CEQA Conclusion: As noted for winter-run Chinook salmon, effects of *Environmental Commitment 12 Methylmercury Management* within the areas restored under Alternative 4A are expected to reduce overall methylmercury levels resulting from habitat restoration. Because it is designed to improve water quality and habitat conditions, impacts would be less than significant. Consequently, no mitigation is required.

Impact AQUA-67: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Spring-Run ESU) (Environmental Commitment 15)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-49) is also applicable to spring-run Chinook salmon.

NEPA Effects: As noted for winter-run Chinook salmon, Environmental Commitment 15 would not have adverse impacts and could benefit spring-run Chinook salmon. Due to the uncertainty in the effectiveness of Environmental Commitment 15, however, it is concluded that there would be no demonstrable effect of this conservation measure on spring-run Chinook salmon.

CEQA Conclusion: As noted for winter-run Chinook salmon, Environmental Commitment 15 would not have a significant impact and could benefit spring-run Chinook salmon. Due to the uncertainties associated with this Environmental Commitment, however, it is concluded that there would be no demonstrable effect on spring-run Chinook salmon. Consequently, no mitigation would be required.

Impact AQUA-68: Effects of Nonphysical Fish Barriers on Chinook Salmon (Spring-Run ESU) (Environmental Commitment 16)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-50) is also applicable to spring-run Chinook salmon.

NEPA Effects: The effects of the NPB would not be adverse because it is intended to improve migratory conditions for juvenile Sacramento River salmon.

CEQA Conclusion: As concluded for winter-run Chinook salmon, the impacts of *Environmental Commitment 16 Nonphysical Fish Barriers* are expected to be less than significant because it is intended to improve migratory conditions for juvenile Sacramento River salmon. Consequently, no mitigation would be required.

Fall-/Late Fall–Run Chinook Salmon

Construction and Maintenance of Water Conveyance Facilities

The discussion of potential effects to delta smelt from construction and maintenance of Water Conveyance Facilities under Alternative 4A is also relevant to fall-run/late fall-run Chinook salmon. Adult and juvenile fall-run/late fall-run Chinook salmon would have the potential to overlap construction and maintenance to a minor degree (Table 11-8).

Impact AQUA-73: Effects of Construction of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

The potential effects of construction of the water conveyance facilities on fall-run/late fall-run Chinook salmon would be the same as those described for Alternative 4, Impact AQUA-73.

NEPA Effects: As concluded for Alternative 4, Impact AQUA-73, the effect would not be adverse for fall-run/late fall-run Chinook salmon.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-73, the impact of construction of the water conveyance facilities on fall-run/late fall-run Chinook salmon would not be significant except for construction noise associated with pile driving. Implementation of Mitigation Measures AQUA-1a and AQUA-1b would reduce that noise impact to less than significant.

Mitigation Measure AQUA-1a: Minimize the Use of Impact Pile Driving to Address Effects of Pile Driving and Other Construction-Related Underwater Noise

Mitigation Measure AQUA-1b: Monitor Underwater Noise and if Necessary, Use an Attenuation Device to Reduce Effects of Pile Driving and Other Construction-Related Underwater Noise

Impact AQUA-74: Effects of Maintenance of Water Conveyance Facilities on Chinook Salmon (Fall-/Late Fall–Run ESU)

NEPA Effects: Once constructed, Alternative 4A structures and facilities will require ongoing periodic maintenance that includes in-water work activities with the potential to affect Chinook salmon. These activities include periodic cleaning and replacement of screens, trash racks, and associated machinery and dredging to maintain intake capacity. These activities will produce disturbance and underwater noise, and may generate turbidity or other water quality effects. In general, the likelihood of adverse effects on Chinook salmon from maintenance activities would be avoided and minimized through the same methods and rationale described for Impact AQUA-1.The potential effects of the maintenance of the water conveyance facilities under Alternative 4A would be the same as those described for Alternative 4, Impact AQUA-74. The impact would not be adverse for fall-run/late fall-run Chinook salmon.

CEQA Conclusion: Once constructed, Alternative 4A structures and facilities will require ongoing periodic maintenance that includes in-water work activities with the potential to affect Chinook salmon. These activities include periodic cleaning and replacement of screens, trash racks, and associated machinery and dredging to maintain intake capacity. These activities will produce disturbance and underwater noise, and may generate turbidity or other water quality effects. In general, the likelihood of adverse effects on Chinook salmon from maintenance activities would be avoided and minimized through the same methods and rationale described for Impact AQUA-1.As described in Alternative 4, Impact AQUA-74, the impact of maintenance of the water conveyance facilities on fall-run/late fall-run Chinook salmon would be less than significant and no mitigation is required.

Operations of Water Conveyance Facilities

Impact AQUA-75: Effects of Water Operations on Entrainment of Chinook Salmon (Fall-/Late Fall–Run ESU)

Overall entrainment under Alternative 4A at the south Delta export facilities would be reduced for all water year types (Table 11-4A-53). Under Scenario H3_ELT, average entrainment across all years would be reduced 42% (~24,000 fish) for fall-run Chinook salmon and reduced 33% (643 fish) for late fall-run Chinook salmon compared to NAA_ELT.

Table 11-4A-53. Juvenile Fall-Run and Late Fall-Run Chinook Salmon Annual Entrainment Index[a] at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 4A (Scenario H3_ELT)

	Absolute Difference (Percent Difference)	
Water Year	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Fall-run Chinook Salmon		
Wet	-79,680 (-62%)	-85,155 (-64%)
Above Normal	-13,483 (-41%)	-14,279 (-42%)
Below Normal	-4,120 (-30%)	-3,951 (-29%)
Dry	933 (5%)	-760 (-4%)
Critical	-13,262 (-32%)	-11,208 (-29%)
All Years	-22,380 (-41%)	-23,707 (-42%)
Late fall-run Chinook Salmon		
Wet	-2,724 (-46%)	-2,895 (-47%)
Above Normal	-225 (-39%)	-223 (-39%)
Below Normal	-24 (-43%)	-26 (-45%)
Dry	-39 (-28%)	-30 (-23%)
Critical	-35 (-22%)	-25 (-16%)
All Years	-622 (-32%)	-643 (-33%)
	Shading indicates10% or greater increased entrainment.	

Note: Estimated annual number of fish lost, based on normalized data.
Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

The annual juvenile population that approaches the Delta is assumed to be 23 million fall-run Chinook salmon and 1 million late fall-run Chinook salmon (juvenile index of abundance). The proportion of juvenile index of abundance lost at the south Delta facilities is very low for both runs under NAA_ELT (fall-run 0.24%, late fall-run 0.20% averaged for all years), and under Scenario H3_ELT decreases to negligible levels (fall-run 0.14%; late fall-run 0.13%).

Lower south Delta export pumping during the spring under Scenario H4_ELT would result in lower entrainment during this period than under Scenario H3_ELT.

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A, but the degree would be less because Alternative 4A would have fewer intakes. Thus under Alternative 4A there would be about a 40% reduction in impingement and predation risk relative to Alternative 1A (Impact AQUA-75).

Predation Associated with Entrainment

Entrainment-related predation loss at the south Delta facilities would be no greater and may be lower than NAA_ELT, due to a reduction in entrainment loss. Scenario H3_ELT entrainment-related predation losses are expected to decrease under Scenario H4_ELT.

Predation at the north Delta would be increased due to the installation of the proposed SWP/CVP North Delta intake facilities on the Sacramento River, although the magnitude of this increase is uncertain. Bioenergetics modeling with a median predator density predicts a predation loss under Alternative 4A of less than 0.6% of the annual juvenile production (155,000 fall-run juveniles, 0.24% annual production; 25,000 late fall-run juveniles, 0.57% annual production) (Table 11-4A-54). Note that this estimate does not provide context to the level of predation in this reach that would occur without implementation of Alternative 4A. See additional discussion under Impact AQUA-78.

Table 11-4A-54. Fall-Run and Late Fall-Run Chinook Salmon Juvenile Predation Loss at the Proposed North Delta Diversion (NDD) Intakes for Alternative 4A (Three Intakes)

Striped Bass at NDD (Three Intakes)			Fall-Run Chinook		Late Fall-Run Chinook	
Density	Bass per 1,000 Feet of Intake	Total Number of Bass	Number Consumed	Percentage of Annual Production Entering the Delta[1]	Number Consumed	Percentage of Annual Production Entering the Delta[1]
Low	18	86	22,025	0.04%	3,703	0.09%
Median	119	571	145,610	0.24%	24,483	0.57%
High	219	1,051	267,971	0.44%	45,056	1.05%

Note: Based on bioenergetics modeling of Chinook salmon consumption by striped bass (Appendix 5F Biological Stressors).

[1] Estimated as 61.6 million for fall-run and 4.3 million for late fall-run. See Section 5.F.3.2.1 in *BDCP Effects Analysis*, Appendix 5F Biological Stressors, hereby incorporated by reference.

NEPA Effects: In conclusion, Alternative 4A would reduce overall entrainment and associated predation losses of juvenile fall-run Chinook salmon and late fall-run Chinook salmon relative to NAA_ELT. The population benefit would be minor because entrainment losses affect a small proportion of the total juvenile population. Conditions under Scenario H4_ELT would further reduce entrainment losses compared to Scenario H3_ELT. The effect of Alternative 4A would not be adverse.

CEQA Conclusion: Scenario H3_ELT would substantially reduce entrainment at the south Delta facilities for fall-run (41% less) and late fall-run Chinook salmon (32% less) compared to Existing Conditions. Proportional losses of the juvenile population (juvenile index of abundance) would be slightly reduced from already-low levels (less than 0.25% on average). Under Scenario H4_ELT, entrainment losses are expected to further decrease relative to Existing Conditions. Overall, impacts to fall-run and late fall-run Chinook salmon under Alternative 4A would be less than significant. No mitigation would be required.

Impact AQUA-76: Effects of Water Operations on Spawning and Egg Incubation Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 4A would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to the NAA_ELT.

H3_ELT/ESO_ELT

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to NAA_ELT during October through January, except for November, in which flow would be up to 18% lower.

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, mean end of September Shasta Reservoir storage under H3_ELT would be similar to storage under NAA_ELT in all water year types (Table 11-4A-27).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month, during October through April, and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H3_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-28. There would be 1 (5%) more years with a "red" level of concern under H3_ELT relative to NAA_ELT. This difference would not be biologically meaningful to fall-run Chinook salmon spawners and eggs.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H3_ELT would be 11 degree-days (19% higher) than those under NAA_ELT during March, but were similar during the remaining months (Table 11-4A-29). This total degree-day difference during March across 82 years would correspond to a negligible difference per day. Therefore, this would not result in a negative effect on fall-run Chinook salmon spawning and egg incubation.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under H3_ELT would be similar to mortality under NAA_ELT in all water year types except below normal years, for which mortality under H3_ELT would be 11% higher (Table 11-4A-55). However, the corresponding absolute increase would be 2% of the fall-run population, which is not substantial. (Therefore, these results indicate that H3_ELT would have negligible effects on fall-run Chinook salmon egg mortality.

Table 11-4A-55. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	4 (40%)	0.2 (1%)
Above Normal	5 (46%)	1 (7%)
Below Normal	7 (62%)	2 (11%)
Dry	7 (47%)	-0.4 (-2%)
Critical	5 (18%)	-0.3 (-1%)
All	5 (39%)	0.4 (2%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

SacEFT predicts that there would be a 33% increase in the percentage of years with good spawning habitat availability for fall-run Chinook salmon, measured as weighted usable area, under H3_ELT relative to NAA_ELT (Table 11-4A-56). SacEFT predicts that there would be a 12% reduction in the percentage of years with good (lower) redd scour risk under H3_ELT relative to NAA_ELT. SacEFT predicts that there would be no difference in the number of years with good egg incubation conditions between H3_ELT and NAA_ELT. SacEFT predicts that there would be a 7% decrease in the number of years with good redd dewatering risk conditions under H3_ELT relative to NAA_ELT.

Table 11-4A-**56. Difference and Percent Difference in Percentage of Years with "Good" Conditions** for Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. H3_ELT	NAA vs. H3_ELT
Spawning WUA	9 (19%)	14 (33%)
Redd Scour Risk	-3 (-5%)	-8 (-12%)
Egg Incubation	-5 (-5%)	0 (0%)
Redd Dewatering Risk	0 (0%)	-2 (-7%)
Juvenile Rearing WUA	1 (3%)	-4 (-11%)
Juvenile Stranding Risk	-8 (-26%)	0 (0%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
WUA = Weighted Usable Area.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to flows under NAA_ELT during February through May.

Shasta Reservoir storage at the end of September would affect flows during the fall-run spawning and egg incubation period. As reported in Impact AQUA-58, end of September Shasta Reservoir storage under H3_ELT would be similar to storage under NAA_ELT in all water year types (Table 11-4A-27).

The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the Sacramento River under H3_ELT would be similar to or lower than mortality under NAA_ELT in all water years (Table 11-4A-57).

Table 11-4A-57. Difference and Percent Difference in Percent Mortality of Late Fall-Run Chinook Salmon Eggs in the Sacramento River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA vs. H3_ELT
Wet	2 (80%)	-0.1 (-3%)
Above Normal	1 (48%)	-1 (-14%)
Below Normal	2 (120%)	0.1 (3%)
Dry	2 (69%)	-0.1 (-2%)
Critical	1 (60%)	0 (0%)
All	2 (76%)	-0.1 (-3%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late fall–run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month, during October through April, and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-4A-14. Differences between baselines and H3_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-28. There would be 1 (5%) more year with a “red” level of concern under H3_ELT. This difference would not be biologically meaningful to late fall-run Chinook salmon spawners and eggs.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H3_ELT would be 19% higher than those under NAA _ELT during March and similar during the remaining months (Table 11-4A-29).

SacEFT predicts that there would be difference 6% reduction in in the percentage of years with good spawning availability for late fall-run Chinook salmon, measured as weighted usable area, between NAA_ELT and H3_ELT (Table 11-4A-58). SacEFT predicts that there would be a 1% reduction in redd scour risk between NAA_ELT and H3_ELT. SacEFT predicts that there would be no difference in the percentage of years with good (lower) egg incubation conditions and redd dewatering risk between H3_ELT and NAA_ELT.

Table 11-4A-**58. Difference and Percent Difference in Percentage of Years with "Good"** Conditions for Late Fall-Run Chinook Salmon Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Spawning WUA	-7 (-13%)	-3 (-6%)
Redd Scour Risk	-3 (-4%)	-1 (-1%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-6 (-10%)	0 (0%)
Juvenile Rearing WUA	-2 (-4%)	-14 (-25%)
Juvenile Stranding Risk	-21 (-29%)	-9 (-15%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
WUA = Weighted Usable Area.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Clear Creek flows below Whiskeytown Reservoir were examined for the September through February fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to flows under NAA_ELT.

The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in September when spawning is assumed to occur. The greatest monthly reduction in Clear Creek flows during September through February under H3_ELT would be the same as those under NAA_ELT for all water year types (Table 11-4A-59).

Table 11-4A-59. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in Clear Creek below Whiskeytown Reservoir during the September through February Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	0 (NA)	0 (NA)
Above Normal	-41 (NA)	0 (0%)
Below Normal	53 (100%)	0 (NA)
Dry	-67 (NA)	0 (0%)
Critical	-33 (-50%)	0 (0%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.
[a] Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in September, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

Feather River

Fall-Run

Flows in the Feather River in the low-flow and high-flow channels were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel under H3_ELT would be identical to those under NAA_ELT. Flows in the high-flow channel under H3_ELT would generally be similar to than those under NAA_ELT, with a few exceptions.

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel during November through January were identical between H3_ELT and NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of H3_ELT on redd dewatering in the Feather River low-flow channel.

Mean monthly water temperatures in the Feather River above Thermalito Afterbay (low-flow channel) and below Thermalito Afterbay (high-flow channel) were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period at either location.

Effects of H3_ELT on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were analyzed by comparing the percent of months between October through April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold at Gridley (Table 11-4A-60). In general, differences in the percent of months exceeding the threshold between NAA_ELT and H3_ELT would be negligible (<5% on an absolute scale), although there would be a 5% reduction (absolute difference) in months exceeding the threshold by >5°F during October.

Table 11-4A-60. Differences between Baseline and H3_ELT Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 56°F Threshold, October through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H3_ELT					
October	0 (0%)	7 (9%)	11 (15%)	25 (61%)	26 (140%)
November	14 (367%)	5 (400%)	2 (NA)	0 (NA)	0 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	15 (200%)	5 (133%)	4 (300%)	1 (NA)	1 (NA)
April	9 (12%)	12 (22%)	20 (64%)	12 (71%)	7 (67%)
NAA_ELT vs. H3_ELT					
October	-1 (-1%)	-1 (-1%)	0 (0%)	-1 (-2%)	-5 (-10%)
November	1 (8%)	0 (0%)	0 (0%)	-1 (-100%)	0 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	4 (20%)	0 (0%)	0 (0%)	-1 (-50%)	0 (0%)
April	0 (0%)	1 (2%)	0 (0%)	0 (0%)	2 (15%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

The effects of H3_ELT on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were also analyzed by comparing the total degree-months in the Feather River at Gridley for months that exceed the 56°F NMFS threshold during the October through April fall-run Chinook salmon spawning and egg incubation period for all 82 years (Table 11-4A-61). Combining all water year types, there would be little difference in total degree-months exceeded between NAA_ELT and H3_ELT. Overall, these methods, combined with other temperature analyses, indicate that there would be no effect of H3_ELT on temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather River.

Table 11-4A-61. Differences between Baseline and H3_ELT Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
October	Wet	32 (44%)	-2 (-2%)
	Above Normal	12 (27%)	-2 (-3%)
	Below Normal	13 (24%)	-4 (-6%)
	Dry	21 (40%)	-1 (-1%)
	Critical	18 (44%)	0 (0%)
	All	96 (36%)	-9 (-2%)
November	Wet	1 (NA)	0 (0%)
	Above Normal	3 (150%)	0 (0%)
	Below Normal	3 (300%)	0 (0%)
	Dry	6 (NA)	0 (0%)
	Critical	4 (400%)	0 (0%)
	All	17 (425%)	0 (0%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	1 (NA)	0 (0%)
	Above Normal	0 (0%)	1 (NA)
	Below Normal	7 (700%)	1 (14%)
	Dry	7 (175%)	0 (0%)
	Critical	6 (150%)	0 (0%)
	All	21 (210%)	2 (7%)
April	Wet	16 (114%)	1 (3%)
	Above Normal	9 (39%)	1 (3%)
	Below Normal	6 (15%)	0 (0%)
	Dry	18 (37%)	2 (3%)
	Critical	14 (48%)	3 (8%)
	All	63 (41%)	7 (3%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under H3_ELT would be similar to or lower than mortality under NAA_ELT in all water years, including above normal and below water years, in which, although there would be a 17% and 19% relative increase, the absolute increase would be 0.4% and 0.6% of the fall-run population, respectively (Table 11-4A-62). Therefore, this increase would not cause an overall effect to fall-run Chinook salmon.

Table 11-4A-62. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the Feather River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	2 (107%)	0.2 (7%)
Above Normal	2 (145%)	0.4 (17%)
Below Normal	2 (106%)	0.6 (19%)
Dry	3 (127%)	-1 (-22%)
Critical	5 (110%)	-1 (-5%)
All	3 (119%)	-0.1 (-2%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT would be similar to or up to 25% greater than flows under NAA_ELT during October, similar to or up to 15% lower than flows under NAA_ELT during November, and generally similar in December and January.

The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in October, when spawning is assumed to occur. The greatest reductions in American River flows during November through January under H3_ELT would range from 30% to 52% (absolute difference) greater in magnitude than under NAA_ELT in wet, below normal, and critical water years and 9% to 13% lower in magnitude than NAA_ELT in above normal and dry water years (Table 11-4A-63).

Table 11-4A-63. Difference and Percent Difference in Greatest Monthly Reduction (Percent Change) in Instream Flow in the American River at Nimbus Dam during the October through January Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA vs. H3_ELT
Wet	-18 (-83%)	-39 (NA)
Above Normal	15 (50%)	9 (37%)
Below Normal	-25 (-131%)	-30 (-197%)
Dry	32 (68%)	13 (45%)
Critical	-16 (-30%)	-52 (-329%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

[a] Redd dewatering risk not applicable for months when flows during the egg incubation period were at or greater than flows in October, when spawning is assumed to occur. A negative value indicates that the greatest monthly reduction would be of greater magnitude (worse) under the alternative than under the baseline.

Mean water temperatures in the American River at the Watt Avenue Bridge were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-4A-64). The percent of months exceeding the threshold under H3_ELT would generally be similar to the percent under NAA_ELT, except for the >5.0°F exceedance category during November, which would be 4% lower (absolute difference) under H3_ELT.

Table 11-4A-64. Differences between Baseline and H3_ELT Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H3_ELT					
November	32 (70%)	35 (127%)	28 (209%)	26 (1050%)	14 (1100%)
December	1 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	6 (50%)	5 (67%)	5 (200%)	1 (100%)	2 (NA)
April	17 (25%)	12 (20%)	17 (38%)	17 (54%)	5 (18%)
NAA_ELT vs. H3_ELT					
November	-5 (-6%)	1 (2%)	-1 (-3%)	-2 (-8%)	-4 (-20%)
December	0 (0%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	0 (0%)	-1 (-9%)	-2 (-25%)	0 (0%)	0 (0%)
April	0 (0%)	0 (0%)	-1 (-2%)	0 (0%)	0 (0%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
NA = could not be calculated because the denominator was 0.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-4A-65). Total degree-months would be similar between NAA_ELT and H3_ELT for all months.

Table 11-4A-65. Differences between Baseline and H3 Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the American River at the Watt Avenue Bridge, November through April

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
November	Wet	34 (136%)	-5 (-8%)
	Above Normal	16 (145%)	-1 (-4%)
	Below Normal	22 (275%)	-4 (-12%)
	Dry	25 (192%)	-1 (-3%)
	Critical	19 (119%)	1 (3%)
	All	116 (159%)	-10 (-5%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	0 (0%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	2 (100%)	0 (0%)
	Above Normal	3 (NA)	0 (0%)
	Below Normal	2 (67%)	0 (0%)
	Dry	3 (75%)	-2 (-22%)
	Critical	6 (60%)	-1 (-6%)
	All	16 (84%)	-3 (-8%)
April	Wet	22 (79%)	0 (0%)
	Above Normal	14 (64%)	0 (0%)
	Below Normal	15 (42%)	-1 (-2%)
	Dry	15 (20%)	0 (0%)
	Critical	14 (24%)	-2 (-3%)
	All	80 (36%)	-3 (-1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under H3_ELT would be similar to mortality under NAA_ELT (Table 11-4A-66).

Table 11-4A-66. Difference and Percent Difference in Percent Mortality of Fall-Run Chinook Salmon Eggs in the American River (Egg Mortality Model)

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	15 (99%)	-0.2 (-1%)
Above Normal	14 (130%)	-1 (-3%)
Below Normal	13 (105%)	0.3 (1%)
Dry	10 (59%)	0 (0%)
Critical	4 (19%)	0 (0%)
All	12 (77%)	0 (0%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to flows under NAA_ELT throughout the period.

Water temperatures throughout the Stanislaus River would be similar under NAA_ELT and H3_ELT throughout the October through January period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to flows under NAA_ELT throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences in mean flows between H3_ELT and NAA_ELT throughout the period for all water year types

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT /HOS_ELT

Sacramento River

Fall-Run

Mean flows in the Sacramento River upstream of Red Bluff during October through January under H4_ELT would be similar to flows under NAA_ELT, except during November in which flows would be up to 15% lower, depending on water year type) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

September Shasta mean storage volume under H4_ELT would be similar to storage volume under NAA_ELT, except in critical water years, in which storage volume would be 24% greater under H4_ELT (Table 11-4A-36).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H4_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-67. There would be 6 (27%) more years without any of the three levels of concern, under H4_ELT relative to NAA_ELT. These results suggest that water temperatures would improve for fall-run Chinook salmon spawning and egg incubation in the Sacramento River under H4_ELT.

Table 11-4A-67. Differences between Baseline Scenarios and H4_ELT Scenarios in the Number of Years in Which Water Temperature Exceedances above 56°F Are within Each Level of Concern, Sacramento River at Red Bluff, October through April

Level of Concern[a]	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
Red	9 (75%)	0 (0%)
Orange	2 (33%)	-5 (-38%)
Yellow	12 (92%)	-1 (-4%)
None	-23 (-45%)	6 (27%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
[a] For definitions of levels of concern, see Table 11-4A-14.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H4_ELT would be 10% lower than those under NAA_ELT for October, 20% lower for November, 16% higher for March, and would be similar for the remaining four months (Table 11-4A-68). The largest difference in degree-days would be the 353 degree-day reduction for October.

Table 11-4A-68. Differences between Baseline and H4_ELT Scenarios in Total Degree-Days (°F-Days) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Sacramento River at Red Bluff, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA vs. H4_ELT
October	Wet	406 (158%)	-16 (-2%)
	Above Normal	191 (73%)	-6 (-1%)
	Below Normal	229 (110%)	-29 (-6%)
	Dry	286 (58%)	-88 (-10%)
	Critical	201 (34%)	-214 (-21%)
	All	1,313 (72%)	-353 (-10%)
November	Wet	7 (700%)	-1 (-11%)
	Above Normal	4 (NA)	1 (33%)
	Below Normal	1 (NA)	-1 (-50%)
	Dry	31 (388%)	-11 (-22%)
	Critical	13 (325%)	-5 (-23%)
	All	56 (431%)	-17 (-20%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	1 (NA)	0 (0%)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	10 (111%)	9 (90%)
	Dry	20 (143%)	0 (0%)
	Critical	11 (1100%)	0 (0%)
	All	42 (175%)	9 (16%)
April	Wet	97 (84%)	0 (0%)
	Above Normal	68 (49%)	-4 (-2%)
	Below Normal	99 (125%)	5 (3%)
	Dry	118 (63%)	11 (4%)
	Critical	49 (408%)	7 (13%)
	All	431 (81%)	19 (2%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

Due to similar Sacramento River flows, reservoir storage, and water temperatures between H4_ELT and H3_ELT, results for additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4_ELT would be similar to results for analyses under H3_ELT. As a result, these additional analyses were not conducted for H4_ELT. Overall, results for H4_ELT would be similar to those for H3_ELT.

Late Fall-Run

There would be no difference (<5%) in mean flows in the Sacramento River upstream of Red Bluff during February through May between NAA_ELT and H4_ELT in any month or water year type throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

September Shasta mean storage volume under H4_ELT would be similar to storage volume under NAA_ELT except in critical water years, in which storage volume would be 24% greater under H4_ELT (Table 11-4A-36).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H4_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-67. There would be 6 (27%) more years without any of the three levels of concern, under H4_ELT relative to NAA_ELT. These results indicate that water temperature conditions would improve for late fall-run Chinook salmon spawning and egg incubation in the Sacramento River under H4_ELT.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H4_ELT would be 10% lower than those under NAA_ELT for October, 20% lower for November, 16% higher for March, and would be similar for the remaining four months (Table 11-4A-68). The largest difference in degree-days would be the 353 degree-day reduction for October, which would correspond to a <0.2°F change per day, which is not expected to affect spawning and egg incubation.

Due to similar Sacramento River flows, reservoir storage, and water temperatures between H4_ELT and H3_ELT, results for additional analyses (e.g., Reclamation egg mortality model, SacEFT) under H4_ELT would be similar to results for analyses under H3_ELT. As a result, these additional analyses were not conducted for H4_ELT. Overall, results for H4_ELT would be similar to those for H3_ELT.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

There would be no differences (<5%) between H4_ELT and NAA_ELT in mean flows in Clear Creek below Whiskeytown Reservoir during October through January for any month or water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Mean flows in the Feather River low-flow channel during October through January would be the same (<5%) between H4_ELT and NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT in the high-flow channel would generally be similar to those under NAA_ELT, with minor exceptions.

Differences in the percent of months exceeding the 56°F NMFS threshold between NAA_ELT and H4_ELT would be negligible (<5% on an absolute scale) during all months except October, March, and April, in which the percent of months under H4_ELT would be similar to or up to 20% lower than (absolute difference) those under NAA_ELT (Table 11-4A-69). This method indicates that there would be benefits of H4_ELT on temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather River.

Table 11-4A-69. Differences between Baselines and H4_ELT Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the Feather River at Gridley Exceed the 56°F Threshold, October through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H4_ELT					
October	1 (1%)	7 (9%)	5 (7%)	22 (55%)	26 (140%)
November	12 (333%)	9 (700%)	4 (NA)	0 (NA)	0 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	2 (33%)	2 (67%)	2 (200%)	1 (NA)	0 (NA)
April	-11 (-16%)	-6 (-11%)	2 (8%)	2 (14%)	-1 (-11%)
NAA_ELT vs. H4_ELT					
October	0 (0%)	-1 (-1%)	-6 (-7%)	-4 (-6%)	-5 (-10%)
November	0 (0%)	4 (60%)	1 (50%)	-1 (-100%)	0 (NA)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-9 (-47%)	-2 (-29%)	-1 (-25%)	-1 (-50%)	-1 (-100%)
April	-20 (-25%)	-17 (-25%)	-17 (-34%)	-10 (-33%)	-6 (-38%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

Combining all water year types, there would be no difference between NAA_ELT and H4_ELT in total degree-months exceeded in all months except October, November, March, and April. For October and November, degree-months would be higher by 8% and 62%, respectively, while for March and April they would be lower by 14% and 19%, respectively (Table 11-4A-70). Splitting monthly results into water year types yields highly variable outcomes. There would be small increases and decreases in degree-months under H4_ELT relative to NAA_ELT depending on month and water year type. Large relative differences between NAA _ELT and H4_ELT during some months and water year types are mathematical artifacts due to small values of degree-months for NAA_ELT and would not translate into biologically meaningful effects on fall-run Chinook salmon. Overall, this method indicates that there would be no effects of H4_ELT on temperature-related fall-run Chinook salmon spawning and egg incubation conditions in the Feather River.

Table 11-4A-70. Differences between Baselines and H4_ELT Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the Feather River at Gridley, October through April

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
October	Wet	47 (64%)	13 (12%)
	Above Normal	15 (34%)	1 (2%)
	Below Normal	24 (44%)	7 (10%)
	Dry	31 (58%)	9 (12%)
	Critical	18 (44%)	0 (0%)
	All	135 (51%)	30 (8%)
November	Wet	8 (NA)	7 (700%)
	Above Normal	3 (150%)	0 (0%)
	Below Normal	7 (700%)	4 (100%)
	Dry	10 (NA)	4 (67%)
	Critical	2 (200%)	-2 (-40%)
	All	30 (750%)	13 (62%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	1 (NA)	0 (0%)
	Above Normal	-1 (-100%)	0 (NA)
	Below Normal	3 (300%)	-3 (-43%)
	Dry	7 (175%)	0 (0%)
	Critical	6 (150%)	0 (0%)
	All	15 (150%)	-4 (-14%)
April	Wet	5 (36%)	-10 (-34%)
	Above Normal	-4 (-17%)	-12 (-39%)
	Below Normal	-16 (-40%)	-22 (-48%)
	Dry	16 (33%)	0 (0%)
	Critical	14 (48%)	3 (8%)
	All	15 (10%)	-41 (-19%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River during October through January would generally be similar between H4_ELT and NAA_ELT, except during October, in which flows would be up to 24% higher under H4 (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-4A-71). The percent of months exceeding the threshold under H4_ELT would be similar to or up to 11% lower (absolute difference) than the percent under NAA_ELT.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-4A-72). Total degree-months would generally be similar between NAA_ELT and H4_ELT for all months.

Table 11-4A-71. Differences between Baseline and H4_ELT Scenarios in Percent of Months during the 82-Year CALSIM Modeling Period during Which Water Temperatures in the American River at the Watt Avenue Bridge Exceed the 56°F Threshold, November through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H4_ELT					
November	27 (59%)	26 (95%)	23 (173%)	17 (700%)	10 (800%)
December	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	2 (20%)	5 (67%)	4 (150%)	1 (100%)	1 (NA)
April	11 (16%)	6 (10%)	10 (22%)	10 (31%)	4 (14%)
NAA_ELT vs. H4_ELT					
November	-10 (-12%)	-7 (-12%)	-6 (-14%)	-11 (-36%)	-7 (-40%)
December	-1 (-100%)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-4 (-20%)	-1 (-9%)	-4 (-38%)	0 (0%)	-1 (-50%)
April	-6 (-7%)	-6 (-8%)	-9 (-13%)	-7 (-15%)	-1 (-4%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

Table 11-4A-72. Differences between Baseline H4_ELT Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 56°F in the American River at the Watt Avenue Bridge, November through April

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
November	Wet	36 (144%)	-3 (-5%)
	Above Normal	16 (145%)	-1 (-4%)
	Below Normal	24 (300%)	-2 (-6%)
	Dry	23 (177%)	-3 (-8%)
	Critical	20 (125%)	2 (6%)
	All	118 (162%)	-8 (-4%)
December	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	1 (NA)	0 (0%)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	1 (NA)	0 (0%)
January	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
February	Wet	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	0 (NA)	0 (NA)
	All	0 (NA)	0 (NA)
March	Wet	2 (100%)	0 (0%)
	Above Normal	3 (NA)	0 (0%)
	Below Normal	2 (67%)	0 (0%)
	Dry	5 (125%)	0 (0%)
	Critical	7 (70%)	0 (0%)
	All	19 (100%)	0 (0%)
April	Wet	19 (68%)	-3 (-6%)
	Above Normal	14 (64%)	0 (0%)
	Below Normal	16 (44%)	0 (0%)
	Dry	14 (18%)	-1 (-1%)
	Critical	17 (29%)	1 (1%)
	All	80 (36%)	-3 (-1%)

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

NA = could not be calculated because the denominator was 0.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under NAA_ELT throughout the period.

Water temperatures throughout the Stanislaus River would be similar under NAA_ELT and H4_ELT throughout the October through January period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under NAA_ELT throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences in mean flows between H4_ELT and NAA throughout the period for all water year types.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, it is concluded that the effect is not adverse because spawning and egg incubation habitat conditions are not substantially reduced. There are no reductions in flows under Alternative 4A or increases in temperatures that would translate into biologically meaningful effects on fall-/late fall-run Chinook salmon. In all rivers, there are no large or consistent differences relative to NAA_ELT. Biological modeling results also indicate that Alternative 4A would not substantially affect fall-/late fall–run Chinook salmon spawning and egg incubation habitat relative to the NAA_ELT. There would generally be no differences among scenarios.

CEQA Conclusion: In general, Alternative 4A would degrade the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions. However, as further described below in the Summary of CEQA Conclusion, reviewing the alternative's impacts in relation to the NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demand. Informed by the NAA_ELT comparison, Alternative 4A would not affect the quantity and quality of spawning and egg incubation habitat for fall-/late fall-run Chinook salmon relative to the CEQA baseline.

H3_ELT /ESO_ELT

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT would be up to 16% lower than flows under Existing Conditions during October and November, and similar during December and January.

Shasta storage volume at the end of September would be 7% to 11% lower under H3_ELT relative to Existing Conditions depending on water year type (Table 11-4A-27).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT during the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-4A-14. Differences between H3_ELT and baselines in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-28. There would be 10 (83%) and 5 (83%) more years with “red” and “orange” levels of concern under H3_ELT than under Existing Conditions. Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H3_ELT would be 78% to 554% higher than those under Existing Conditions during October, November, March, and April, and there were no differences during December through February (Table 11-4A-29).

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Sacramento River under H3_ELT would be 18% to 62% greater than mortality under Existing Conditions, depending on water year type (Table 11-4A-55).

SacEFT predicts that there would be a 19% increase in the percentage of years with good spawning availability, measured as weighted usable area, under H3_ELT relative to Existing Conditions (Table 11-4A-56). SacEFT predicts that there would be a 5% reduction in the percentage of years with good (lower) redd scour risk under H3_ELT relative to Existing Conditions. SacEFT predicts that there would be a 5% relative decrease in the percentage of years with good (lower) egg incubation conditions under H3_ELT compared to Existing Conditions. SacEFT predicts that there would be no difference in the percentage of years with good (lower) redd dewatering risk between H3_ELT and Existing Conditions.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II*

Model Results utilized in the Fish Analysis). Mean flows under H3_ELT would generally be similar to flows under Existing Conditions for all months and water year types during the period.

Shasta storage volume at the end of September would be 7% to 11% lower under H3_ELT relative to Existing Conditions, depending on water year type (Table 11-4A-27).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month or water year type throughout the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between H3_ELT and baselines in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-28. There would be 10 (83%) and 5 (83%) more years with "red" and "orange" levels of concern under H3_ELT than under Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H3_ELT would be 78% to 554% higher than those under Existing Conditions during October, November, March, and April, and there would be no differences during December through February (Table 11-4A-29).

The Reclamation egg mortality model predicts that late fall-run Chinook salmon egg mortality in the Sacramento River under H3_ELT would be 60% to 120% greater than mortality under Existing Conditions (Table 11-4A-57). However, absolute differences in the percent of the late-fall population subject to mortality would be minimal in all water years.

SacEFT predicts that there would be a 13% relative decrease in the percentage of years with good spawning availability, measured as weighted usable area, under H3_ELT compared to Existing Conditions (Table 11-4A-58). SacEFT predicts that there would be a 4% relative decrease in the percentage of years with good (lower) redd scour risk under H3_ELT compared to Existing Conditions. SacEFT predicts that there would be no difference in the percentage of years with good (lower) egg incubation conditions under H3_ELT relative to Existing Conditions. SacEFT predicts that there would be a 10% relative decrease in the percentage of years with good (lower) redd dewatering risk under H3 compared to Existing Conditions.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined during the September through February fall-run spawning and egg incubation period. Flows under H3_ELT would be up to 40% greater during January and February, and generally similar during September through December to flows under Existing Conditions, with minor exceptions.

The potential risk of redd dewatering in Clear Creek was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in September when spawning occurred. Clear Creek flows would be reduced during October through February under H3_ELT up to 67% (absolute difference) in above normal, dry, and critical water years and increased in below normal water years (Table 11-4A-59).

Feather River

Fall-Run

Flows in the Feather River low-flow channel during October through January under H3_ELT would be identical to those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the high-flow channel under H3_ELT would be up to 47% lower than flows under Existing Conditions during January, up to 24% greater during October, 18% higher and up to 26% lower in December, and generally similar during November.

The potential risk of redd dewatering in the Feather River low-flow channel was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in October when spawning is assumed to occur. Minimum flows in the low-flow channel were identical between H3_ELT and Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, there would be no effect of Alternative 4 on redd dewatering in the Feather River low-flow channel.

Mean water temperatures in the Feather River above Thermalito Afterbay (low-flow channel) and below Thermalito Afterbay (high-flow channel) were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H3_ELT and Existing Conditions would be no different (<5%) at either location.

Effects of H3_ELT on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were analyzed by comparing the percent of months between October through April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold at Gridley (Table 11-4A-60). In general, the percent of months exceeding the threshold under H3_ELT would be up to 25% greater than the percent under Existing Conditions in all months except December, January, and February, during which the percent would not differ from Existing Conditions. This comparison includes the effects of climate change.

The effects of H3_ELT on water temperature-related spawning and egg incubation conditions for fall-run Chinook salmon in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 56°F NMFS threshold during the October through April fall-run Chinook salmon spawning and egg incubation period for all 82 years (Table 11-4A-61). In general, total degree-months under H3_ELT would be up to 96 degree-months (36%) greater than under Existing Conditions in all months except December, January, and February, during which degree-months would not differ from Existing Conditions. This comparison includes the effects of climate change.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the Feather River under H3_ELT would be 106% to 145% greater than mortality under Existing Conditions (Table 11-4A-62).

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River under H3_ELT would generally be up to 24% lower than flows under Existing Conditions during November and January, but generally similar to flows under Existing Conditions during October and December, with some exceptions.

The potential risk of redd dewatering in the American River at Nimbus Dam was evaluated by comparing the magnitude of flow reduction each month during the incubation period to the flow in October when spawning is assumed to occur. The greatest monthly reduction in American River flows during November through January under H3_ELT would be 30% to 131% greater magnitude than those under Existing Conditions for all year types except above normal (50% lower magnitude)(Table 11-4A-63).

Mean water temperatures in the American River at the Watt Avenue Bridge were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean temperatures under H3_ELT would be 6% to 7% higher than those under Existing Conditions during October of all water year types except critical (5% higher).

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-4A-64). The percent of months exceeding the threshold under H3_ELT would be up to 35% greater (absolute difference) than the percent under Existing Conditions during November, March, and April and similar to the percent under Existing Conditions during December through February.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-4A-65). Total degree-months under H3_ELT would be 36% to 159% greater than total degree-months under Existing Conditions during November, March and April and similar to total degree months under Existing Conditions during December through February.

The Reclamation egg mortality model predicts that fall-run Chinook salmon egg mortality in the American River under H3_ELT would be 19% to 130% greater than mortality under Existing Conditions (Table 11-4A-66).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under Existing Conditions.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H3_ELT would not be different (<5%) from those under Existing Conditions for all months and water year types of the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar in all months of the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT would be up to 28% greater than flows under Existing Conditions during December, and would generally be similar to flows under Existing Conditions during the other three months of the period.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT / HOS_ELT

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined during the October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT 4 would generally be similar to flows under Existing Conditions. September Shasta storage volume under H4_ELT would be similar to or up to 12% lower than to storage volume under Existing Conditions, depending on water year type (Table 11-4A-36).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4_ELT during the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a “level of concern”, as defined in Table 11-4A-14. Differences between baselines and H4_ELT in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-67. There would be 75% and 33% increases in the number of years with “red” and “orange” levels of concern, respectively, under H4_ELT relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H4_ELT would be 72% to 431% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-4A-68).

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were evaluated during the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to flows under Existing Conditions. End of September Shasta storage volume under H4_ELT would be up to 12% lower than storage volume under Existing Conditions (Table 11-4A-36).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the February through May late fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4_ELT during the period.

The number of days at Red Bluff on which temperature exceeded 56°F by >0.5°F to >5°F in 0.5°F increments was determined for each month during October through April and year of the 82-year modeling period (Table 11-4A-13). The combination of number of days and degrees above the 56°F threshold were further assigned a "level of concern", as defined in Table 11-4A-14. Differences between baselines and H1in the highest level of concern across all months and all 82 modeled years are presented in Table 11-4A-67. There would be 75% and 33% increases in the number of years with "red" and "orange" levels of concern, respectively, under H4_ELT relative to Existing Conditions.

Total degree-days exceeding 56°F were summed by month and water year type at Red Bluff during October through April. Total degree-days under H4_ELT would be 72% to 431% higher than those under Existing Conditions during October, November, March, and April, and similar during December through February (Table 11-4A-68).

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek flows below Whiskeytown Reservoir were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be up to 40% greater during January and February, and generally similar during September through December, than flows under Existing Conditions.

Feather River

Fall-Run

Flows in the Feather River were evaluated in the low- and high-flow channels during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the low-flow channel would be identical between Existing Conditions and H4_ELT. Mean flows in the high-flow channel under

H4_ELT would be up to 36% lower than those under Existing Conditions throughout the period, with a few exceptions.

Mean water temperatures in the Feather River above Thermalito Afterbay (low-flow channel) and below Thermalito Afterbay (high-flow channel) were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean monthly water temperatures would be no different (<5%) under H4_ELT relative to Existing Conditions at either location.

Differences in the percent of months exceeding the 56°F NMFS threshold between Existing Conditions and H4_ELT would be negligible (<5% on an absolute scale) during all months except October, November, March, and April, in which the percent of months under H4_ELT would be similar to or up to 26% higher (absolute difference) than those under Existing Conditions.

Combining all water year types, there would be no difference between Existing Conditions and H4_ELT in total degree-months exceeded in all months except October, November, March, and April, during which degree-months under H4_ELT would be greater by up to 135 degree-months (51% higher).

American River

Fall-Run

Flows were evaluated in the American River at the confluence with the Sacramento River during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4_ELT would be up to 25% lower than those under Existing Conditions during November and would generally be similar between Existing Conditions and H4_ELT during the other three months of the period, with a few exceptions.

Mean water temperatures in the American River at the Watt Avenue Bridge were examined during the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean temperatures under H4 ELT would be 6% to 7% greater than those under Existing Conditions during October of all water year types except critical (5% greater) and would be no different (<5%) for all other months and water year types of the period.

The percent of months exceeding the 56°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during November through April (Table 11-4A-71). The percent of months exceeding the threshold under H4 ELT would be up to 27% greater (absolute difference) than the percent under Existing Conditions during November, March, and April and similar to the percent under Existing Conditions during December through February.

Total degree-months exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-4A-72). Total degree-months under H4 ELT would be 36% to 159% greater than total degree-months under Existing Conditions during November, March and April and similar to total degree months under Existing Conditions during December through February.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar between Existing Conditions and H4_ELT.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the October through January fall-run spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H4_ELT would be no different (<5%) than Existing Conditions throughout the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be generally similar to those under Existing Conditions throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for the October through January fall-run Chinook salmon spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4_ELT would generally be similar to flows under Existing Conditions during October, November, and January, and up to 28% greater than flows under Existing Conditions during December.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Under Alternative 4A, there would be moderate to substantial flow reductions and substantial increases in temperatures and temperature exceedances above thresholds in the Sacramento, Feather, and American Rivers, which would interfere with fall-/late fall--run Chinook salmon spawning and egg incubation. Biological models, including the Reclamation egg mortality model and SacEFT, predict substantially degraded spawning and egg incubation habitat conditions in the Sacramento, Feather, and American Rivers. These modeling results are generally consistent for H3_ELT and H4_ELT. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce suitable spawning habitat and substantially reduce the number of fall-/late fall-run Chinook salmon as a result of egg mortality.

However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison of results between the alternative and NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

When compared to NAA_ELT and informed by the NEPA analysis above, there would be no effect of Alternative 4A on flows, reservoir storage, and water temperatures that would cause a substantial reduction in fall-/late fall-run Chinook salmon. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows, reservoir storage, and water temperature under Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, this impact is found to be less than significant and no mitigation is required.

Impact AQUA-77: Effects of Water Operations on Rearing Habitat for Chinook Salmon (Fall-/Late Fall–Run ESU)

In general, Alternative 4A would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to the NAA_ELT.

H3_ELT /ESO_ELT

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Sacramento River upstream of Red Bluff under H3_ELT would generally be similar to flows under NAA_ELT.

Shasta Reservoir storage at the end of September would affect flows during the fall-run larval and juvenile rearing period. As reported in AQUA-58, mean end of September Shasta Reservoir storage under H3_ELT would be similar to storage under NAA_ELT in all water year types (Table 11-4A-27).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

SacEFT predicts that there would be an 11% decrease (4% on an absolute scale) in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under H3_ELT relative to NAA_ELT (Table 11-4A-56). SacEFT predicts that there would be no difference in the percentage of years with "good" (lower) juvenile stranding risk between H3_ELT and NAA_ELT.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under H3_ELT would be similar to mortality under NAA_ELT.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).Upstream of Red Bluff, mean flows under H3_ELT would generally be similar to those under NAA throughout the period.

Shasta Reservoir storage at the end of September and May would affect flows during the late fall-run larval and juvenile rearing period. As reported in AQUA-156, end of September Shasta Reservoir storage under H3_ELT would be similar to storage under NAA_ELT in all water year types (Table 11-4A-27).

As reported in AQUA-40, May Shasta storage volume under H3_ELT would be similar to storage under NAA_ELT for all water year types (Table 11-4A-19).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

SacEFT predicts that there would be a 25% relative decrease in the percentage of years with good juvenile rearing habitat availability for late fall-run Chinook salmon, measured as weighted usable area, under H3_ELT compared to NAA_ELT (Table 11-4A-58). SacEFT predicts that there would be a 15% reduction in the percentage of years with "good" (lower) juvenile stranding risk under H3_ELT relative to NAA_ELT, which would be negligible on an absolute scale (4% difference).

SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under H3_ELT would be similar (<5% difference) to mortality under NAA_ELT. These results are inconsistent with SacEFT results, which indicate that juvenile rearing habitat availability would decline under H3_ELT (Table 11-4A-58).

Both SacEFT and SALMOD are considered to be reliable models for late fall-run Chinook salmon in the Sacramento River. SALMOD has been used for decades for assessing changes in flows associated with SWP and CVP and SacEFT has been peer-reviewed. Therefore, results of both models were used to draw conclusions about late fall-run Chinook salmon rearing conditions. The SALMOD model incorporates effects to all early life stages, including eggs, fry, and juveniles. Therefore, although SacEFT predicts that juvenile rearing habitat availability may be reduced under H3_ELT, when combined with all early life stage effects in SALMOD, there would be no effect of H3_ELT on late-fall-run Chinook salmon habitat-related survival of all early life stages, including juveniles. Further, results from SALMOD are consistent with results described above that indicate that there would be no differences in instream flows or reservoir storage between NAA_ELT and H3_ELT.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined for the January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to those under NAA_ELT throughout the period.

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout this period under H3_ELT would not differ from those under NAA_ELT. In the high-flow channel, mean flows under H3_ELT would generally be similar to those under NAA_ELT during December through April and up to 106% greater during May and June.

As reported in AQUA-59, May Oroville mean storage volume under H3_ELT would be similar to storage under NAA_ELT for all water year types (Table 11-4A-42).

As reported in AQUA-58, September Oroville mean storage volume under H3_ELT would be similar to volume in wet, above normal, and below normal water years and 12% to 15% greater than volume under NAA_ELT during dry and critical water years (Table 11-4A-39).

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).* There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under NAA_ELT throughout the period.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River for H3_ELT are not different from those under NAA_ELT, for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures throughout the Stanislaus River would be similar between NAA_ELT and H3_ELT throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis for H3_ELT are not different from those under NAA_ELT, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta for H3_ELT are not different from those under NAA_ELT, for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT/HOS_ELT

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were evaluated during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows under H4_ELT during this period would generally be similar to those under NAA_ELT.

September Shasta mean storage volume under H4_ELT would generally be similar to September storage volume under NAA_ELT, except in critical years (24% higher under H4_ELT) (Table 11-4A-36).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA and H4 in any month or water year type throughout the period.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were evaluated during the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT during this period would be similar to those under NAA_ELT for all year types throughout the period.

September Shasta mean storage volume under H4_ELT would be similar to September storage volume under NAA_ELT except in critical years (24% higher under H4) (Table 11-4A-36). May Shasta storage volume under H4_ELT would be similar to May storage volume under NAA_ELT except in critical years (11% higher under H4_ELT) (Table 11-4A-19).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Mean flows in Clear Creek below Whiskeytown Reservoir during January through May under H4_ELT would generally be similar to those under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River were evaluated at both above (low-flow channel) and at (high-flow channel) Thermalito Afterbay during the December through June fall-run juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the low-flow channel would be identical between NAA_ELT and H4_ELT. Mean flows in the high-flow channel would generally be similar to or greater than those under NAA_ELT (up to 548% greater for below normal year types in April) than flows under NAA_ELT.

September Oroville mean storage under H4_ELT would generally be similar to mean storage volume under NAA_ELT in wet, above normal, and below normal water year types and 28% to 44% greater in dry and critical water year types (Table 11-4A-39). May Oroville storage under H4_ELT would be 11% to 16% lower than storage under NAA_ELT in wet, above normal, and below normal water years, similar in dry water years, and 24% greater in critical water years (Table 11-4A-45).

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis).* There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were evaluated during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to flows under NAA_ELT throughout the period.

Mean water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Mean flows in the Stanislaus River at the confluence with the San Joaquin River for H4_ELT are not different (<5%) from those under NAA_ELT for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures throughout the Stanislaus River would be similar between NAA_ELT and H4_ELT throughout the January through May fall-run rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Fall-Run

Mean flows in the San Joaquin River at Vernalis for H4_ELT are not different (<5%) from those under NAA_ELT for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Mean flows in the Mokelumne River at the Delta for H4_ELT are not different (<5%) from those under NAA_ELT for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*)

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: All changes in flow rates and water temperatures are generally small and infrequent under Alternative 4A relative to the NAA_ELT. Therefore, there would be no biologically meaningful effects to fall- or late fall-run Chinook salmon. Biological modeling generally supports this conclusion, except for a reduction in late fall-run Chinook salmon juvenile rearing habitat conditions predicted by SacEFT. However, review of this result in combination with SALMOD results, which evaluates habitat-related survival of all early life stages and found no effect of Alternative 4A, it is concluded that the effect to juvenile habitat conditions predicted by SacEFT would not have a substantial effect on all early life stages combined, including juveniles, as predicted by SALMOD As such, the effect is not adverse because it does not have the potential to substantially reduce the amount of suitable habitat of fish.

CEQA Conclusion: In general, Alternative 4A would not affect the quantity and quality of larval and juvenile rearing habitat for fall-/late fall-run Chinook salmon relative to Existing Conditions.

H3_ELT /ESO_ELT

Sacramento River

Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under Existing Conditions throughout the period.

As reported in AQUA-58, end of September Shasta Reservoir mean storage would be 7% to 11% lower under H3_ELT relative to Existing Conditions, depending on water year type (Table 11-4A-27).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month or water year type throughout the period.

SacEFT predicts that there would be a 3% increase in the percentage of years with good juvenile rearing availability for fall-run Chinook salmon, measured as weighted usable area, under H3_ELT relative to Existing Conditions (Table 11-4A-56). SacEFT predicts that there would be a 26% reduction in the percentage of years with “good” (lower) juvenile stranding risk under H3_ELT relative to Existing Conditions.

SALMOD predicts that fall-run smolt equivalent habitat-related mortality under H3_ELT would be similar to mortality under Existing Conditions.

Late Fall-Run

Sacramento River flows upstream of Red Bluff were examined for the March through July late fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3 would generally be up to 20% greater during May and June, and similar in the remaining months.

As reported in AQUA-58, mean storage volume at the end of September under H3_ELT would be 7% to 11% lower relative to Existing Conditions, depending on water year type (Table 11-4A-27).

As reported in AQUA-40, Shasta Reservoir mean storage volume at the end of May under H3_ELT would be similar to volume under Existing Conditions for all water year types (Table 11-4A-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento*

River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in any month or water year type throughout the period.

SacEFT predicts that there would be a 4% reduction in the percentage of years with good juvenile rearing availability for late fall-run Chinook salmon, measured as weighted usable area, under H3_ELT relative to Existing Conditions (Table 11-4A-58). SacEFT predicts that there would be a 29% reduction in the percentage of years with "good" (lower) juvenile stranding risk under H3_ELT relative to Existing Conditions.

SALMOD predicts that late fall-run smolt equivalent habitat-related mortality under H3_ELT would be 4% higher than mortality under Existing Conditions.

Clear Creek

No temperature modeling was conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined from January through May fall-run Chinook salmon rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under Existing Conditions, except for critical year types during January through April (10% greater under H3_ELT in all four months) and wet year types in January and February (up to 40% greater under H3_ELT) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) during December through June were reviewed to determine flow-related effects on larval and juvenile fall-run rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Relatively constant flows in the low-flow channel throughout the period under H3_ELT would not differ from those under Existing Conditions. In the high-flow channel, relative to Existing Conditions, mean flows under H3_ELT would generally be similar during December, March, and April, lower during January and February (by up to 48%), and higher during May and June (up to 140%).

As reported under AQUA-59, May Oroville mean storage volume under H3_ELT would be up to 12% lower (dry year types) than Existing Conditions (Table 11-4A-42).

As reported in AQUA-58, September Oroville mean storage volume would be 5% to 29% lower under H3_ELT relative to Existing Conditions depending on water year type, except for critical years (Table 11-4A-33).

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (5%) in mean water temperature between H3_ELT and Existing Conditions in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined for the January through May fall-run larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT during the period would be up to 18% lower and up to 15% higher than flows under Existing Conditions, depending on the month and water year type.

Mean water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H3_ELT would be no different than (<5%) those under Existing Conditions during the period.

Stanislaus River

Fall-Run

Mean flows in the Stanislaus River at the confluence with the San Joaquin River for H3_ELT would generally be lower than those under Existing Conditions during the January through May fall-run larval and juvenile rearing period for most water year types (up to 29% lower for critical year types in February) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H3_ELT would be no different than (<5%) those under Existing Conditions throughout the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to or moderately lower than flows under Existing Conditions throughout the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be generally similar to or moderately greater than those under Existing Conditions during January through March and similar to or slightly lower than flows under Existing Conditions during April and May.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT/HOS_ELT

Sacramento River

Fall-Run

Sacramento River mean flows upstream of Red Bluff during January through May under H4_ELT would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). September Shasta mean storage volume under H4_ELT would generally be similar to or slightly lower than September mean storage volume under Existing Conditions (Table 11-4A-27).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the January through March fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4_ELT in any month or water year type throughout the period.

Late Fall-Run

Sacramento River mean flows upstream of Red Bluff during March through July under H4_ELT would generally be similar to flows under Existing Conditions throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

September Shasta mean storage volume under H4_ELT would generally similar to or slightly lower than September mean storage volume under Existing Conditions (Table 11-4A-36). May Shasta mean storage volume under H4_ELT would be similar to mean storage volume under Existing Conditions for all water year types (Table 11-4A-19).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the March through July late fall–run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4_ELT in any month or water year type throughout the period.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Fall-Run

Mean flows in Clear Creek below Whiskeytown Reservoir during January through May under H4_ELT would be similar to or greater than those under Existing Conditions (up to 40% greater for wet years in January) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Fall-Run

Flows were evaluated in the Feather River both above (low-flow channel) and at (high-flow channel) Thermalito Afterbay during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the low-flow channel would be identical between Existing Conditions and H4_ELT. Mean flows in the high-flow channel under H4_ELT would generally be lower than flows under Existing Conditions during December through February (up to 36% lower for below normal year types in January), similar during March, and greater than flows under Existing Conditions during April through June (up to 509% greater for below normal year types in April).

September Oroville mean storage under H4_ELT would be 23% to 24% lower than flows under Existing Conditions in wet, above normal, and below normal water years, and 5% to 32% higher in dry and critical water years (Table 11-4A-39). May Oroville mean storage would be 11% to 19% lower under H4_ELT than under Existing Conditions in all water year types except critical, in which storage would be 15% higher (Table 11-4A-45).

Mean monthly water temperatures in the Feather River both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the December through June fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (5%) in mean water temperature between H4_ELT and Existing Conditions in any month or water year type throughout the period at either location.

American River

Fall-Run

Flows were evaluated in the American River at the confluence with the Sacramento River during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be up to 20% lower than flows under Existing Conditions during May, up to 14% higher during February, and similar, with minor exceptions, in the remaining months of the rearing period.

Mean monthly water temperatures in the American River at the Watt Avenue Bridge were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (5%) in mean water temperature between H4_ELT and Existing Conditions in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Mean flows in the Stanislaus River at the confluence with the San Joaquin River for H4_ELT would be lower for most water year types than those under Existing Conditions in the January through May fall-run larval and juvenile rearing period (up to 29% lower for critical years during February) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through May fall-run Chinook salmon juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between H4_ELT and Existing Conditions in any month or water year type throughout the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined for the January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to or moderately lower than those under Existing Conditions for most water year types in the January through May fall-run larval and juvenile rearing period. Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined for January through May fall-run Chinook salmon larval and juvenile rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean monthly flows under H4_ELT would be similar to those under Existing Conditions for most water year types than in the January through May fall-run larval and juvenile rearing period.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Under Alternative 4A, including climate change effects, there would be persistent moderate flow reductions in the Feather, American, Stanislaus, Mokelumne, and San Joaquin Rivers, which would interfere with fall-/late fall--run Chinook salmon juvenile rearing habitat conditions. Contrary to the NEPA conclusion set forth above, these modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce suitable rearing habitat and substantially reduce the number of fall-/late fall-run Chinook salmon as a result of degraded juvenile rearing conditions.

However, this interpretation of the biological modeling results is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA_ELT) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison of results between the alternative and NAA_ELT is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands. When compared to NAA_ELT and informed by the NEPA analysis above, flows, reservoir storage, and water temperatures in the Sacramento River would generally be similar between NAA_ELT and Alternative 4A. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows, reservoir storage, and water temperature under

Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, this impact is found to be less than significant and no mitigation is required.

Impact AQUA-78: Effects of Water Operations on Migration Conditions for Chinook Salmon (Fall-/Late Fall–Run ESU)

With implementation of Mitigation Measure AQUA-78d, the effect of Alternative 4A on migration conditions for fall-/late fall–run Chinook salmon relative to the No Action Alternative would not be adverse.

Upstream of the Delta

H3_ELT /ESO_ELT

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to flows under NAA_ELT throughout the juvenile migration period.

Mean water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA _ELT and H3_ELT in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook salmon upstream migration period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under NAA_ELT during August, October and December, and would be up to 18% lower during September and November (mean reduction combining all water year types of 6% and 12%, respectively). These reductions would not be of sufficient magnitude or frequency to cause a biologically meaningful effect to fall-run Chinook salmon migration.

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Late Fall-Run

Mean flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January through March) under H3_ELT would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Mean flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon upstream migration period (December through February) under H3_ELT would be generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA and H3 in any month or water year type throughout the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined for juvenile fall-run migrants during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to those under NAA_ELT.

Flows in Clear Creek below Whiskeytown Reservoir were examined during the adult fall-run Chinook salmon upstream migration period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT would generally be similar to flows under NAA_ELT with few exceptions.

Feather River

Fall-Run

Flows in the Feather River at the confluence with the Sacramento River were reviewed for the fall-run juvenile migration period (February through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to or greater than flows under NAA_ELT throughout the period (up to 12% greater for above normal year types in February).

Mean water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Flows in the Feather River at the confluence with the Sacramento River were reviewed for the August through December fall-run Chinook salmon adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar or up to 17% greater than those under NAA_ELT during October through December. During August and September, flows would be up to 28% lower than flows under NAA_ELT except in critical water years in which the flows would be up to 21% greater. Mean flow reductions across all water year types for August and September would be 11% and 15%, respectively. These reductions would not be of sufficient magnitude or frequency to cause a biologically meaningful effect to fall-run Chinook salmon migration. Flows would be similar between NAA_ELT and H3_ELT during November.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were examined during the August through December fall-run Chinook salmon adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to flows under NAA_ELT throughout the migration period, except during April of critical years (17% greater mean flow under H3_ELT).

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Flows in the American River at the confluence with the Sacramento River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be up to 25% lower than flows under NAA_ELT during August, September and November, and similar or up to 25% higher during October and December. Mean flow reductions across all water year types during August, September and November would be 11%, 16%, and 10%, respectively. Because these reductions occur in the majority of migration months, this is considered an adverse effects to fall-run Chinook salmon migration conditions.

Mean monthly water temperatures in the American River at the confluence with the Sacramento River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be no different than (<5%) those under NAA_ELT in all months and water year types throughout the period.

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be no different than (<5%) those under NAA_ELT in both months and water year types of the period.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H3_ELT in either month or any water year type of the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be no different than (<5%) those under NAA_ELT in all months and water year types throughout the period.

Flows in the San Joaquin River at Vernalis were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H3_ELT in either month or any water year type of the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H3_ELT in any month or water year type throughout the period.

Flows in the Mokelumne River at the Delta were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H3_ELT in either month or any water year type of the period.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT /HOS_ELT

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run Chinook salmon downstream migration period (February through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under NAA_ELT throughout the period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook salmon upstream migration period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to those under NAA_ELT except during November, when flows would be up to 15% lower under H4_ELT.

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in either month or any water year type of the period.

Late Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for the juvenile fall-run Chinook salmon downstream migration period (January through March) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under NAA_ELT throughout the period for all water year types.

Mean water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined for the adult fall-run Chinook salmon upstream migration period (December through February) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to flows under NAA_ELT throughout the period.

Mean water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in either month or any water year type of the period.

Clear Creek

Water temperature modeling was not conducted in Clear Creek.

Fall-Run

Flows in the Clear Creek below Whiskeytown Reservoir during the February through May fall-run Chinook salmon juvenile migration period under H4_ELT would generally be similar to flows under NAA_ELT, (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the Clear Creek below Whiskeytown Reservoir during the August through December fall-run Chinook salmon adult migration period under H4_ELT would generally be no different than (<5%) those under NAA_ELT.

Feather River

Fall-Run

Flows were evaluated in the Feather River at the confluence with the Sacramento River during the February through May juvenile late fall-run Chinook salmon emigration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to or greater than flows under NAA_ELT throughout the period (up to 119% greater for April of below normal year types).

Mean water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile late fall-run Chinook salmon emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows were evaluated in the Feather River at the confluence with the Sacramento River during the August through December fall-run Chinook salmon adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be lower during August and September than those under NAA_ELT for all water year types except critical year types (up to 42% lower in August of wet years and up to 42% higher in August of critical years). Mean reductions for all water year types combined during August and September would be 32% and 22%, respectively. These reductions are substantial and, therefore, would cause an adverse effect to fall-run Chinook salmon. Mean flows during October through December would generally be similar to flows under NAA_ELT.

American River

Fall-Run

Flows were evaluated in the American River at the confluence with the Sacramento River during the February through May fall-run Chinook salmon juvenile migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under NAA_ELT throughout the period, except for critical years types in April (12% higher under H4_ELT) and May (17% lower under H4_ELT).

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results* *utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows were evaluated in the American River at the confluence with the Sacramento River during the August through December fall-run Chinook salmon adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4 ELT would generally be lower than those under NAA_ELT during September and November (up to 22% lower), but would generally be similar or higher during August, October and December (up to 24% higher). However, flow during August of critical water years would be 33% lower under H4_ELT. These flow reductions would not be frequent or of high enough magnitude to be considered adverse.

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the September and October adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in either month or any water year type of the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be no different than (<5%) those under NAA_ELT in all months and water year types of the period.

Mean water temperatures in the Stanislaus River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flows between NAA_ELT and H4_ELT in either month or any water year type of the period.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between NAA_ELT and H4_ELT in either month or any water year type of the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be no different than (<5%) those under NAA_ELT for all months or water year types of the period.

Flows in the San Joaquin River at Vernalis were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H4_ELT in either month or any water year type of the period.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H4_ELT in any month or water year type throughout the period.

Flows in the Mokelumne River at the Delta were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean flow between NAA_ELT and H4_ELT in either month or any water year type of the period.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Fall-Run

Juveniles

Alternative 4A operations would generally reduce OMR reverse flows under Scenario H3_ELT (Appendix B, Supplemental Modeling for Alternative 4A), with a corresponding increase in net positive downstream flows, during the migration period of Chinook salmon through the interior Delta channels. Conditions under Scenario H4_ELT would further improve overall average OMR flows compared to NAA_ELT. These improved net positive downstream flows would be benefits of the proposed operations.

Predation risk at the north Delta would be increased due to the installation of the proposed SWP/CVP North Delta intake facilities on the Sacramento River. Bioenergetics modeling with a median predator density predicts a predation loss under Alternative 4 of less than 0.6% of the annual juvenile production (0.24% fall run; 0.57% late fall-run) (Table 11-4A-54). A conservative assumption of 5% loss per intake would yield a cumulative loss of about 13% of juvenile fall-run and late fall-run Chinook that reach the north Delta. This assumption is uncertain and represents an upper bound estimate. For a discussion of this topic see Impact AQUA-42 for Alternative 1A and additional discussion under Impact AQUA-42 of Alternative 4A for winter-run Chinook salmon.

H3_ELT

Flows below the north Delta intakes would be reduced during the juvenile emigration period for fall-run Chinook (February through May) and late fall-run Chinook salmon (January through March), which may increase predation potential. Mean monthly flows averaged across all water years would decrease about 17% to 22% under H3_ELT compared to NAA_ELT. As noted for winter-run and spring-run Chinook salmon, the modeling of NAA_ELT does not account for any flow entering the Yolo Bypass because of Fremont Weir modifications that would occur separately from Alternative 4A (but which are included in the modeling of H3_ELT and H4_ELT; see also section 4.1.1.3 of Section 4); this would slightly decrease the amount of water in the Sacramento River under NAA_ELT, so the above comparison of H3_ELT vs. NAA_ELT is conservative.

Under Scenario H3_ELT, through-Delta survival of Sacramento River fall-run Chinook salmon, as estimated by the Delta Passage Model, averaged 24.3% across all years, 20.6% in drier years and 30.5% in wetter years (Table 11-4A-74). Compared to NAA_ELT, average survival under Scenario H3 would be similar (<4% lower) across all years, although this estimate does not account for the adjustments that can be made during real-time operations to further protect migrating fish. These real-time operational adjustments would be based on biological and hydrological triggers developed by NMFS and DFW to protect migrating salmonids. However, as noted for winter-run Chinook salmon in the discussion of Impact AQUA-42, the DPM modeling results do not account for the inclusion of Yolo Bypass improvements in NAA_ELT. Applying the same modification to NAA_ELT outputs as described in the discussion of Impact AQUA-42 resulted in the relative difference between NAA_ELT and H3_ELT increasing: the relative difference across all years increased from 4% less compared to NAA_ELT to nearly 6% less compared to NAA_ELT (mod.)(Table 11-4A-74).

H4_ELT

Under the high outflow scenario H4_ELT, mean monthly flows below the NDD would decrease by about 4% to 18% during the emigration period, with the greatest relative reduction of 18% in February of below normal years. Under H4_ELT, flow decreases in April and May would be less than 10% compared to NAA_ELT, with small increases in mean monthly flow in some water year types (e.g., 7–15% greater than NAA_ELT in below normal years). Survival based on the DPM under Scenario H4 would be similar to NAA_ELT (<2% relative difference; Table 11-4A-74) based on operations assuming no adjustments made in real-time in response to actual presence of fish; as described above, real-time operational adjustments would be made, based on biological and hydrological triggers developed by NMFS and DFW to protect migrating salmonids. As noted in the discussion for H3_ELT, the DPM modeling results do not account for the inclusion of Yolo Bypass improvements in NAA_ELT. Applying the same modification to NAA_ELT outputs as described in the discussion of Impact AQUA-42 for winter-run Chinook salmon resulted in the relative difference between NAA_ELT and H4_ELT changing slightly: the relative difference across all years changed from 1.6% more compared to NAA_ELT to nearly 0.4% less compared to NAA_ELT (mod.)(Table 11-4A-74).

Overall, Alternative 4A would not have an adverse effect on Sacramento River fall-run Chinook salmon juvenile survival due to relatively low differences in survival for most operations, as well as the inclusion in Alternative 4A of bypass flow criteria, real-time management, and several conservation measures (Environmental Commitment 6, Environmental Commitment 15, Environmental Commitment 16) to offset any adverse effects, as discussed for winter-run Chinook salmon under Impact AQUA-42.

Table 11-4A-74. Through-Delta Survival (%) of Emigrating Juvenile Fall-Run Chinook Salmon under Alternative 4A (Scenarios H3_ELT and H4_ELT)

	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	Scenario					EXISTING CONDITIONS vs. Alt 4A Scenario		NAA_ELT vs. Alt 4A Scenario			
Water Year Type	EXISTING CONDITIONS	NAA_ ELT	NAA_ ELT (mod.)	H3_ ELT	H4_ ELT	H3_ELT	H4_ELT	H3_ELT	H4_ELT	H3_ELT (vs. NAA_ELT mod.)	H4_ELT (vs. NAA_ELT mod.)
Sacramento											
Wetter	34.5	33.0	33.3	30.5	34.4	-4.0 (-11.6%)	-0.1 (-0.2%)	-2.5 (-7.5%)	1.4 (4.3%)	-2.8 (-8.3%)	1.1 (3.4%)
Drier	20.6	20.7	21.3	20.6	20.4	0.0 (0.0%)	-0.1 (-0.7%)	-0.1 (-0.4%)	-0.2 (-1.1%)	-0.7 (-3.5%)	-0.9 (-4.0%)
All Years	25.8	25.3	25.8	24.3	25.7	-1.5 (-5.8%)	-0.1 (-0.4%)	-1.0 (-3.9%)	0.4 (1.6%)	-1.5 (-5.8%)	-0.1 (-0.4%)
Mokelumne											
Wetter	17.2	16.3	N/A	18.2	19.2	1.0 (5.6%)	2.1 (11.9%)	1.9 (11.6%)	3.0 (18.2%)	N/A	N/A
Drier	15.6	15.7	N/A	15.6	15.8	-0.1 (-0.4%)	0.2 (1.1%)	-0.2 (-1.1%)	0.1 (0.4%)	N/A	N/A
All Years	16.2	15.9	N/A	16.5	17.1	0.3 (1.9%)	0.9 (5.6%)	0.6 (3.8%)	1.2 (7.5%)		
San Joaquin											
Wetter	19.3	20.7	N/A	16.9	16.6	-2.5 (-12.7%)	-2.7 (-14.0%)	-3.8 (-18.5%)	-4.1 (-19.7%)	N/A	N/A
Drier	9.9	9.8	N/A	10.9	10.7	1.0 (9.9%)	0.8 (7.5%)	1.1 (11.1%)	0.9 (8.7%)	N/A	N/A
All Years	13.5	13.9	N/A	13.2	12.9	-0.3 (-2.2%)	-0.6 (-4.4%)	-0.7 (-5.0%)	-1.0 (-7.2%)	N/A	N/A

Note: Average Delta Passage Model results for survival to Chipps Island.
Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).
Wetter = Wet and Above Normal Water Years (6 years).
Drier = Below Normal, Dry and Critical Water Years (10 years).
H3_ELT = ESO_ELT operations, H4_ELT = High Outflow.
NAA_ELT (mod.) = NAA_ELT with Yolo Bypass entry % and Yolo Bypass survival of H3_ELT.
N/A = not applicable because the Mokelumne and San Joaquin populations do not encounter the upstream end of the Yolo Bypass.

Adults

Attraction flows and olfactory cues in the west Delta for migrating adults would be altered because of shifts in exports from the south Delta to the North Delta under Alternative 4A. Sacramento River flows downstream of the north Delta diversion would be reduced, with concomitant increase in San Joaquin River flow contribution.

Results of fingerprint simulation modeling (DSM2 modeling of percentage of water at Collinsville that originated in the Sacramento River water) for Scenario H3_ELT predicted a minimal reduction in Sacramento River source water September–November (1–4% less) compared with NAA (Table 11-4A-75). Studies indicate that a 20% or less reduction in source flows that provides olfactory cues would not adversely affect adult attraction (Fretwell 1989). The reduction in olfactory cues under Scenario H3_ELT is small and is expected to be within the broad range of olfactory cues and migration conditions that currently occur within the lower reach of the Sacramento River.

Table 11-4A-75. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Fall-Run and Late Fall-Run Chinook Salmon Migration Period for Alternative 4A (Scenario H3_ELT)

	Scenario			Percentage Difference	
Month	EXISTING CONDITIONS	NAA_ ELT	H3_ELT	EXISTING CONDITIONS vs. H3_ELT	NAA vs. H3_ELT
Fall-Run—Sacramento River					
September	60	65	61	0	-4
October	60	64	65	5	1
November	60	64	63	3	-1
December	67	67	65	-1	-1
Fall-Run—San Joaquin River					
September	0.3	0.2	1.7	1.4	1.5
October	0.2	0.2	3.5	3.4	3.3
November	0.4	0.8	5.2	4.8	4.4
December	0.9	1.0	2.9	2.0	1.9
Late Fall-Run—Sacramento River					
December	67	67	65	-1	-1
January	76	75	73	-2	-2
February	75	74	69	-6	-4
March	78	77	69	-9	-8

Shading indicates 10% or greater absolute difference.

Note: Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Late Fall-Run

Juveniles

Alternative 4A operations would generally reduce OMR reverse flows under all flow scenarios (Appendix B, Supplemental Modeling for Alternative 4A), with a corresponding increase in net positive downstream flows that would benefit juveniles migrating through the Delta. Reduced flows below the north Delta intakes may increase predation potential. Through-Delta survival by emigrating juvenile late fall-run Chinook salmon under Scenario H3_ELT as estimated with the DPM averaged 22% across all years, 19.4% in drier years, and 26.4% in wetter years (Table 11-4A-76). Juvenile survival under the Scenario H3_ELT was similar or slightly lower than under NAA_ELT for drier, wetter and all years averaged (around 3-4% less in relative difference) based on operations assuming no adjustments made in real-time in response to actual presence of fish (Table 11-4A-76).

The results were similar for H4_ELT, in keeping with the timing of late fall-run emigration through the Delta mostly lying outside the spring period in which H3_ELT operations would differ from H4_ELT operations. However, as noted for winter-run Chinook salmon in the discussion of Impact AQUA-42, the DPM modeling results do not account for the inclusion of Yolo Bypass improvements in NAA_ELT. Applying the same modification to NAA_ELT outputs as described in the discussion of Impact AQUA-42 resulted in the relative difference between NAA_ELT and H3_ELT/H4_ELT increasing: for H3_ELT, the relative difference across all years increased from 3.4% less compared to NAA_ELT to just over 5.8% less compared to NAA_ELT (mod.); whereas for H4_ELT, the relative difference across all years increased from 3.5% less compared to NAA_ELT to 6.1% less compared to NAA_ELT (mod.) (Table 11-4A-51). Overall, Alternative 4A would not have an adverse effect on late fall-run Chinook salmon juvenile survival due to similar survival between Alternative 4A and NAA_ELT during all water year types.

Table 11-4A-76. Through-Delta Survival (%) of Emigrating Juvenile Late Fall-Run Chinook Salmon under Alternative 4A (Scenarios H3_ELT and H4_ELT)

	Average Percentage Survival					Difference in Percentage Survival (Relative Difference)					
	Scenario					EXISTING CONDITIONS vs. Alt 4A Scenario		NAA_ELT vs. Alt 4A Scenario			
Water Year Type	EXISTING CONDITIONS	NAA_ ELT	NAA_ ELT (mod.)	H3_ ELT	H4_ ELT	H3_ELT	H4_ELT	H3_ELT	H4_ELT	H3_ELT (vs. NAA_ELT mod.)	H4_ELT (vs. NAA_ELT mod.)
Wetter	28.8	27.5	28.1	26.4	26.5	-2.4 (-8.2%)	-2.3 (-7.9%)	-1.1 (-4.0%)	-1.0 (-3.7%)	-1.7 (-6.1%)	-1.6 (-5.9%)
Drier	18.8	20.0	20.5	19.4	19.3	0.7 (3.5%)	0.5 (2.7%)	-0.6 (-3.0%)	-0.8 (-3.7%)	-1.1 (-5.5%)	-1.3 (-6.3%)
All Years	22.5	22.8	23.4	22.0	22.0	-0.5 (-2.2%)	-0.5 (-2.2%)	-0.8 (-3.4%)	-0.8 (-3.5%)	-1.4 (-5.8%)	-1.4 (-6.1%)

Note: Delta Passage Model results for survival to Chipps Island.

Negative numbers indicate lower values under Alternative 4A (i.e., the calculations are based on Alternative 4A minus the baseline).

Wetter = Wet and Above Normal Water Years (6 years).

Drier = Below Normal, Dry and Critical Water Years (10 years).

H3_ELT = ESO_ELT operations, H4_ELT = High Outflow.

NAA_ELT (mod.) = NAA_ELT with Yolo Bypass entry % and Yolo Bypass survival of H3_ELT.

Adults

Flows in the Sacramento River downstream of the north Delta intake diversions would be reduced under Alternative 4A, with concomitant proportional increases in San Joaquin River flows. Under Scenario H3_ELT, the percentage of Sacramento River water at Collinsville would be similar in December, and slightly reduced (2% to 8%) in January through March compared to NAA (Table 11-4A-75). The effect on olfactory cues for migrating adults late fall-run Chinook salmon would be negligible because the change in flow proportions is less than 10% in absolute terms.

Mokelumne River

Fall-Run

Juveniles

Through-Delta survival of Mokelumne River fall-run Chinook salmon under Scenario H3_ELT averaged 16.5% across all years (Table 11-4A-74). Survival under Scenario H3_ELT was similar to NAA_ELT averaged across all years (0.6% greater, or 4% more in relative difference) and in drier years (a 1% relative difference), and there was a 2% increase in survival (nearly a 12% relative difference) in wetter years. Juvenile survival under H4_ELT (high outflow) was similar to Scenarios H3_ELT and NAA_ELT in drier years, and slightly increased (by 7.5% relative difference) when averaged across all years. In wetter years, survival increased 3% under Scenario H4_ELT (an 18% relative difference). Overall, Alternative 4A would not have an adverse effect on Mokelumne River fall-run Chinook salmon juvenile survival due to minor differences in survival for most operations, and a moderate increase in survival for the high outflow years, particularly under operations Scenario H4_ELT. Note that this analysis is conservative because increased flow into the Yolo Bypass with Fremont Weir modifications under NAA_ELT would result in less flow remaining in the Sacramento River; these Fremont Weir modifications were not accounted for in the modeling of NAA_ELT. As described in *BDCP Appendix 5.C, Section 5C.4.3.2.2 hereby incorporated by reference*, the export-dependent survival function for juvenile Chinook salmon in the interior Delta (including Mokelumne River fall-run) is a ratio of survival in the mainstem Sacramento River below Georgiana Slough, which has a positive relationship with Sacramento River flow. Thus, the estimates of through-Delta survival under NAA_ELT for Mokelumne River fall-run Chinook salmon that do not account for flow entering the Yolo Bypass because of Fremont Weir modifications would tend to slightly overestimate survival for NAA_ELT; therefore, the differences between NAA_ELT and H3_ELT/H4_ELT discussed above would be somewhat greater if the flow entering Yolo Bypass under NAA_ELT was accounted for.

San Joaquin River

Fall-Run

Juveniles

Under Alternative 4A Scenario H3_ELT operations, through-Delta survival by juvenile fall-run Chinook salmon emigrating from the San Joaquin River averaged 13% across all years, 11% in drier years, and 17% in wetter years (Table 11-4A-74). Compared to NAA_ELT, average survival across all years was lower for both operations scenarios (H3_ELT and H4_ELT). Survival is slightly increased in drier years (1% greater, a 9–11% relative difference). Survival is greatest in wetter years, but is moderately reduced relative to NAA_ELT by about 4% (19-20% relative difference for Scenarios H3_ELT and H4_ELT). As described in *BDCP Appendix 5.C, Section 5C.5.3.4.5 hereby incorporated by reference*, these results are driven by appreciably lower through-Delta survival of San Joaquin River fall-run Chinook salmon under Alternative 4A scenarios relative to NAA_ELT in very wet years (1982/1983). During these types of years, the Head of Old River operable gate would not be closed because of exceedance of the 10,000-cfs Vernalis flow criterion permitting its closure, so less fish would use the main stem San Joaquin River pathway. In addition, south Delta exports would be very low (averaging 40-50 cfs for H3_ELT in 1983, for example) because of operation of the north Delta intakes, which would result in estimated survival that is relatively low because of the DPM's positive relationship between survival and exports, based on current relationships. There is considerable uncertainty in effects on San Joaquin River Chinook salmon survival at such low levels of exports because the studies upon which the DPM flow- and export-survival relationships are based did not include these low levels of exports. SalSim, a recently completed San Joaquin River watershed Chinook salmon analysis tool that includes juvenile survival through the Delta derived in a different manner than DPM, includes a positive relationship between probability of juvenile survival and flow in the mainstem San Joaquin River at Stockton Deepwater Ship Channel; this flow term is positively related to flow at Vernalis, inversely related to south Delta exports, and positively related to Head of Old River barrier operation; the results of SalSim modeling therefore would be expected to illustrate a benefit of Alternative 4A across any modeled year, which is more in keeping with the anticipated effect of the alternative. Overall and in light of these uncertainties, Alternative 4A would not have an adverse effect on through-Delta migration because the reduction in south Delta exports generally would be expected to benefit through-Delta survival.

Adults

The percentage of water at Collinsville that originated from the San Joaquin River is very small (no more than 1% under NAA_ELT) during the fall-run migration period (September to December). The fingerprinting analysis showed a small increase in olfactory cues from the San Joaquin River passing downstream through the Delta under Scenario H3_ELT (Table 11-4A-75). Although the relative change is substantial (i.e., a severalfold increase in the percentage of flow from the San Joaquin River under Scenario H3_ELT compared to NAA_ELT), the percentage of flow attributable to San Joaquin River water under all scenarios is quite low (no more than around 5%). Scenario H4_ELT would not have as great a relative change because exports at the north Delta diversion would be lower than under Scenario H3_ELT. Overall, Alternative 4A operations conditions would incrementally increase olfactory cues associated with attraction flows in the lower San Joaquin River, but the increase would be small. However, even this seemingly small increase could provide moderate benefits: as illustrated in *BDCP Appendix 5.C, Section 5C.5.3.13.1.5 hereby incorporated by reference,* based on the study of Marston et al. (2012), greater olfactory cues under Alternative 4A could decrease severalfold the straying rate of adult San Joaquin River Chinook salmon to the Sacramento River. This would not be an adverse effect on adult fall-run Chinook salmon migrating to the San Joaquin River.

NEPA Effects: Upstream of the Delta, these modeling results indicate that the effect of Alternative 4A could be adverse because flows in the Feather and American Rivers (depending on scenario – H3_ELT or H4_ELT) would be reduced substantially and persistently and could cause biologically meaningful effects to fall-run Chinook salmon adult migration. There are no substantial upstream flow changes in other rivers evaluated and no water temperature-related effects in any river for which temperature modeling is available. However, with implementation of Mitigation Measure AQUA-78d, this impact would not be adverse.

As described for winter-run and spring-run Chinook salmon, near-field effects of Alternative 4A NDD on fall- and late fall-run Chinook salmon related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating fall- and late fall-run Chinook salmon, although there is high uncertainty regarding the overall effects. Estimates within the effects analysis range from very low levels of effects (<1% mortality) to more significant effects (~ 13% mortality above current baseline levels). Environmental Commitment 15 would be implemented with the intent of providing localized and temporary reductions in predation pressure at the NDD. Additionally, several pre-construction surveys to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Similarly, Alternative 4A also includes investigations to better understand factors affecting juvenile through-Delta migration (as described in the adaptive management and monitoring program in Section 4.1) and includes biologically based triggers for real time operations. However, at this time, due to the absence of comparable facilities anywhere in the lower Sacramento River/Delta, the degree of predation-related mortality expected from near-field effects at the NDD remains highly uncertain.

As noted for Alternative 4, two recent studies (Newman 2003 and Perry 2010) indicate that far-field effects associated with the new intakes could cause a reduction in smolt survival in the Sacramento River downstream of the NDD intakes due to reduced flows in this area. The analyses of other elements of Alternative 4A related to reduced interior Delta entry (Environmental Commitment 16) and reduced south Delta entrainment suggest that these could counter the far-field effects of reduced flow (see, for example, Table 5.C.5.3-46 in the *BDCP Effects Analysis Appendix 5.C hereby incorporated by reference*). The overall magnitude of each of these factors and how they might interact and/or offset each other in affecting salmonid survival through the plan area is uncertain, and the adaptive management and monitoring program will investigate these outcomes.

As described for Alternative 4 and as discussed for winter-run and spring-run Chinook salmon above, the DPM is a flow-based model incorporating flow-survival and junction routing relationships with flow modeling of Alternative 4a operations to estimate relative differences between scenarios in smolt migration survival throughout the entire Delta. The DPM predicted that smolt migration survival under Alternative 4A would be similar or slightly lower than survival estimated for NAA_ELT, based on operations assuming no adjustments made in real-time in response to actual presence of fish. Although refinements to the DPM are likely to occur based on new data available from future studies and the current analysis has some uncertainty, the DPM analysis of Alternative 4A on juvenile fall-/late fall-run Chinook salmon migration suggests a potential adverse effect of small magnitude. As noted for winter-run Chinook salmon, the DPM focuses on smolt-sized individuals (70 mm or more) and is not based on survival data for fry-sized individuals, which also may be migrating and could be affected by Alternative 4A operations. There are no fry through-Delta survival data to inform the effects to these individuals in relation to operations and it is uncertain whether the relative difference between scenarios estimated from the DPM for smolt-sized fish would be representative of relative differences for fry. The potential adverse effect on fall-run and late-fall run Chinook salmon would be minimized through the inclusion within Alternative 4A of specific important Environmental Commitments. These include *Environmental Commitment 6 Channel Margin Enhancement* to offset loss of channel margin habitat to the NDD footprint and far-field (water level) effects; *Environmental Commitment 15 Localized Reduction of Predatory Fishes* to limit predation potential at the NDD; and *Environmental Commitment 16 Nonphysical Fish Barriers* to reduce entry of Chinook salmon juveniles into the low-survival interior Delta.

Overall, with implementation of Mitigation Measure AQUA-78d to address upstream flow reductions, the effects on fall-/late-fall run Chinook migration are not adverse in the ELT.

The effect of Alternative 4A in the LLT on fall-/late-fall run Chinook upstream migration conditions would be not adverse. Instream flows in the Sacramento, Feather, and American Rivers during late summer and fall months would decline from ELT to LLT such that flows would be substantially reduced under Alternative 4A relative to the NEPA baseline in the LLT, compared to the ELT comparison. Similar to ELT, implementation of Mitigation Measure AQUA-78d will reduce the magnitude of this effect.

CEQA Conclusion: With implementation of Mitigation Measure AQUA-78d, the impact of Alternative 4A on migration conditions for fall-/late fall–run Chinook salmon relative to Existing Conditions would be less than significant.

Upstream of the Delta

H3_ELT /ESO_ELT

Sacramento River

Fall-Run

Flows in the Sacramento River upstream of Red Bluff were examined for juvenile fall-run migrants during February through May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under Existing Conditions.

Mean water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month throughout the period.

Flows in the Sacramento River upstream of Red Bluff were examined during the adult fall-run Chinook salmon upstream migration period (August through December) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT during August and September would be up to 22% lower (September of dry years) and up to 32% higher (September of above normal years) than those under Existing Conditions. Mean flows would be up to 17% lower under H3_ELT during October and November, would be similar during December. The flow reductions in three of five migration months would constitute a substantial impact to fall-run Chinook salmon migration conditions.

Mean water temperatures in the Sacramento River at Red Bluff were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month throughout the period.

Late Fall-Run

Mean flows in the Sacramento River upstream of Red Bluff for juvenile late fall-run migrants (January through March) under H3_ELT would be similar to flows under Existing Conditions, with minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month throughout the period. Mean flows in the Sacramento River upstream of Red Bluff during the adult late fall-run Chinook salmon upstream migration period (December through February) under H3_ELT would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month throughout the period.

Clear Creek

Fall-Run

Flows in Clear Creek below Whiskeytown Reservoir were examined during the juvenile fall-run Chinook salmon upstream migration period (February through May). Mean flows under H3_ELT would generally be similar to or slightly greater than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean flows in Clear Creek below Whiskeytown Reservoir during the adult fall-run Chinook salmon upstream migration period (August through December) under H3_ELT would generally be similar to those under Existing Conditions, except for September of critical years (19% lower under H3_ELT) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Water temperature modeling was not conducted in Clear Creek

Feather River

Fall-Run

Mean flows in the Feather River at the confluence with the Sacramento River during the fall-run juvenile migration period (February through May) under H3_ELT would generally be similar to or lower than flows under Existing Conditions (up to 15% lower for March of below normal years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H3_ELT in any month throughout the period.

Flows in the Feather River at the confluence with the Sacramento River were examined during the August through December fall-run Chinook salmon adult migration period. Mean flows under H3_ELT during August and September would be up to 100% greater (September of wet years) and up to 43% lower (August of dry years) than flows under Existing Conditions. Mean flows under H3_ELT during October through December would be similar to or up to 21% greater (dry years) than those under Existing Conditions, except for 19% lower flow in December of critical years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Feather River at the confluence with the Sacramento River were examined during the August through December fall-run Chinook salmon adult upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in any month throughout the period.

American River

Fall-Run

Flows in the American River at the confluence with the Sacramento River were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be up to 15% greater than flows under Existing Conditions during February and March, and similar during April, and up to 18% lower than flows under Existing Conditions during January and May, depending on water year type.

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in any month throughout the period.

Flows in the American River at the confluence with the Sacramento River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT during August, September, and November would be consistently lower than flows under Existing Conditions, ranging from 10% lower to 52% lower. Mean flows under H3_ELT during October and December would be up to 11% lower and up to 15% higher than flows under Existing Conditions, depending on water year type, but mean reductions across water year types would be small (-2% and 4%, respectively).

Mean water temperatures in the American River at the confluence with the Sacramento River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). Mean water temperatures under H3_ELT would be 5% higher than those under Existing Conditions during August of dry years and 5% to 6% higher during October, except in critical water years. There would there would be no differences (<5%) during the other three months of the period.

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT throughout this period would generally be lower than Existing Conditions for all water year types (up to 29% lower for February of critical years), except for wet water years, in which flows would be similar or up to 17% greater (February) than flows under Existing Conditions.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in any month throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to flows under Existing Conditions for all months and water year types of the period.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H3 in either month or any water year type of the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to flows under Existing Conditions with few exceptions (up to 12% lower).

Flows in the San Joaquin River at Vernalis were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be lower than those under Existing Conditions during August and September (up to 14%), but similar to flows under Existing Conditions during the remaining three months.

Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to those under Existing Conditions during March through May, and would be up to 15% higher than flows under Existing Conditions during February.

Flows in the Mokelumne River at the Delta were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be up to 32% lower than flows under Existing Conditions during August and September, and up to 28% greater than flows under Existing Conditions during December. Flows during October and November would be largely similar between H3_ELT and Existing Conditions.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT /HOS_ELT

Sacramento River

Fall-Run

Mean monthly flows and water temperatures in the Sacramento River at Red Bluff were examined during the February through May juvenile fall-run Chinook salmon migration period. Mean flows under H4_ELT would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean monthly water temperature between Existing Conditions and H4_ELT in any month throughout the period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Flows and water temperatures in the Sacramento River at Red Bluff were examined during the August through December adult fall-run Chinook salmon upstream migration period. Mean flows during September under H4_ELT would be up to 49% greater (above normal years) and up to 18% lower (dry years) than flows under Existing Conditions, but flows during the other four months of the period would generally be similar (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean water temperatures under H4_ELT would not be different (<5%) from those under Existing Conditions(Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Late Fall-Run

Mean flows and water temperatures in the Sacramento River at Red Bluff were examined during the January through March juvenile late fall-run Chinook salmon emigration period. Mean flows under H4_ELT would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in water temperature between Existing Conditions and H4_ELT in any month or water year type. (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Mean flows and water temperatures in the Sacramento River at Red Bluff were examined during the December through February adult late fall-run Chinook salmon migration period. Mean flows under H4_ELT would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H4_ELT in either month of the period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Clear Creek

Fall-Run

Mean flows in the Clear Creek below Whiskeytown Reservoir during February through May under H4_ELT would generally be similar to or up to 13% greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Clear Creek below Whiskeytown Reservoir during August through December under H4_ELT would generally be similar to flows under Existing Conditions.

Water temperature modeling was not conducted in Clear Creek.

Feather River

Fall-Run

Flows and water temperatures in the Feather River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period. Mean flows under H4_ELT would generally be similar to flows under Existing Conditions during February and March, but would be up to 112% greater during April and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H4_ELT in any month throughout the period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Flows and water temperatures in the Feather River at the confluence with the Sacramento River were examined during the August through December fall-run Chinook salmon adult upstream migration period. Mean flows under H4_ELT during August and September would be from 51% lower (August of dry years) to 87% higher (September of wet years) than flows under Existing Conditions, and from 26% lower to 19% higher than flows under Existing Conditions during October through December (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The prevalence of reduced flows across months and water year types suggests that this would be an adverse effect to fall-run Chinook salmon migration conditions.

Mean water temperatures under H4_ELT would be no different from (<5%) those under Existing Conditions during both months and all water year types (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

American River

Fall-Run

Flows and water temperatures in the American River at the confluence with the Sacramento River were examined during the February through May juvenile fall-run Chinook salmon migration period. Mean flows under H4_ELT would generally be similar to or higher than flows under Existing Conditions during February (up to 14% higher for above normal years), and similar to or lower than flows under Existing Conditions during March through May (up to 20% lower for May of above normal years) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H4_ELT in any month throughout the period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Flows and water temperatures in the American River at the confluence with the Sacramento River were examined during the August through December adult fall-run Chinook salmon upstream migration period. Mean flows under H4_ELT during August, September, and November would be lower than those under Existing Conditions for almost all water year types, ranging from 7% lower in November of above normal years to 47% lower in September of critical years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows during October and December would generally be similar to or greater than those under Existing Conditions. Mean water temperatures under H4_ELT would be 5% to 6% higher during October than those under Existing Conditions and would be similar during the remainder of the migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

Stanislaus River

Fall-Run

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT throughout this period would generally be lower than Existing Conditions (up to 29% lower for February of critical years), except in wet years, in which flows would be similar or up to 17% greater (February) than flows under Existing Conditions.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the February through May juvenile fall-run Chinook salmon migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H4_ELT in any month throughout the period.

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to flows under Existing Conditions throughout the migration period.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). There would be no differences (<5%) in mean water temperature between Existing Conditions and H4_ELT in either month of the period.

San Joaquin River

Fall-Run

Flows in the San Joaquin River at Vernalis were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to flows under Existing Conditions for all months with some exceptions (up to 12% lower).

Flows in the San Joaquin River at Vernalis were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4_ELT would be over than those under Existing Conditions during August and September (up to 14%), but similar to flows under Existing Conditions during the remaining three months. Water temperature modeling was not conducted in the San Joaquin River.

Mokelumne River

Fall-Run

Flows in the Mokelumne River at the Delta were examined during the February through May juvenile Chinook salmon fall-run migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to or up to 15% higher than those under Existing Conditions during February, generally similar during March and April, and up to 11% lower than flows under Existing Conditions during May.

Flows in the Mokelumne River at the Delta were examined during the August through December adult fall-run Chinook salmon upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be up to 32% lower than flows under Existing Conditions during August and September, and up to 28% greater than flows under Existing Conditions during December. Flows during October and November would be largely similar between H4_ELT and Existing Conditions.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Fall-Run

Juveniles

As described above, Scenario H3_ELT operations would reduce overall OMR reverse flows and reduce Sacramento River flows below the north Delta diversions (Appendix B, Supplemental Modeling for Alternative 4A). Based on the DPM, survival of Sacramento River fall-run Chinook salmon juveniles under Scenario H3_ELT averaged for all years was less than Existing Conditions, was similar in drier years, and was moderately reduced by about 4% (a 12% relative difference) in wetter years (Table 11-4A-74). Under Scenario H4_ELT average survival was similar (~1% or less relative decrease) to Existing Conditions for all years, drier years, and wetter years. These results do not account for adjustments that would be made during real-time operations to further protect migrating fish, based on biological and hydrological triggers developed by NMFS and DFW.

Adults

The percentage of Sacramento River origin flow at Collinsville, would be slightly increased (5% or less in September to December) under Scenario H3_ELT compared to Existing Conditions (Table 11-4A-75). This would not significantly affect olfactory cues for adults migrating to the Sacramento River because the change is less than 10%.

Late Fall-Run

Juveniles

As described above, Alternative 4A operations would reduce OMR reverse flows and reduce Sacramento River flows below the north Delta diversions (Appendix B, Supplemental Modeling for Alternative 4A). Conditions under Scenario H4_ELT would further improve OMR flow conditions relative to the Scenario H3_ELT. As estimated by DPM, through-Delta survival by emigrating juvenile late fall-run Chinook salmon under Scenario H3_ELT averaged across all years was similar (around 2% relative difference) to Existing Conditions (Table 11-4A-76). Survival was marginally greater in drier years (0.7% increase, a 3.5% relative difference) but reduced in wetter years (2.4%, an 8% relative difference). The results for H4_ELT were very similar to those for H3_ELT because the late fall-run migration period lies outside the spring period when H4_ELT and H3_ELT operations differ (higher outflow under H4_ELT). As noted for fall-run Chinook salmon from the Sacramento River (described above), the DPM results do not account for adjustments that would be made during real-time operations to further protect migrating fish, based on biological and hydrological triggers developed by NMFS and DFW.

Adults

As described above, the percentage of Sacramento River water would be slightly reduced in December and March (1% to 9% less) compared to NAA_ELT (Table 11-4A-75). This effect would be less in March under Scenario H4_ELT compared to Scenario H3_ELT due to reduced north Delta exports. Olfactory cues would be slightly decreased, but the impact would be minor because flow changes are than 10% for the bulk of the late fall-run migration.

Mokelumne River

Fall-Run

Average through-Delta survival of emigrating juveniles estimated by DPM under Scenario H3_ELT was similar to Existing Conditions for all years and drier years (less than 2% relative difference), whereas average survival in wetter years was slightly greater than Existing Conditions (1% absolute difference in survival, 5.6% relative difference) (Table 11-4A-74). Average through-Delta survival under Scenario H4_ELT was similar to Existing Conditions in drier years, but was slightly greater than Existing Conditions when averaged over all years (5.6% relative difference) and was moderately greater than Existing Conditions in wetter years (nearly 12% relative difference). This reflected the inclusion of higher outflow in wetter years under H4_ELT compared to H3_ELT.

San Joaquin River

Fall-Run

Juveniles

Under Alternative 4A (operation Scenarios H3_ELT and H4_ELT), mean survival of juveniles migrating from the San Joaquin River averaged around 13% (Table 11-4A-74). Alternative 4A survival under both was similar (less than 5% relative difference) to Existing Conditions when averaged over all years. Survival was slightly greater than Existing Conditions in drier years (0.8–1% greater survival, or 7.5–10% more in relative difference) and moderately reduced in wetter years (2.5–2.7% decrease, or 13-14% less in relative difference). As described for the NEPA analysis above and described further in *BDCP Appendix 5.C, Section 5C.5.3.4.5 hereby incorporated by reference*, these results are driven by appreciably lower through-Delta survival of San Joaquin River fall-run Chinook salmon under Alternative 4A scenarios relative to Existing Conditions in very wet years (1982/1983) during which the Head of Old River operable gate would not be closed and south Delta exports would be very low, resulting in estimated survival that is relatively low because of the DPM's positive relationship between survival and exports. There is considerable uncertainty in effects on San Joaquin River Chinook salmon survival at such low levels of exports because the studies upon which the DPM flow- and export-survival relationships are based did not include these low levels of exports. As noted in the NEPA analysis above, SalSim, a recently completed San Joaquin River watershed Chinook salmon analysis tool that includes juvenile survival through the Delta derived in a different manner than DPM, includes a positive relationship between probability of juvenile survival and flow in the mainstem San Joaquin River at Stockton Deepwater Ship Channel; this flow term is positively related to flow at Vernalis, inversely related to south Delta exports, and positively related to Head of Old River barrier operation; the results of SalSim modeling therefore would be expected to illustrate a benefit of Alternative 4A across any modeled year, which is more in keeping with the anticipated effect of the alternative.

Adults

As described above, the percentage of San Joaquin River water at Collinsville is very small (less than 1% under Existing Conditions) during the fall-run migration period (September to December). Under Scenario H3_ELT operations, this would increase by 1.4–4.8% in September-December (Table 11-4A-75). Olfactory cues for adults migrating to the San Joaquin River would be slightly increased under all flow scenarios for Alternative 4A.

Summary of CEQA Conclusion

These modeling results indicate that the difference between Existing Conditions and Alternative 4A could be significant because the alternative could substantially reduce migration conditions for fall-/late fall-run Chinook salmon upstream of the Delta. Under Alternative 4A, instream flows would be lower in multiple upstream rivers during the fall-run Chinook salmon migration period relative to Existing Conditions, depending on scenario (H3_ELT or H4_ELT). Degraded migration habitat conditions would delay or eliminate successful migration necessary to complete the fall-run Chinook salmon life cycle. However, the impact of Alternative 4A across the operational range (Scenarios H3_ELT and H4_ELT) on through-Delta migration conditions would be small due to generally similar juvenile survival and a minor effect on olfactory cues for adults.

This interpretation of the biological modeling is likely attributable to different modeling assumptions for four factors: sea level rise, climate change, future water demands, and implementation of the alternative. As discussed in Section 11.3.3, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to vary between one another under the same impact discussion. The baseline for the CEQA analysis is Existing Conditions at the time the NOP was prepared. Both the action alternative and the NEPA baseline (NAA) models anticipated future conditions that would occur at 2025 (ELT implementation period), including the projected effects of climate change (precipitation patterns), sea level rise and future water demands, as well as implementation of required actions under the 2008 USFWS BiOp and the 2009 NMFS BiOp. Because the action alternative modeling does not partition the effects of implementation of the alternative from the effects of sea level rise, climate change, and future water demands, the comparison to Existing Conditions may not offer a clear understanding of the impact of the alternative on the environment. This suggests that the comparison in results between the alternative and NAA, is a better approach because it isolates the effect of the alternative from those of sea level rise, climate change, and future water demands.

This impact would still be considered significant in the ELT due to changes in upstream flows. However, when informed by the NEPA analysis above, and with the implementation of Mitigation Measure AQUA-78d, this impact would be less than significant to fall-/late fall-run Chinook salmon.

As noted for winter-run and spring-run Chinook salmon and described in the adaptive management and monitoring program in Section 4.1, several pre-construction studies to better understand how to minimize losses associated with the three new intake structures will be implemented as part of the final NDD screen design effort. Similarly, Alternative 4A also includes investigations to better understand factors affecting juvenile through-Delta migration (as described in the adaptive management and monitoring program in Section 4.1) and includes biologically based triggers for real time operations. Also, with the inclusion of *Environmental Commitment 6 Channel Margin Enhancement*, *Environmental Commitment 15 Localized Reduction of Predatory Fishes*, and *Environmental Commitment 16 Nonphysical Barriers*, the impacts would be minimized.

Given that Mitigation Measure AQUA-78d reduces this impact to less than significant for fall-run Chinook, the impact on the fall-run Chinook salmon commercial fishery also would be less than significant in the ELT.

Mitigation Measure AQUA-78d: Slightly adjust the timing and magnitude of Shasta, Folsom, and/or Oroville Reservoir releases, within all existing regulations and requirements, to ameliorate changes in instream flows that would cause an adverse effect to fall-run Chinook salmon.

Whenever possible during real-time operations, project proponents will slightly adjust Shasta, Folsom and/or Oroville Reservoir operations to ensure that instream flows are sufficient to minimize or avoid migration-related effects to fall-run Chinook salmon. Based on the timing of the modeled flow fluctuations, it is expected that adjustments to minimize drastic changes in releases during operations among various months in which there are increases and decreases in flow, will minimize or avoid substantial reductions in flow without effects on existing applicable regulations or operations.

Fall-/late fall-run Chinook salmon migration conditions in the Sacramento, Feather, and American rivers, would substantially decline from ELT to LLT. However, when informed by the NEPA analysis above, implementation of Mitigation Measure AQUA-78d will reduce the magnitude of this effect to less than adverse. The commercial fishery effect of Alternative 4 in the LLT would be less than significant in the LLT.

Restoration Measures (Environmental Commitment 4, Environmental Commitment 6, Environmental Commitment 7, and Environmental Commitment 10)

As described for winter-run Chinook salmon, Alternative 4A includes a greatly reduced extent of restoration measures relative to Alternative 4 and Alternative 1A, upon which the discussion of impacts for Alternative 4 is based. The general discussion of impacts to winter-run Chinook salmon (Impacts AQUA-43, AQUA-44, and AQUA-45) also applies to fall-/late fall-run Chinook salmon, which would have the potential to overlap the effects of restoration measures both temporally and spatially.

Impact AQUA-79: Effects of Construction of Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-43) is also applicable to fall-run/late fall-run Chinook salmon.

NEPA Effects: For the reasons described under Impact AQUA-43, the effects of short-term construction activities would not be adverse to fall-run/late fall-run Chinook salmon.

CEQA Conclusion: As discussed for winter-run Chinook salmon, the potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce fall-run/late fall-run Chinook salmon habitat, restrict its range, or interfere with its movement. No additional mitigation would be required.

Impact AQUA-80: Effects of Contaminants Associated with Restoration Measures on Chinook Salmon (Fall-/Late Fall–Run ESU)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-44) is also applicable to fall-run/late fall-run Chinook salmon.

NEPA Effects: As noted for winter-run Chinook salmon, the effect of restoration measures on chemical contaminants is not adverse to fall-run/late fall-run with respect to selenium, copper, ammonia, pesticides, and methylmercury (with implementation of Environmental Commitment 12).

CEQA Conclusion: As noted for winter-run Chinook salmon, the impact of contaminants is considered less than significant because it would not substantially affect fall-run/late fall-run Chinook salmon either directly or through habitat modifications. Consequently, no mitigation would be required.

Impact AQUA-81: Effects of Restored Habitat Conditions on Chinook Salmon (Fall-/Late Fall–Run ESU)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-45) is also applicable to fall-run/late fall-run Chinook salmon.

NEPA Effects: The effects of restored habitat conditions on fall-run/late fall-run Chinook salmon would not be adverse because effects would be avoided by limiting the frequency, duration, and spatial extent of in-water work and implementing the commitments described in detail under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*.

CEQA Conclusion: As described for winter-run Chinook salmon, habitat restoration activities could result in short-term effects on fall-run/late fall-run Chinook salmon, primarily as a result of increased potential for contaminated sediments to enter the water column. However, these effects are likely to be localized, sporadic, and of low magnitude. Adverse effects during restoration would be avoided by limiting the frequency, duration, and spatial extent of in-water work and implementing the commitments described in detail under Impact AQUA-1 and in Appendix 3B, *Environmental Commitments*. The potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce fall-run/late fall-run Chinook salmon habitat, restrict its range or interfere with its movement. Additionally, there would be substantial long-term net benefits of habitat restoration. Consequently, no additional mitigation would be required.

Other Environmental Commitments (Environmental Commitment 12, Environmental Commitment 15, and Environmental Commitment 16)

As noted for winter-run Chinook salmon, Alternative 4A includes three other Environmental Commitments, which are reduced in their extent relative to the Conservation Measures included in other Alternatives (e.g., Alternative 1A and Alternative 4). While the extent of these measures is reduced compared to these alternatives, the nature of the mechanisms remains the same. The general discussion of impacts to winter-run Chinook salmon (Impacts AQUA-46, AQUA-49, and AQUA-50) also applies to fall-run/late fall-run Chinook salmon.

Impact AQUA-82: Effects of Methylmercury Management on Chinook Salmon (Fall-/Late Fall–Run ESU) (Environmental Commitment 12)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-46) is also applicable to fall-run/late fall-run Chinook salmon.

NEPA Effects: The effects of methylmercury management on fall-run/late fall-run Chinook salmon would not be adverse because it is expected to reduce overall methylmercury levels resulting from habitat restoration.

CEQA Conclusion: As noted for winter-run Chinook salmon, effects of Environmental Commitment 12 Methylmercury Management within the areas restored under Alternative 4A are expected to reduce overall methylmercury levels resulting from habitat restoration. Because it is designed to improve water quality and habitat conditions, impacts would be less than significant. Consequently, no mitigation is required.

Impact AQUA-85: Effects of Localized Reduction of Predatory Fish on Chinook Salmon (Fall-/Late Fall–Run ESU) (Environmental Commitment 15)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-49) is also applicable to fall-run/late fall-run Chinook salmon.

NEPA Effects: Environmental Commitment 15 would not have an adverse effect on Chinook salmon and could potentially benefit the species. As noted for winter-run Chinook salmon, due to the uncertainty in the effectiveness of Environmental Commitment 15, there would be no demonstrable effect of this conservation measure on fall-run/late fall-run Chinook salmon.

CEQA Conclusion: Due to the uncertainties associated with this Environmental Commitment, there would be no demonstrable effect on fall-run/late fall-run Chinook salmon. Thus, the impact would be less than significant. Consequently, no mitigation would be required.

Impact AQUA-86: Effects of Nonphysical Fish Barriers on Chinook Salmon (Fall-/Late Fall–Run ESU) (Environmental Commitment 16)

As noted above, the impact discussion for winter-run Chinook salmon (Impact AQUA-50) is also applicable to fall-/late fall–run Chinook salmon. In addition, fall-run Chinook salmon from the San Joaquin River watershed would be unlikely to encounter the nonphysical barrier at the divergence of Georgiana Slough from the Sacramento River.

NEPA Effects: The effects of NPBs would not be adverse, because it is expected to improve Chinook salmon migration conditions.

CEQA Conclusion: As concluded for winter-run Chinook salmon, the impacts of *Environmental Commitment 16 Nonphysical Fish Barriers* are expected to be less than significant because it is expected to improve Chinook salmon migration conditions. Consequently, no mitigation would be required.