

Appendix G3e

Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers for the Proposed Voluntary Agreements

G3e.1 Introduction

This appendix describes estimated water temperature effects on the Sacramento, Feather, and American Rivers under the proposed Voluntary Agreements (VAs). Inputs to the water temperature simulations use SacWAM results that include VA tributary flow assets, but do not include unspecified water purchases (including flow assets for the PWA Water Purchase Market Price Program and permanent state water purchases) because the sources of these flow assets are not fully known at this time. As discussed in Chapter 9, the unspecified water purchases under the proposed VAs could be provided from inflows from the Sacramento/Delta watershed or from SWP/CVP export reductions. If unspecified water purchases are provided from sources in the Sacramento, Feather, and American River watersheds, water temperatures on these rivers could be further affected beyond the model results presented in this appendix.

Appendix A6, *Water Temperature Modeling and Fish Assessment for the Sacramento, Feather, and American Rivers*, describes the HEC-5Q models, model performance, and methodology used to estimate water temperature and associated fish effects for the 35, 45, 55, 65, and 75 model scenarios (the proposed Plan amendments and the Low and High Flow Alternatives). The methodology used for assessing the proposed VAs is the same as for these scenarios. As a result, this appendix focusses on model results. Please see Appendix A6 for information regarding background and methodology for the water temperature analysis.

G3e.2 Temperature Modeling for the Baseline and Proposed Voluntary Agreements

G3e.2.1 Model Inputs for Baseline and Proposed Voluntary Agreements

The methods used for developing model inputs in this analysis are identical to those described in Appendix A6, Section A6.2.1, Model Inputs for Baseline and Flow Scenarios.

G3e.2.2 HEC-5Q Results for Baseline and the Proposed Voluntary Agreements

Simulated temperatures are presented here in tables showing the 10th, 50th, and 90th percentiles of baseline temperatures and changes from baseline. The 50th and 90th percentile values presented in the tables represent the temperatures of greatest concern for cold-water fish because they represent typical and warmer temperatures, respectively. Maximum values are not shown because they represent only a single month out of the entire simulation period. Temperature results are provided for locations important for understanding hydrologic effects on water temperature (e.g.,

temperature of reservoir releases) and for locations used in the fish assessment described in Section G4e.3, Fish Assessment). Temperature results for the Sacramento River are shown in Tables G4e-1 through G4e-10. Results for the Feather River are shown in Tables G4e-11 through G4e-16, and those for the American river are shown in Tables G4e-17 through G4e-19. The shading provided in these tables is only for attracting attention to the larger deviations from baseline. Shading does not indicate any impact conclusions.

Temperature results for the Sacramento and American Rivers are presented in upstream to downstream order. Temperatures in the Feather River are complicated by the movement of water through both the Thermalito Afterbay and the Low Flow Channel. Feather River water is diverted to the Thermalito Afterbay at the Thermalito Diversion Dam, and minimum required flows are left in the river to move through the Low Flow Channel. Baseline and the flow scenarios have almost the same flows through the Low Flow Channel. Increased reservoir releases associated with the proposed VAs are simulated as moving through the Thermalito Afterbay, eventually returning to the Feather River at the downstream end of the Low Flow Channel. Temperature results for the Low Flow Channel (below the fish barrier dam and at Robinson Riffle) are presented before the temperatures of the Thermalito Afterbay discharge, which returns to the Feather River downstream of Robinson Riffle.

Water temperature effects associated with the proposed VAs could result from changes in hydrology. Changes in hydrology for the Sacramento, Feather, and American Rivers are summarized by changes in end-of-April storage, end-of-September storage (carryover storage), and river flow as presented in figures and tables in Chapter 9 and Appendix G4a. The hydrologic effects represent reservoir operations expected to result from providing the VA tributary flow assets identified for the Sacramento, Feather, and American Rivers subject to constraints identified by VA parties (see Appendix G4a), meeting the goals of the proposed VAs. In general, the SacWAM results show that the proposed VAs could result in increases or decreases in reservoir storage levels in Shasta Reservoir, Oroville Reservoir, and Folsom Reservoir. Flows would generally increase in the spring and decrease in some months during other times of the year. As discussed in Chapter 9, if the VAs were adopted, actual operation could vary to some degree from SacWAM modeled outcomes and there could be additional changes in streamflows and reservoir levels beyond the modeled changes. For example, the proposed VAs include flexibility in the timing of flow assets, so streamflows and reservoir levels could deviate to some degree from modeled results.

Carryover storage is important for maintaining supply of cool water deep in a reservoir, although spring storage may also be important because early release of water may reduce the initial volume of cold water captured in a reservoir. An additional way storage can affect reservoir release temperature is by influencing how temperature control devices (TCDs) can be used; higher reservoir storage may allow more points of withdrawal that can allow release of warmer water when cold water is not needed and colder water when it is needed. Lower reservoir storage is typically associated with a smaller cold water pool, but during late fall and winter, low reservoir volume could result in faster meteorological cooling of the reservoir.

River flow controls the longitudinal rate at which water temperature approaches equilibrium values as water moves downstream. Cool reservoir release temperatures are maintained for greater distances at higher flows. Changes in carryover storage and flow are most likely to affect water temperature if storage and flow are already relatively low (e.g., within the lowest 25 percent of values).

Reservoir release temperatures represent the effect of reservoir storage on temperature. As water moves downstream, river flow begins to have a greater effect on temperature, although eventually differences in temperature between the scenarios are muted as temperatures for all scenarios approach the same equilibrium values.

Table G3e-1. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River below Shasta Dam.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	48.1	49.7	52.1	47.7	45.5	46.6	49.7	49.3	48.3	48.3	48.2	47.6
50	51.0	52.8	53.7	50.0	48.1	48.4	51.1	49.8	48.3	48.3	48.6	49.5
90	56.2	56.0	55.2	51.7	49.7	50.1	53.0	53.4	51.5	51.1	50.4	52.1
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.3	-0.3	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.1
50	-0.1	-0.3	0.0	0.0	-0.1	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.2
90	-0.2	0.4	-0.1	-0.1	0.0	0.0	-0.1	0.1	0.3	-0.5	-0.1	0.4

Table G3e-2. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River below Keswick.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	49.8	49.8	51.3	47.6	45.7	47.2	50.2	50.8	50.1	50.2	50.6	50.1
50	52.4	52.9	52.9	49.6	48.2	49.1	52.4	52.0	50.6	50.9	51.8	52.6
90	56.5	56.5	54.4	51.6	49.7	50.7	54.4	54.8	53.1	54.0	53.6	55.5
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.2	0.0	-0.2	-0.2	-0.1	-0.1	0.0	0.0	0.1	0.1	0.0	0.1
50	-0.2	-0.2	-0.1	0.0	-0.1	0.0	-0.2	0.0	0.1	0.1	0.0	-0.2
90	-0.2	0.3	0.0	-0.1	0.0	0.1	-0.4	0.0	0.1	0.0	-0.2	0.1

Table G3e-3. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River above Clear Creek.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	50.3	49.9	51.1	47.7	45.9	47.5	50.6	51.5	51.1	51.2	51.5	50.9
50	52.8	52.9	52.6	49.5	48.5	49.7	53.3	53.0	51.9	51.9	52.9	53.6
90	56.7	56.4	54.2	51.5	50.0	51.4	55.4	55.6	54.0	55.2	54.6	56.5
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.2	0.1	-0.2	-0.2	-0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.1
50	-0.1	-0.3	-0.1	0.0	0.0	0.0	-0.3	-0.1	0.1	0.1	0.1	-0.3
90	-0.1	0.1	0.0	-0.1	0.0	0.1	-0.8	-0.1	0.2	-0.1	-0.3	0.1

Table G3e-4. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River at Balls Ferry.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	51.4	49.9	48.7	46.2	46.0	47.9	51.6	53.2	52.7	52.4	53.1	52.5
50	53.5	51.9	50.5	47.6	47.6	49.7	54.2	54.9	54.3	53.7	54.2	54.8
90	56.7	55.5	52.3	49.4	49.1	51.6	56.0	56.7	55.8	56.4	56.1	58.2
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.1	-0.1	-0.2	0.0	0.0	-0.1	0.0	-0.1	0.2	0.3	0.0	0.1
50	-0.2	0.1	-0.2	0.1	0.0	0.0	-0.3	-0.2	0.3	0.0	0.0	-0.4
90	-0.1	-0.3	-0.1	-0.1	0.0	0.0	-0.5	-0.1	0.8	0.0	-0.2	0.0

Table G3e-5. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River near Bend Bridge.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	52.2	49.9	48.1	46.1	46.3	48.6	52.8	54.6	54.4	54.1	54.8	53.8
50	54.0	51.9	49.7	47.2	47.6	50.4	55.2	56.4	56.3	55.5	55.9	56.2
90	56.9	54.8	51.5	48.8	49.1	52.2	56.8	58.1	58.0	58.1	57.8	59.4
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.2	-0.2	-0.1	0.0	-0.1	0.0	-0.2	-0.3	0.2	0.2	-0.1	0.0
50	-0.1	-0.1	-0.1	0.1	-0.1	-0.1	-0.5	-0.3	0.1	0.1	0.0	-0.2
90	-0.1	-0.1	-0.1	0.0	0.0	0.2	-0.5	0.0	0.0	-0.1	0.1	0.0

Table G3e-6. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River near Red Bluff.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	52.8	49.9	48.0	46.1	46.4	48.9	53.1	55.3	55.5	55.2	56.0	54.6
50	54.4	51.8	49.5	47.2	47.7	50.7	55.6	57.3	57.3	56.8	57.1	57.0
90	57.0	54.4	51.1	48.8	49.2	52.7	57.4	59.0	59.1	59.4	58.9	60.2
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.2	-0.1	-0.2	-0.1	-0.1	0.0	-0.3	-0.3	0.2	0.1	-0.1	0.1
50	-0.1	-0.1	-0.2	0.0	0.0	0.0	-0.4	-0.3	0.1	0.0	0.0	-0.1
90	0.0	0.1	-0.1	-0.1	0.0	0.1	-0.5	0.1	-0.1	-0.1	0.2	0.1

Table G3e-7. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River at Hamilton City.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	54.6	50.4	47.7	46.2	46.9	49.7	54.3	57.8	60.3	60.4	60.4	58.0
50	56.5	52.1	49.2	47.3	48.4	52.3	58.1	61.2	62.0	62.4	62.4	61.2
90	59.0	54.9	50.7	48.9	50.3	54.7	60.9	63.1	64.4	65.2	64.3	64.5
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.1	-0.2	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.1	-0.1	0.2
50	-0.1	-0.1	-0.2	0.0	0.1	0.2	-0.3	-0.6	0.1	-0.1	-0.1	-0.2
90	0.0	0.0	0.0	-0.1	0.1	0.5	-0.6	0.3	-0.2	-0.4	0.2	-0.1

Table G3e-8. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River at Butte City.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	55.6	50.5	47.4	45.8	46.9	49.7	54.6	59.2	62.8	63.3	62.9	60.0
50	57.6	52.1	48.7	47.0	48.5	52.8	59.1	63.1	64.7	65.7	65.5	63.4
90	59.9	55.1	50.3	48.6	50.6	55.5	62.4	65.4	67.2	68.6	67.5	66.6
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	-0.1	-0.2	-0.1	0.0	0.0	0.0	0.1	0.0	0.2	-0.1	0.1
50	-0.1	0.0	-0.3	-0.1	0.0	0.3	-0.2	-0.7	0.2	-0.2	-0.1	-0.3
90	0.2	-0.1	0.2	0.0	0.1	0.4	-0.6	0.1	-0.1	-0.3	0.0	-0.1

Table G3e-9. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River at Wilkins Slough.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	56.6	50.9	47.1	45.8	47.2	50.2	55.2	60.6	65.1	66.7	65.7	62.1
50	58.9	52.3	48.6	47.0	48.8	53.5	60.2	65.3	67.7	69.5	69.0	65.9
90	61.3	55.5	50.3	48.7	51.1	56.4	63.7	67.9	70.2	72.1	71.1	68.8
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.1	0.0	-0.3	-0.2	-0.1	0.0	0.1	0.1	0.5	0.0	-0.2	-0.1
50	-0.2	-0.1	-0.2	0.0	0.2	0.3	0.0	-0.9	0.1	-0.2	-0.2	-0.4
90	0.4	0.1	-0.1	0.1	0.3	0.6	-0.5	0.1	-0.1	-0.2	0.0	0.0

Note: shading provided only to attract attention to the larger deviations from baseline. Shading does not indicate any impact conclusions.

Table G3e-10. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Sacramento River at Knights Landing.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	57.4	51.0	46.9	45.9	47.4	50.6	55.8	61.5	66.9	68.8	67.5	63.3
50	59.8	52.5	48.5	47.0	49.0	53.9	60.8	66.7	69.6	71.8	71.2	67.5
90	62.1	55.6	50.2	48.7	51.4	57.0	64.5	69.2	72.2	74.7	73.4	70.3
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	-0.2	-0.2	0.0	0.1	0.2	0.1	0.2	0.1	-0.1	-0.1
50	-0.1	0.1	-0.2	0.0	0.2	0.3	0.1	-1.0	0.0	-0.2	-0.3	-0.5
90	0.2	0.1	0.0	0.1	0.3	0.6	-0.4	0.2	-0.2	-0.2	-0.3	0.0

Table G3e-11. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Feather River below Oroville Dam.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	50.6	51.7	50.8	46.2	45.1	47.4	50.0	51.2	55.3	57.0	56.2	50.4
50	51.0	52.1	54.2	48.5	47.9	50.4	50.2	51.5	55.7	57.8	56.9	50.8
90	55.2	55.0	56.4	53.4	50.5	53.1	50.6	52.0	56.2	58.5	57.9	51.7
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
50	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	0.0
90	-1.5	-0.7	0.0	0.0	0.4	0.0	0.1	0.1	-0.1	-0.1	0.3	1.5

Table G3e-12. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Feather River Low Flow Channel below the Fish Barrier Dam

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	51.4	51.9	50.5	46.4	45.3	47.7	50.7	52.5	56.8	58.4	58.0	51.9
50	51.7	52.1	53.6	48.6	49.0	51.5	53.0	53.1	57.2	59.1	59.0	52.4
90	55.9	54.9	55.6	52.8	50.8	53.7	53.9	53.6	57.7	59.6	59.9	55.0
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
50	0.0	0.0	0.0	0.1	0.1	0.0	-0.5	-0.1	0.0	0.1	0.1	0.1
90	-1.3	-0.4	0.0	0.1	0.4	0.0	-0.8	-0.1	0.1	-0.1	0.0	0.5

Table G3e-13. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the Feather River Low Flow Channel at Robinson Riffle.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	52.1	50.7	48.5	44.8	45.3	48.4	52.1	55.2	59.4	61.6	60.8	54.9
50	52.6	51.2	50.8	47.3	47.9	51.2	54.3	55.9	60.0	62.1	61.5	55.4
90	56.0	53.3	52.8	50.6	50.0	53.8	55.2	56.5	60.6	62.7	62.2	57.2
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.0
50	0.0	0.0	0.1	0.0	0.1	0.0	-0.3	-0.1	0.0	0.0	0.0	0.1
90	-1.1	-0.1	0.2	0.0	0.1	-0.1	-0.5	-0.1	0.0	-0.1	0.0	0.5

Table G3e-14. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions for Feather River Discharges from the Thermalito Afterbay

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	55.8	53.6	49.8	46.4	46.7	49.5	53.6	56.2	61.4	63.0	62.9	56.9
50	57.1	54.7	51.7	49.3	52.4	59.0	66.1	62.7	65.2	63.9	66.8	60.1
90	63.5	57.4	54.4	52.0	55.7	64.2	70.6	66.4	68.6	68.6	74.9	71.5
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
50	0.0	0.1	0.1	0.2	0.0	-0.5	-1.0	-1.9	0.1	0.1	-0.9	0.6
90	0.3	0.4	0.0	-0.1	0.1	-0.2	-1.9	-1.4	0.2	0.2	0.0	0.2

Table G3e-15. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions for the Feather River below the Discharge from the Thermalito Afterbay

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	55.0	51.7	48.7	45.1	46.7	49.5	53.6	56.0	61.5	63.1	62.9	56.9
50	55.9	52.8	50.9	47.7	49.2	53.0	58.2	60.3	64.3	64.0	63.9	59.5
90	59.0	54.1	53.9	51.3	51.8	57.3	61.6	61.6	65.4	66.9	67.6	63.1
Proposed Voluntary Agreements Minus Baseline (°F)												
10	-0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1
50	0.0	0.0	0.1	0.0	0.0	0.0	1.8	-0.3	-0.1	0.0	0.3	0.3
90	0.2	0.1	0.0	-0.1	-0.1	0.0	1.1	0.1	0.0	0.2	-0.3	0.3

Table G3e-16. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions for the Feather River at Gridley.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	55.5	52.2	48.9	45.3	46.9	49.8	54.1	56.7	62.3	64.0	63.8	57.6
50	56.5	53.1	50.9	47.9	49.7	53.8	59.4	61.6	65.6	64.9	65.7	60.4
90	59.8	54.4	53.8	51.3	52.3	57.7	62.3	62.9	66.7	68.2	69.0	64.0
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
50	0.0	0.1	0.0	-0.1	0.3	0.0	1.3	-0.4	0.0	0.1	-0.2	0.5
90	0.1	0.1	-0.1	-0.1	-0.2	0.3	1.2	0.0	0.2	0.1	-0.4	0.8

Table G3e-17. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions for the American River below Folsom Dam.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	58.7	56.9	50.8	45.9	45.9	47.8	49.1	50.6	52.6	53.4	57.8	60.7
50	63.2	58.1	55.2	49.4	48.1	49.2	50.2	51.6	54.2	56.5	60.0	63.2
90	66.9	59.2	59.2	52.1	49.7	50.3	52.8	54.9	57.4	61.3	63.6	67.0
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	-0.4	0.5	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
50	0.0	0.0	0.0	0.3	0.1	0.0	0.1	0.2	0.4	0.1	0.1	0.0
90	-0.3	0.1	0.0	0.0	0.1	0.1	0.3	0.0	0.7	0.4	-0.3	-0.2

Table G3e-18. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions for the American River at Hazel Avenue.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	59.1	56.7	50.6	45.9	46.0	48.4	50.0	52.0	53.9	55.6	58.9	62.1
50	63.0	57.9	54.4	49.0	48.3	49.9	51.7	53.6	55.7	58.3	62.1	64.0
90	66.5	59.1	58.0	51.8	50.3	52.0	55.0	58.8	60.8	64.3	65.6	67.8
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
50	0.0	0.0	0.2	0.4	0.1	0.0	0.0	-0.1	0.2	0.1	0.1	0.1
90	-0.3	0.2	0.0	0.0	0.1	0.0	-0.2	-0.2	0.3	0.7	-0.1	-0.4

Table G3e-19. Comparison of Modeled Baseline and Proposed Voluntary Agreements Monthly Temperature Distributions in the American River at Watt Avenue.

Percentile	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Baseline (°F)												
10	60.6	56.8	50.6	46.2	46.7	49.7	52.0	54.9	57.2	60.4	62.0	65.3
50	64.2	58.1	53.8	49.3	49.5	51.9	55.0	57.4	59.3	63.2	66.5	66.8
90	67.4	59.3	56.8	51.7	51.9	56.0	60.2	65.7	68.4	70.0	71.3	70.9
Proposed Voluntary Agreements Minus Baseline (°F)												
10	0.0	0.1	0.1	0.0	0.0	0.0	0.0	-0.1	0.0	0.1	0.0	0.0
50	0.0	-0.1	0.0	0.2	0.1	-0.1	0.0	0.0	0.3	0.5	0.6	0.1
90	-0.1	0.0	0.0	0.1	0.1	0.0	-0.1	-0.3	-1.7	1.4	-0.1	-0.4

G3e.3 Fish Assessment

G3e.3.1 Methods

The methods used in this analysis are identical to those presented in Appendix A6, Section A6.3, *Fish Assessment*.

G3e.3.2 Results

The results of the water temperature index value analysis are presented in this section. Results are organized by river and then by fish species/race. Results of the analysis are presented in tables showing, by month and water year type: (1) the difference in percent of days above the index value between the proposed VAs and the baseline; and (2) the difference in mean degrees per day above the index value between the proposed VAs and the baseline. Only tables that include favorable and unfavorable results, as defined in Appendix A6, Section A6.3.1, *Methods*, are included in this appendix.

The interpretation and discussion of these results can be found in Section 9.7.7, *Aquatic Biological Resources*. The tables in this section utilize the following abbreviations:

Water Year Type:

- W: Wet
- AN: Above Normal
- BN: Below Normal
- D: Dry
- C: Critical
- All: All water year types combined

Months are indicated by a numeric value, 1–12. For example, January is 1, and December is 12.

G3e.3.2.1 Sacramento River**Winter-Run Chinook Salmon**

Model results indicate that water temperatures under the baseline scenario are generally lower than the winter-run criteria for all life stages, except during the spawning, embryo, and alevin incubation period, in which baseline conditions are inhospitable in all but the most upstream locations, which generally reflects observed spawning location data (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-12).

A summary of potential temperature-related effects of the VA scenario on winter-run Chinook salmon is provided in Table G3e-20. The frequency of unfavorable changes would be low or zero for all life stages. There would be two total occurrences of an unfavorable change for winter-run Chinook salmon across all life stages, locations, months, and water year types– one for adult holding and one for the spawning, egg incubation, and alevin life stage. Detailed results for each unfavorable change are reported in Table G3e-21 and Table G3e-22. There were no favorable changes for any life stage.

Table G3e-20. Summary of Potential Effects of the VA Scenario on Winter-Run Chinook Salmon, Sacramento River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0.8%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0.3%
Fry and Juvenile Rearing and Emigration	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-21. Water Temperature Index Value Analysis Results, Winter-Run Chinook Salmon, Spawning, Egg Incubation, and Alevins, Sacramento River at Clear Creek, 55.4°F 7DADM¹.

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
4	W	-1.0	0.1
4	AN	-9.7	0.0
4	BN	-8.2	-0.4
4	D	-12.7	-0.1
4	C	-6.2	-0.2
4	All	-6.9	-0.2
5	W	-0.3	-0.1
5	AN	-1.1	-0.2
5	BN	8.0	-0.2
5	D	5.2	-0.2
5	C	-10.8	0.0
5	All	0.7	-0.1
6	W	0.0	0.0
6	AN	10.0	0.6
6	BN	7.6	-0.2
6	D	5.7	-0.3
6	C	8.7	-0.1
6	All	5.4	-0.3
7	W	0.0	0.0
7	AN	-0.5	-0.2
7	BN	0.0	-0.1
7	D	1.4	-0.3
7	C	4.7	-0.1
7	All	1.0	-0.1
8	W	0.0	-0.1
8	AN	5.9	-0.1
8	BN	-6.3	-0.3
8	D	9.7	-0.4
8	C	-14.0	0.4
8	All	-0.5	-0.1
9	W	-1.8	0.0
9	AN	-1.4	0.3
9	BN	-1.8	-0.1
9	D	-8.4	0.1
9	C	-2.7	0.2
9	All	-3.4	0.1
10	W	-0.5	-0.1
10	AN	-1.9	0.4
10	BN	-5.7	0.8

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
10	D	-3.5	0.1
10	C	-2.2	0.6
10	All	-2.6	0.3

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the VA scenario relative to Baseline; red cells indicate >5% higher values under the VA scenario relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the VA scenario relative to Baseline; red cells indicate >0.5°F higher values under the VA scenario relative to Baseline.

Table G3e-22. Water Temperature Index Value Analysis Results, Winter-Run Chinook Salmon, Adult Holding, Sacramento River at Red Bluff Diversion Dam, 61°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.0
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	-2.2	-0.3
4	BN	-5.3	-0.3
4	D	-6.8	-0.3
4	C	0.2	-0.1
4	All	-2.8	-0.2
5	W	-0.7	0.0
5	AN	-2.4	-0.1
5	BN	-0.6	0.0
5	D	-4.9	0.1
5	C	-2.4	0.1

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
5	All	-2.1	0.1
6	W	-0.6	0.0
6	AN	8.6	0.5
6	BN	0.2	0.4
6	D	-0.8	-0.1
6	C	-0.4	0.0
6	All	0.7	0.1
7	W	-0.1	0.0
7	AN	-0.5	-0.1
7	BN	0.0	0.0
7	D	0.6	-0.5
7	C	-4.3	0.0
7	All	-0.7	-0.1
8		-0.5	-0.1
8	AN	2.2	0.1
8	BN	-0.2	0.0
8	D	-0.2	0.0
8	C	-1.3	0.4
8	All	-0.1	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Spring-Run Chinook Salmon

Model results indicate that water temperatures under the baseline scenario are generally be lower than the spring-run criteria for all life stages, except during the spawning, embryo, and alevin incubation period, in which baseline conditions are inhospitable in all but the most upstream locations, which generally reflects observed spawning location data (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-14).

A summary of potential temperature-related effects of the VA scenario on spring-run Chinook salmon is provided in Table G3e-23. The frequency of favorable unfavorable changes would be low or zero for all life stages. There would be one total occurrence of a favorable change for spring-run Chinook salmon across all life stages, locations, months, and water year types in the fry and juvenile rearing and emigration life stage. There would be two total occurrences of an unfavorable change for spring-run Chinook salmon across all life stages, locations, months, and water year types – one during the adult holding period and one during the fry and juvenile rearing and emigration period. Detailed results for each favorable and unfavorable change are Table G3e-24, Table G3e-25, and Table G3e-26.

Table G3e-23. Summary of Potential Effects of the VA Scenario on Spring-Run Chinook Salmon, Sacramento River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	1.1%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%
Fry and Juvenile Rearing and Emigration	
Favorable	0.3%
Unfavorable	0.3%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-24. Water Temperature Index Value Analysis Results, Spring-Run Chinook Salmon, Fry and Juvenile Rearing and Emigration, Sacramento River at Red Bluff Diversion Dam, 61°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	-2.2	-0.3
4	BN	-5.3	-0.3
4	D	-6.8	-0.3
4	C	0.2	-0.1
4	All	-2.8	-0.2
5	W	-0.7	0.0
5	AN	-2.4	-0.1
5	BN	-0.6	0.0
5	D	-4.9	0.1
5	C	-2.4	0.1
5	All	-2.1	0.1
6	W	-0.6	0.0
6	AN	8.6	0.5
6	BN	0.2	0.4
6	D	-0.8	-0.1
6	C	-0.4	0.0
6	All	0.7	0.1
7	W	-0.1	0.0
7	AN	-0.5	-0.1
7	BN	0.0	0.0
7	D	0.6	-0.5
7	C	-4.3	0.0
7	All	-0.7	-0.1
8	W	-0.5	-0.1
8	AN	2.2	0.1
8	BN	-0.2	0.0
8	D	-0.2	0.0
8	C	-1.3	0.4
8	All	-0.1	0.0
9	W	-0.1	-0.1
9	AN	4.7	0.6
9	BN	1.4	0.1
9	D	-1.3	0.2
9	C	-0.2	0.1
9	All	0.5	0.0
10	W	0.0	0.0
10	AN	0.0	0.0
10	BN	0.0	0.0
10	D	-0.2	-0.2
10	C	0.4	0.6

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
10	All	0.0	0.2
11	W	0.0	0.0
11	AN	0.0	0.0
11	BN	0.0	0.0
11	D	0.0	0.0
11	C	0.7	0.2
11	All	0.1	0.2
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-25. Water Temperature Index Value Analysis Results, Spring-Run Chinook Salmon, Fry and Juvenile Rearing and Emigration, Sacramento River at Wilkins Slough, 64°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.4
3	All	0.0	0.4
4	W	1.4	0.2

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
4	AN	-1.1	0.0
4	BN	-8.8	-0.1
4	D	-6.8	-0.3
4	C	3.6	0.1
4	All	-2.3	0.0
5	W	3.9	0.1
5	AN	-4.8	-0.6
5	BN	-7.6	-0.5
5	D	-5.7	-0.6
5	C	-1.7	-0.3
5	All	-2.4	-0.3
6	W	0.5	0.0
6	AN	1.7	0.2
6	BN	2.5	0.1
6	D	-0.3	-0.3
6	C	0.2	0.1
6	All	0.8	0.0
7	W	0.0	-0.2
7	AN	1.6	0.5
7	BN	0.4	0.4
7	D	0.0	-0.5
7	C	0.0	-0.2
7	All	0.3	0.0
8	W	-0.2	-0.2
8	AN	0.3	0.2
8	BN	0.2	-0.1
8	D	0.0	-0.5
8	C	0.0	-0.2
8	All	0.0	-0.2
9	W	-1.4	-0.1
9	AN	1.7	0.2
9	BN	1.0	0.1
9	D	-1.0	-0.3
9	C	0.0	-0.1
9	All	-0.3	-0.1
10	W	0.8	-0.1
10	AN	-0.8	0.1
10	BN	-0.8	0.2
10	D	-1.2	0.0
10	C	0.6	0.1
10	All	-0.2	0.1
11	W	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
11	AN	0.0	0.0
11	BN	0.0	0.0
11	D	0.0	0.0
11	C	0.2	0.0
11	All	0.0	0.0
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-26. Water Temperature Index Value Analysis Results, Spring-Run Chinook Salmon, Adult Holding, Sacramento River at Red Bluff Diversion Dam, 61°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
4	W	0.0	0.0
4	AN	-2.2	-0.3
4	BN	-5.3	-0.3
4	D	-6.8	-0.3
4	C	0.2	-0.1
4	All	-2.8	-0.2
5	W	-0.7	0.0
5	AN	-2.4	-0.1
5	BN	-0.6	0.0
5	D	-4.9	0.1
5	C	-2.4	0.1
5	All	-2.1	0.1
6	W	-0.6	0.0
6	AN	8.6	0.5
6	BN	0.2	0.4
6	D	-0.8	-0.1
6	C	-0.4	0.0
6	All	0.7	0.1
7	W	-0.1	0.0
7	AN	-0.5	-0.1
7	BN	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
7	D	0.6	-0.5
7	C	-4.3	0.0
7	All	-0.7	-0.1
8	W	-0.5	-0.1
8	AN	2.2	0.1
8	BN	-0.2	0.0
8	D	-0.2	0.0
8	C	-1.3	0.4
8	All	-0.1	0.0
9	W	-0.1	-0.1
9	AN	4.7	0.6
9	BN	1.4	0.1
9	D	-1.3	0.2
9	C	-0.2	0.1
9	All	0.5	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Fall-Run Chinook Salmon

Modeled water temperatures under the baseline scenario would generally be lower than the fall-run Chinook salmon water temperature criteria used for this analysis for adult migration, adult holding, and fry and juvenile rearing and emigration life stages (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-16). Modeled water temperatures indicate that baseline conditions are inhospitable for a sizable portion of the spawning, egg incubation, and alevin period, and conditions worsen from upstream to downstream.

A summary of potential temperature-related effects of the VA scenario on fall-run Chinook salmon is provided in Table G3e-27. The frequency of favorable and unfavorable changes would be low or zero for all life stages. There would be one total favorable change and one unfavorable change across all life stages, locations, months, and water year types, both of which would occur in the fry and juvenile rearing and emigration life stage. Detailed results for these occurrences are reported in Table G3e-28 and Table G3e-29.

Table G3e-27. Summary of Potential Effects of the VA Scenario on Fall-Run Chinook Salmon, Sacramento River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%
Fry and Juvenile Rearing and Emigration	
Favorable	0.5%
Unfavorable	0.5%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-28. Water Temperature Index Value Analysis Results, Fall-Run Chinook Salmon, Fry and Juvenile Rearing and Emigration, Sacramento River at Red Bluff Diversion Dam, 61°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.0
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	-2.2	-0.3
4	BN	-5.3	-0.3
4	D	-6.8	-0.3
4	C	0.2	-0.1
4	All	-2.8	-0.2
5	W	-0.7	0.0
5	AN	-2.4	-0.1
5	BN	-0.6	0.0
5	D	-4.9	0.1
5	C	-2.4	0.1
5	All	-2.1	0.1
6	W	-0.6	0.0
6	AN	8.6	0.5
6	BN	0.2	0.4
6	D	-0.8	-0.1
6	C	-0.4	0.0
6	All	0.7	0.1

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-29. Water Temperature Index Value Analysis Results, Fall-Run Chinook Salmon, Fry and Juvenile Rearing and Emigration, Sacramento River at Wilkins Slough, 64°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0
1	W	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.4
2	All	0.0	0.4
3	W	0.0	0.2
3	AN	0.0	0.0
3	BN	0.0	-0.1
3	D	0.0	-0.3
3	C	0.0	0.1
3	All	0.0	0.0
4	W	1.4	0.1
4	AN	-1.1	-0.6
4	BN	-8.8	-0.5
4	D	-6.8	-0.6
4	C	3.6	-0.3
4	All	-2.3	-0.3
5	W	3.9	0.0
5	AN	-4.8	0.2
5	BN	-7.6	0.1
5	D	-5.7	-0.3
5	C	-1.7	0.1
5	All	-2.4	0.0
6	W	0.5	0.0
6	AN	1.7	0.0
6	BN	2.5	0.0
6	D	-0.3	0.0
6	C	0.2	0.0
6	All	0.8	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Late Fall-Run Chinook Salmon

Modeled water temperatures indicate that baseline conditions are inhospitable for a sizable portion of the late fall-run spawning period, and conditions worsen from upstream to downstream (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-18). Water temperatures under the baseline scenario during the fry and juvenile rearing and emigration and adult immigration periods are rarely above the temperatures criteria at all locations except at Wilkins Slough, where temperatures would be above the 64°F criterion in 44.8% of days.

A summary of potential temperature-related effects of VA scenario on late fall-run Chinook salmon is provided in Table G3e-30. The frequency of favorable and unfavorable changes would be low or zero for all life stages. There would be one favorable change and one unfavorable change across all life stages, locations, months, and water year types. The favorable change would occur during the fry and juvenile rearing and emigration period. The unfavorable change would occur during the spawning, egg incubation, and alevin period. Detailed results for both occurrences are reported Table G3e-31 and Table G3e-32.

Table G3e-30. Summary of Potential Effects of the VA Flow Scenario on Late Fall-Run Chinook Salmon, Sacramento River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0.6%
Fry and Juvenile Rearing and Emigration	
Favorable	0.3%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-31. Water Temperature Index Value Analysis Results, Late Fall-Run Chinook Salmon, Spawning, Egg Incubation, and Alevins, Sacramento River at Clear Creek, 55.4°F 7DADM¹²

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	W	1.8	0.1
12	AN	-0.3	0.0
12	BN	-1.9	0.0
12	D	-6.6	0.0
12	C	-4.7	0.2
12	All	-2.1	0.1

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	-0.3	0.0
1	BN	0.4	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.1
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	-0.2	-0.1
3	D	0.0	0.1
3	C	0.4	0.4
3	All	0.0	0.1
4	W	-1.0	0.1
4	AN	-9.7	0.0
4	BN	-8.2	-0.4
4	D	-12.7	-0.1
4	C	-6.2	-0.2
4	All	-6.9	-0.2
5	W	-0.3	-0.1
5	AN	-1.1	-0.2
5	BN	8.0	-0.2
5	D	5.2	-0.2
5	C	-10.8	0.0
5	All	0.7	-0.1
6	W	0.0	0.0
6	AN	10.0	0.6
6	BN	7.6	-0.2
6	D	5.7	-0.3
6	C	8.7	-0.1
6	All	5.4	-0.3

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-32. Water Temperature Index Value Analysis Results, Late Fall-Run Chinook Salmon, Fry and Juvenile Rearing and Emigration, Sacramento River at Wilkins Slough, 64°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.4
3	All	0.0	0.4
4	W	1.4	0.2
4	AN	-1.1	0.0
4	BN	-8.8	-0.1
4	D	-6.8	-0.3
4	C	3.6	0.1
4	All	-2.3	0.0
5	W	3.9	0.1
5	AN	-4.8	-0.6
5	BN	-7.6	-0.5
5	D	-5.7	-0.6
5	C	-1.7	-0.3
5	All	-2.4	-0.3
6	W	0.5	0.0
6	AN	1.7	0.2
6	BN	2.5	0.1
6	D	-0.3	-0.3
6	C	0.2	0.1
6	All	0.8	0.0
7	W	0.0	-0.2
7	AN	1.6	0.5
7	BN	0.4	0.4
7	D	0.0	-0.5
7	C	0.0	-0.2
7	All	0.3	0.0
8	W	-0.2	-0.2
8	AN	0.3	0.2
8	BN	0.2	-0.1
8	D	0.0	-0.5
8	C	0.0	-0.2
8	All	0.0	-0.2
9	W	-1.4	-0.1
9	AN	1.7	0.2
9	BN	1.0	0.1

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
9	D	-1.0	-0.3
9	C	0.0	-0.1
9	All	-0.3	-0.1
10	W	0.8	-0.1
10	AN	-0.8	0.1
10	BN	-0.8	0.2
10	D	-1.2	0.0
10	C	0.6	0.1
10	All	-0.2	0.1
11	W	0.0	0.0
11	AN	0.0	0.0
11	BN	0.0	0.0
11	D	0.0	0.0
11	C	0.2	0.0
11	All	0.0	0.0
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Central Valley Steelhead

Modeled water temperatures under the baseline scenario indicate that baseline conditions may be inhospitable for a sizable portion of the steelhead spawners, eggs, and alevins (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-20). Water temperatures under the baseline scenario during other life stages are rarely above temperatures criteria at all locations.

A summary of potential temperature-related effects of the VA scenario on steelhead is provided in Table G3e-33. The frequency of favorable changes would be zero for all life stages. There would be one unfavorable change across all life stages, locations, months, and water year types, which would occur during the smolt emigration period. Detailed results for this occurrence are reported in Table G3e-34.

Table G3e-33. Summary of Potential Effects of the VA Scenario on Central Valley Steelhead, Sacramento River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%
Kelt Emigration	
Favorable	0%
Unfavorable	0%
Juvenile Rearing	
Favorable	0%
Unfavorable	0%
Smoltification	
Favorable ^b	0%
Unfavorable ^c	0%
Smolt Emigration (excluding migrant parr)	
Favorable	0%
Unfavorable	0.3%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-34. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Smolt Emigration, Sacramento River near Bend Bridge, 61°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
11	W	0.0	0.0
11	AN	0.0	0.0
11	BN	0.0	0.0
11	D	0.0	0.0
11	C	0.7	0.2
11	All	0.1	0.2
12	W	0.0	0.0
12	AN	0.0	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.0
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	-2.2	-0.3
4	BN	-5.3	-0.3
4	D	-6.8	-0.3
4	C	0.2	-0.1
4	All	-2.8	-0.2
5	W	-0.7	0.0
5	AN	-2.4	-0.1
5	BN	-0.6	0.0
5	D	-4.9	0.1
5	C	-2.4	0.1
5	All	-2.1	0.1
6	W	-0.6	0.0
6	AN	8.6	0.5
6	BN	0.2	0.4
6	D	-0.8	-0.1
6	C	-0.4	0.0
6	All	0.7	0.1

¹ 7DADM = 7-day average daily maximum² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Green Sturgeon

Modeled water temperatures under the baseline scenario are generally lower than the green sturgeon water temperature criteria used for this analysis for all life stages, with some exceptions at Hamilton City and Knights Landing (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-22). This indicates that baseline conditions are generally acceptable for green sturgeon except at downstream locations.

A summary of potential temperature-related effects of the VA scenario on green sturgeon is provided in Table G3e-35. There would be no occurrence of a favorable or unfavorable change in any life stage, location, month, or water year type.

Table G3e-35. Summary of Potential Effects of the VA Scenario on Green Sturgeon, Sacramento River ^a

Life Stage	Percent
Spawning and Embryo Incubation	
Favorable ^b	0%
Unfavorable ^c	0%
Non-Spawning Adult Presence	
Favorable	0%
Unfavorable	0%
Larval and Juvenile Rearing and Emigration	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

G3e.3.2.2 American River

Winter-Run Chinook Salmon

Model results indicate that baseline conditions are inhospitable for winter-run Chinook salmon rearing during a substantial portion of time Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-24.

A summary of potential temperature-related effects of the VA scenario on green sturgeon is provided in Table G3e-36. There would be no occurrence of a favorable or unfavorable change in any month, or water year type.

Table G3e-36. Summary of Potential Effects of the VA Scenario on Winter-Run Chinook Salmon, American River ^a

Life Stage	Percent
Non-Natal Rearing	
Favorable ^b	0%
Unfavorable ^c	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Fall-Run Chinook Salmon

Water temperature modeling reveals that baseline conditions in the American River are inhospitable during much of fall-run Chinook salmon freshwater presence (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-26). Baseline conditions are somewhat better upstream at Hazel Avenue compared to Watt Avenue.

A summary of potential temperature-related effects of the VA scenario on fall-run Chinook salmon is provided in Table G3e-37. The frequency of favorable and unfavorable changes would be low or zero for all life stages. There would be one total favorable change and one unfavorable change across all life stages, locations, months, and water year types. The favorable change would occur during the fry and juvenile rearing and emigration period. The unfavorable change would occur during the adult immigration period. Detailed results for both occurrences are reported in Table G3e-38 and Table G3e-39.

Table G3e-37. Summary of Potential Effects of the VA Scenario on Fall-Run Chinook Salmon, American River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	1.7%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%
Fry and Juvenile Rearing and Emigration	
Favorable	2.0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-38. Water Temperature Index Value Analysis Results, Fall-run Chinook Salmon, Fry and Juvenile Rearing and Emigration, American River at Watt Avenue, 64°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	-0.4	0.0
3	All	-0.1	0.0
4	W	0.0	0.0
4	AN	0.0	0.0
4	BN	-1.0	-0.1
4	D	-4.6	-0.2
4	C	-2.0	-0.2
4	All	-1.5	-0.2
5	W	-0.1	-0.1
5	AN	-2.2	0.1
5	BN	-0.2	0.0
5	D	-22.3	-0.6
5	C	-1.5	0.1
5	All	-5.6	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-39. Water Temperature Index Value Analysis Results, Fall-run Chinook Salmon, Adult Immigration, American River at Watt Avenue, 68°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
7	W	0.8	0.1
7	AN	2.4	0.1
7	BN	6.1	0.3
7	D	16.1	1.0
7	C	0.2	-0.1
7	All	5.3	0.0
8	W	-0.5	0.2
8	AN	6.2	0.0
8	BN	-4.7	0.7
8	D	0.5	0.2
8	C	0.6	0.1
8	All	0.0	0.3
9	W	0.8	0.1
9	AN	5.8	0.1
9	BN	1.6	0.1
9	D	1.4	0.1
9	C	0.0	-0.2
9	All	1.6	0.0
10	W	1.4	0.0
10	AN	1.6	0.1
10	BN	0.2	-0.3
10	D	-1.1	-0.1
10	C	6.9	-0.5
10	All	1.5	-0.2
11	W	0.0	0.0
11	AN	-0.3	0.3
11	BN	0.0	0.0
11	D	-0.2	0.0
11	C	1.1	-0.6
11	All	0.1	-0.1
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Central Valley Steelhead

Modeled water temperatures indicate that baseline conditions may be inhospitable for a sizable portion of all steelhead life stages other than kelt emigration and adult immigration (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-28).

A summary of potential temperature-related effects of the VA scenario on Central Valley steelhead is provided in Table G3e-40. The frequency of favorable and unfavorable changes would be low or zero for all life stages. There would be four total favorable changes and four unfavorable changes across all life stages, locations, months, and water year types. All unfavorable changes would occur at Watt Avenue using different temperature criteria during the juvenile rearing period. Three of the favorable changes would occur during the fry and juvenile rearing and emigration period; the fourth change would be during the smolt emigration period. The unfavorable change would occur during the adult immigration period. Detailed results for all favorable and unfavorable results are reported in Table G3e-41 through Table G3e-45.

Table G3e-40. Summary of Potential Effects of the VA Scenario on Central Valley Steelhead, American River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%
Kelt Emigration	
Favorable	0%
Unfavorable	0%
Juvenile Rearing	
Favorable	1.0%
Unfavorable	1.3%
Smoltification	
Favorable ^b	0%
Unfavorable ^c	0%
Smolt Emigration (excluding migrant parr)	
Favorable	1.4%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-41. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Juvenile Rearing, American River at Watt Avenue, 63°F

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	-0.2	0.0
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	0.0	0.0
4	BN	-1.2	-0.1
4	D	-2.9	-0.2
4	C	-2.7	-0.1
4	All	-1.3	-0.1
5	W	-0.5	0.0
5	AN	-0.3	0.1
5	BN	0.4	0.0
5	D	-25.0	-0.2
5	C	-1.7	0.2
5	All	-6.0	0.1
6	W	-0.1	0.0
6	AN	0.0	0.0
6	BN	-1.0	-1.7
6	D	3.7	-0.9
6	C	0.9	-0.4
6	All	0.8	-0.8
7	W	1.7	0.1
7	AN	16.1	0.1
7	BN	7.2	0.3

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
7	D	6.3	1.2
7	C	0.0	-0.1
7	All	5.3	0.2
8	W	0.2	0.0
8	AN	-1.1	0.2
8	BN	2.7	0.2
8	D	3.1	0.1
8	C	0.0	0.1
8	All	1.1	0.1
9	W	0.0	0.1
9	AN	0.0	0.2
9	BN	0.0	0.1
9	D	0.0	0.1
9	C	0.0	-0.2
9	All	0.0	0.1
10	W	0.3	0.1
10	AN	2.4	0.1
10	BN	2.3	-0.2
10	D	-0.3	-0.1
10	C	-1.3	0.1
10	All	0.6	0.0
11	W	0.1	-0.2
11	AN	0.6	-0.1
11	BN	-0.6	0.2
11	D	-0.6	0.0
11	C	0.9	0.2
11	All	0.0	0.0
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0

¹ Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

² Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-42. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Juvenile Rearing, American River at Watt Avenue, 69°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	0.0	0.0
3	All	0.0	0.0
4	W	0.0	0.0
4	AN	0.0	0.0
4	BN	0.0	0.0
4	D	0.0	0.0
4	C	0.0	0.0
4	All	0.0	0.0
5	W	0.0	0.0
5	AN	0.0	0.0
5	BN	0.0	0.0
5	D	-5.8	-0.3
5	C	0.4	0.1
5	All	-1.2	0.2
6	W	0.0	0.0
6	AN	0.0	0.0
6	BN	-7.3	-1.2
6	D	-6.5	1.2
6	C	0.7	-0.8
6	All	-2.7	0.3
7	W	0.3	0.0
7	AN	1.3	0.2
7	BN	5.7	0.4

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
7	D	17.1	1.1
7	C	-0.2	-0.1
7	All	5.1	-0.1
8	W	-0.5	0.3
8	AN	5.9	0.0
8	BN	-1.5	0.8
8	D	2.3	0.2
8	C	1.9	0.0
8	All	1.2	0.2
9	W	4.4	0.0
9	AN	11.4	0.0
9	BN	1.2	0.1
9	D	1.9	0.1
9	C	0.0	-0.2
9	All	3.4	-0.1
10	W	0.6	0.0
10	AN	-0.8	0.4
10	BN	-1.3	-0.2
10	D	-1.7	-0.1
10	C	1.7	-0.4
10	All	-0.3	-0.1
11	W	0.0	0.0
11	AN	0.0	0.0
11	BN	0.0	0.0
11	D	0.0	0.0
11	C	0.0	0.0
11	All	0.0	0.0
12	W	0.0	0.0
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.0	0.0
12	C	0.0	0.0
12	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-43. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Juvenile Rearing, American River at Watt Avenue, 65°F¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
5	W	-0.2	-0.5
5	AN	0.0	0.0
5	BN	0.0	0.0
5	D	-13.2	-0.2
5	C	0.4	0.1
5	All	-3.0	0.1
6	W	0.0	0.0
6	AN	0.0	0.0
6	BN	-7.3	-1.2
6	D	-3.3	0.0
6	C	4.7	-1.1
6	All	-1.3	-0.4
7	W	0.5	0.2
7	AN	2.7	0.1
7	BN	6.3	0.3
7	D	16.7	1.0
7	C	0.2	-0.1
7	All	5.4	0.0
8	W	-0.2	0.2
8	AN	6.7	0.0
8	BN	-4.4	0.7
8	D	0.5	0.2
8	C	1.1	0.0
8	All	0.3	0.2
9	W	0.1	0.1
9	AN	2.5	0.1
9	BN	0.4	0.1
9	D	0.8	0.1
9	C	0.0	-0.2
9	All	0.6	0.0
10	W	2.3	0.0
10	AN	-0.5	0.3
10	BN	-0.8	-0.1
10	D	0.3	-0.2
10	C	3.7	-0.2
10	All	1.1	-0.1

¹ Source: ^NMFS 2019 BiOp² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-44. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Juvenile Rearing, American River at Watt Avenue, 68°F¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
5	W	0.0	0.0
5	AN	0.0	0.0
5	BN	0.0	0.0
5	D	-2.9	-0.4
5	C	0.4	0.0
5	All	-0.6	0.2
6	W	0.0	0.0
6	AN	0.0	0.0
6	BN	-7.5	-0.9
6	D	-2.7	1.1
6	C	-0.7	-0.7
6	All	-2.1	0.4
7	W	0.0	0.0
7	AN	0.0	0.0
7	BN	4.2	0.5
7	D	18.4	1.2
7	C	-3.9	0.2
7	All	4.3	-0.6
8	W	1.0	0.0
8	AN	-2.2	-0.1
8	BN	12.5	0.3
8	D	8.3	-0.1
8	C	1.5	0.0
8	All	4.4	-0.2
9	W	0.1	0.0
9	AN	1.7	0.0
9	BN	1.2	0.2
9	D	9.5	-0.3
9	C	-4.2	-0.1
9	All	1.9	-0.2
10	W	0.2	-0.1
10	AN	0.5	0.4
10	BN	-0.9	-0.3
10	D	-1.5	0.0
10	C	-4.7	0.0
10	All	-1.1	0.0

¹ Source: ^NMFS 2019 BiOp² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Table G3e-45. Water Temperature Index Value Analysis Results, Central Valley Steelhead, Smolt Emigration, American River at Watt Avenue, 64°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	W	0.1	-0.2
12	AN	0.0	0.0
12	BN	0.0	0.0
12	D	0.2	0.0
12	C	0.0	0.0
12	All	0.1	-0.3
1	W	0.0	0.0
1	AN	0.0	0.0
1	BN	0.0	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.0	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0
3	W	0.0	0.0
3	AN	0.0	0.0
3	BN	0.0	0.0
3	D	0.0	0.0
3	C	-0.4	0.0
3	All	-0.1	0.0
4	W	0.0	0.0
4	AN	0.0	0.0
4	BN	-1.0	-0.1
4	D	-4.6	-0.2
4	C	-2.0	-0.2
4	All	-1.5	-0.2
5	W	-0.1	-0.1
5	AN	-2.2	0.1
5	BN	-0.2	0.0
5	D	-22.3	-0.6
5	C	-1.5	0.1
5	All	-5.6	0.0
6	W	-0.8	0.0
6	AN	-1.4	-0.2
6	BN	-1.0	-1.4

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
6	D	6.8	-0.8
6	C	0.7	-0.3
6	All	1.0	-0.6

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

G3e.3.2.3 Feather River

Winter-Run Chinook Salmon

Model water temperatures indicate that baseline conditions in the Feather River High Flow Channel are inhospitable for winter-run Chinook salmon rearing during a sizable portion of time (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-30).

A summary of potential temperature-related effects of the VA scenario on winter-run Chinook salmon juvenile non-natal rearing in the Feather River is provided in Table G3e-46. There would be no favorable change during the non-natal rearing period across both locations and in all months and water year types.

Table G3e-46. Summary of Potential Effects of Flow Scenarios on Winter-Run Chinook Salmon, Feather River^a

Life Stage	Percent
Non-Natal Rearing	
Favorable ^b	0%
Unfavorable ^c	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline.

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Spring-Run Chinook Salmon

Water temperature modeling reveals that baseline conditions in the Feather River are inhospitable during much of the time spring-run Chinook salmon are present, particularly in the High Flow Channel (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-32). Over the past two decades, the majority of Chinook salmon have spawned and reared in the Low Flow Channel relative to the High Flow Channel (DWR 2021b, unpubl. data), due at least in part to the poor habitat conditions in the High Flow Channel.

A summary of potential temperature-related effects of the proposed VAs on spring-run Chinook salmon is provided in Table G3e-47. The frequency of favorable and unfavorable changes would be zero for all life stages, except for a 1.7% occurrence of both favorable and unfavorable changes

during the spawning, egg incubation, and alevin presence period. Detailed results for these occurrences are reported in Table G3e-48

Table G3e-47. Summary of Potential Effects of the VA Scenario on Spring-Run Chinook Salmon, Feather River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	1.7%
Unfavorable	1.7%
Fry and Juvenile Rearing and Emigration	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-48. Water Temperature Index Value Analysis Results, Spring-Run Chinook Salmon, Spawning, Egg Incubation, and Alevins, Feather River Low Flow Channel below the Fish Barrier Dam, 55.4°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
9	W	1.0	-0.2
9	AN	-2.8	-0.4
9	BN	20.6	-0.3
9	D	3.7	0.0
9	C	10.0	1.5
9	All	6.1	0.3
10	W	-1.0	1.2
10	AN	-4.0	1.2
10	BN	-5.1	1.0
10	D	-2.3	-1.1
10	C	-5.4	-1.3
10	All	-3.2	0.0
11	W	-1.3	2.6
11	AN	-5.8	0.4

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
11	BN	-0.2	0.2
11	D	-1.3	-0.6
11	C	-8.7	0.4
11	All	-2.9	0.5
12	W	-1.5	0.1
12	AN	0.5	0.0
12	BN	-0.9	0.0
12	D	2.3	0.0
12	C	-0.6	0.0
12	All	-0.1	0.0
1	W	0.1	0.0
1	AN	0.0	0.0
1	BN	0.2	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.1	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Fall-Run Chinook Salmon

Water temperature modeling reveals that baseline conditions in the Feather River are inhospitable during the adult holding and spawning, egg incubation, and alevin life stages of fall-run Chinook salmon, particularly in the High Flow Channel (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-34). Over the past two decades, the majority of Chinook salmon have spawned and reared in the Low Flow Channel relative to the High Flow Channel (^DWR 2021b, unpubl. data), due at least in part to the poor habitat conditions in the High Flow Channel.

A summary of potential temperature-related effects of the proposed VAs on fall-run Chinook salmon is provided in Table G3e-49. There would be no unfavorable results for any life stage. There would be ≤2% of month and water year type combinations with favorable results. Detailed results for these occurrences are reported in Table G3e-50.

Table G3e-49. Summary of Potential Effects of the VA Scenario on Fall-Run Chinook Salmon, Feather River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	2%
Unfavorable	0%
Fry and Juvenile Rearing and Emigration	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Table G3e-50. Water Temperature Index Value Analysis Results, Fall-run Chinook Salmon, Spawning, Egg Incubation, and Alevins, Feather River Low Flow Channel below the Fish Barrier Dam, 55.4°F 7DADM¹

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
10	W	-1.0	1.2
10	AN	-4.0	1.2
10	BN	-5.1	1.0
10	D	-2.3	-1.1
10	C	-5.4	-1.3
10	All	-3.2	0.0
11	W	-1.3	2.6
11	AN	-5.8	0.4
11	BN	-0.2	0.2
11	D	-1.3	-0.6
11	C	-8.7	0.4
11	All	-2.9	0.5
12	W	-1.5	0.1
12	AN	0.5	0.0
12	BN	-0.9	0.0
12	D	2.3	0.0

Month	Water Year Type	Difference in Percent of Days above Index Value ²	Difference in Mean Degrees per Day above Index Value (°F) ³
12	C	-0.6	0.0
12	All	-0.1	0.0
1	W	0.1	0.0
1	AN	0.0	0.0
1	BN	0.2	0.0
1	D	0.0	0.0
1	C	0.0	0.0
1	All	0.1	0.0
2	W	0.0	0.0
2	AN	0.0	0.0
2	BN	0.0	0.0
2	D	0.0	0.0
2	C	0.0	0.0
2	All	0.0	0.0

¹ 7DADM = 7-day average daily maximum

² Green cells indicate >5% lower values under the Proposed VAs relative to Baseline; red cells indicate >5% higher values under the Proposed VAs relative to Baseline.

³ Only includes months on which temperature exceeded Index value; green cells indicate >0.5°F lower values under the Proposed VAs relative to Baseline; red cells indicate >0.5°F higher values under the Proposed VAs relative to Baseline.

Central Valley Steelhead

Modeled water temperatures indicate that baseline conditions may be inhospitable for a sizable portion of all steelhead life stages other than adult immigration and kelt emigration, particularly in the High Flow Channel (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-36). Over the past two decades, the majority of steelhead have spawned and reared in the Low Flow Channel relative to the High Flow Channel (^DWR 2021b, unpubl. data), due at least in part to the poor habitat conditions in the High Flow Channel.

A summary of potential temperature-related effects of the proposed VAs on fall-run Chinook salmon is provided in Table G3e-51. There would be no favorable or unfavorable results for any life stage.

Table G3e-51. Summary of Potential Effects of the VA Scenario on Central Valley Steelhead, Feather River ^a

Life Stage	Percent
Adult Immigration	
Favorable ^b	0%
Unfavorable ^c	0%
Adult Holding	
Favorable	0%
Unfavorable	0%
Spawning, Egg Incubation, and Alevins	
Favorable	0%
Unfavorable	0%

Life Stage	Percent
Kelt Emigration	
Favorable	0%
Unfavorable	0%
Juvenile Rearing	
Favorable	0%
Unfavorable	0%
Smoltification	
Favorable ^b	0%
Unfavorable ^c	0%
Smolt Emigration (excluding migrant parr)	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the VA scenario compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

Green Sturgeon

Modeled water temperatures indicate that baseline conditions may be inhospitable for a sizable portion of each life stage of green sturgeon in the High Flow Channel (Section 7.6.2, *Aquatic Biological Resources*, Table 7.6.2-38). Modeled water temperatures under the baseline scenario generally would be lower than water temperature criteria used for this analysis for all life stages in the Low Flow Channel.

A summary of potential temperature-related effects of VA scenario on green sturgeon is provided in Table G3e-52. There would be no favorable or unfavorable results for any life stage.

Table G3e-52. Summary of Potential Effects of the VA Scenario on Green Sturgeon, Feather River ^a

Life Stage	Percent
Spawning and Embryo Incubation	
Favorable ^b	0%
Unfavorable ^c	0%
Non-Spawning Adult Presence	
Favorable	0%
Unfavorable	0%
Larval and Juvenile Rearing and Emigration	
Favorable	0%
Unfavorable	0%

^a Presented as the percent of month-water year type combinations with favorable and unfavorable results of the proposed VAs compared to baseline at all locations combined.

^b The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% lower than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F lower than the exceedance under the baseline

^c The following criteria are met: (1) frequency of exceedance above the temperature criteria under the VA scenario was >5% higher than the frequency of exceedance under the baseline, and (2) average daily exceedance above the temperature criteria under the VA scenario was >0.5°F higher than the exceedance under the baseline.

G3e.4 References Cited

G3e.4.1 Common References

[^]National Marine Fisheries Service (NMFS). 2019. *Biological Opinion on Long-term Operation of the Central Valley Project and the State Water Project*.

[^]California Department of Water Resources (DWR). 2021b. Unpublished Data on Salmonid Escapement (2000-2019) and Redd Surveys (2003-2011) in the Feather River Low Flow and High Flow channels. Data provided by Jason Kindopp, Senior Environmental Scientist at the California Department of Water Resources.