reducing the value of the system DeliveryIndex_first variable by up to 200 TAF as a function of the system DemandIndex variable (Table H1a-11). For the SWP, this is accomplished by defining a lookup table to use the otherwise unused variable DI_Buffer, which is referenced in the expressions for Allocation_init and Allocation_adjustment (H1a-12). In each case the dependent variable (Adjustment or DI_Buffer) is determined by linear interpolation based on the value of the respective CVP or SWP DemandIndex variable.

Table H1a-11. CVP DeliveryIndex_first Adjustment (TAF) Lookup Table as a Function of DemandIndex (TAF) for 55 WSA Scenario.

DemandIndex	Adjustment
0	0
3,990	200
5,442	200
7,162	200
8.717	100
10,434	50
11,395	25
15,099	0

Table H1a-12. SWP DI_Buffer (TAF) Lookup Table as a Function of DemandIndex (TAF) for 55 WSA Scenario.

DemandIndex	DI_Buffer
0	100
1,000	100
2,000	87.5
4,000	50
6,000	12.5
8,000	0
10,000	0

H1a.4.6 Export Pool

The Existing scenario makes use of two user defined constraints, CVPBufferExpLimit_P72 and SWPBufferExpLimit_P72, to limit releases for export from Shasta and Oroville Reservoirs, respectively. For these two reservoirs, these constraints take place of the usual WEAP reservoir buffering capabilities used for other reservoirs, including Folsom. The percent of unimpaired flow scenarios modeled for the Draft Staff Report substituted standard buffers on Shasta and Oroville Reservoirs with priorities set to limit release for delivery to SRSC and Feather River Service Area water users. In the revised version of SacWAM, Shasta and Oroville Reservoir buffering key assumptions each contain a new variable named “Export Pool” referenced by CVPBufferExpLimit_P72 and SWPBufferLimit_P72, respectively. This approach maintains the same behavior in the Existing (baseline) scenario.

The 55 WSA scenario uses the usual WEAP reservoir buffering capabilities to limit releases for delivery to SRSC and Feather River Service Area water users as in prior percent of unimpaired flow scenarios, in combination with Export Pool limitations on release from each reservoir for export. Export Pool volumes for the Existing and 55 WSA scenarios are shown for Shasta Reservoir in Table H1a-13 and for Oroville Reservoir in Table H1a-14.

Table H1a-13. Shasta Reservoir Export Pool Volumes (TAF) for Existing and 55 WSA Scenarios.

Month	Existing	55 WSA
October	1,522	2,522
November	1,509	2,600
December	1,830	2,830
January	2,052	3,100
February	2,380	3,400
March	2,722	3,622
April	2,929	3,829
May	2,856	3,756
June	2,519	3,519
July	2,035	3,035
August	1,688	2,688
September	1,500	2,500

Table H1a-14. Oroville Reservoir Export Pool Volumes (TAF) for Existing and 55 WSA Scenarios.

Month	Existing	55 WSA
October	1,374	1,674
November	1,300	1,600
December	1,436	1,736
January	1,566	1,866
February	1,775	2,075
March	2,011	2,211
April	2,222	2,422
May	2,316	2,516
June	2,162	2,462
July	1,810	2,110
August	1,530	1,830
September	1,388	1,688

H1a.4.7 Export Constraints Based on San Joaquin River Flows (San Joaquin River Inflow to Export Ratio or I:E) Requirement for the CVP

To reflect the current regulatory provisions for the CVP under the 2024 LTO of the CVP and SWP (Reclamation 2024) and associated Biological Opinions and the provisions of the December 2025 revised draft Bay-Delta Plan, in the 55 WSA scenario the San Joaquin inflow to export ratio (I:E) constraints on CVP exports from April through May (that vary between 4:1 and 1:1) beyond those included in State Water Board Decision 1641 were removed. Consistent with the baseline and alternatives described in the 2023 Draft Staff Report this constraint was not removed from the baseline and was also not removed in the 55 (without WSAs) scenario. The I:E requirement is still assumed to apply to the SWP in the 55 WSA scenario. While the December 2025 revised draft Bay-

Delta Plan does not include any additional I:E requirements for either the CVP or the SWP beyond State Water Board Decision 1641, DWR's Incidental Take Permit for the SWP continues to include these requirements and only identifies that the requirements would be removed under the VAs.

Results of modified percent of unimpaired flow scenarios showing the effects of removing the I:E constraint from CVP operations are shown in Appendix H1a4, *Sacramento Water Allocation Model Results for CVP Export Constraint Sensitivity Analysis*. Results of modified percent of unimpaired flow scenarios showing the effects of removing the I:E constraint from both CVP and SWP operations are shown in Appendix H1a5, *Sacramento Water Allocation Model Results for Export Constraint Sensitivity Analysis*.

H1a.4.8 Feather River Fall Operations

SacWAM includes logic to adhere to the 1983 Memorandum of Understanding (MOU) between DWR and California Department of Fish and Wildlife (CDFW). According to the MOU, if fall releases from Oroville Reservoir to the high flow channel are above 4,000 cfs and 2,500 cfs in October and November, respectively, high flows need to be maintained all winter. Previously, SacWAM limited releases in October and November to avoid having to make high releases all winter, which at times led to the unimpaired flow requirement not being met or forcing higher releases from other reservoirs.

In this update, if the unimpaired flow requirement in the 55 WSA and other percent of unimpaired scenarios is greater than the thresholds in October and November, the unimpaired flow requirement at the mouth of the Feather River is reduced to accommodate limits to required releases from Oroville Reservoir of 4,000 cfs and 2,500 cfs in October and November, respectively.

H1a.4.9 New Bullards Bar Reservoir Buffer Pool

Based on updated temperature data and comments received, the buffer pool in New Bullards Bar Reservoir was lowered to allow the reservoir to be drawn down further throughout the summer. Previously, the buffer pool had an end of September value of 750 TAF in the 55 scenario. In the 55 WSA scenario, the end of September buffer pool is 650 TAF.

H1a.4.10 Camanche Reservoir Operations

Refinements were made to the Camanche Reservoir buffer pool and the variable East Bay Municipal Utilities District cutback fraction, which allows for greater deliveries through the Mokelumne Aqueduct in drier years.

The Camanche buffer pool was previously a static curve regardless of the inflow hydrology, with an end of September value of 169 TAF. In the 55 with WSAs scenario, the buffer pool was increased to 179 TAF except in drier years when it was reduced to 139 TAF, which holds more water in storage in wetter years and allows the reservoir to be drawn down further in drier years.

H1a.5 References Cited

California Department of Water Resources (DWR). 2024. Final Environmental Impact Report for the Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta, Suisun Marsh, and Suisun Bay. Available: https://water.ca.gov/News/Public-Notices/2024/Oct-24/FEIR-LTO-SWP-2024. Accessed: November 24, 2025.

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