Steelhead

Construction and Maintenance of Water Conveyance Facilities

The discussion of potential effects to delta smelt from construction and maintenance of the water conveyance facilities under Alternative 4A is also relevant to steelhead. Adult and juvenile steelhead would have the potential to overlap construction and maintenance to a minor degree (Table 11-8).

Impact AQUA-91: Effects of Construction of Water Conveyance Facilities on Steelhead

The potential effects of construction of the water conveyance facilities on steelhead would be the same as described for Alternative 4 (Impact AQUA-91). This section provides additional detail on underwater noise impacts which are also applicable to Impact AQUA-91 in Alternative 4.

Table 11-8 presents the life stages of CCV steelhead and the months of their potential presence in the north, east, and south Delta during the proposed in-water construction period (June 1–October 31). Steelhead eggs and fry would not be exposed to underwater noise from pile driving activities because the proposed construction activities are located in areas that are downstream from the principal spawning and early rearing areas.

Under Alternative 4A, adult steelhead could be exposed to pile driving sound during their migrations past the construction sites of the proposed intakes, barge unloading facilities, and Head of Old River. Based on historical migration timing, migrating adults may be present in the Delta and lower Sacramento and San Joaquin Rivers during their upstream migration from August through November and during their downstream migration as kelts (post-spawn adults) from February through May (Hallock 1961, Busby et al. 1996). Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows, with peaks in abundance in the spring (March through June) and fall (October through November) (McEwan 2001, Nobriga and Cadrett 2001).

Similar to Chinook salmon, the risk of injury or mortality of adult steelhead from pile driving noise is low because of their large size, high mobility, and rapid migration rates through the Delta and lower rivers. The risk of exposure to harmful levels of underwater noise and/or delays in migration is further reduced by the intermittent nature of pile driving activities, the daily cessation of pile driving at night, and the implementation of vibratory driving or other no-impact pile driving methods whenever feasible. Based on the general timing of steelhead outmigration through the Delta, exposure of juvenile steelhead to pile driving noise will be substantially minimized by the restriction of in-water pile driving period to June 1 through October 31. Most steelhead potentially encountering pile driving noise are large, yearling and older smolts (> 10 grams) that are expected to migrate rapidly through the Delta based on recent telemetry studies using tagged hatchery juveniles (DeLaney et al. 2014). As discussed for Chinook salmon, the restriction of pile driving to daylight hours would also reduce the exposure of juvenile steelhead to pile driving noise because of the general tendency for salmonids to migrate at night. However, pile driving noise could have indirect effects on survival by disrupting feeding, resting, and sheltering behavior of individuals that are within the range of noise levels associated with behavioral effects.

Based on the foregoing analysis, the potential exists for some injury and mortality of juvenile steelhead from pile driving noise but only a small proportion of the population is at risk based on the low degree of overlap of pile driving activities with outmigration timing, and the relatively large size and mobility of juveniles that may encounter pile driving noise (migrating smolts). Implementation of Mitigation Measures AQUA-1a and AQUA-1b will further reduce this risk.

NEPA Effects: As concluded for Alternative 4, Impact AQUA-91, the effect would not be adverse for steelhead. Implementation of the measures described in Appendix 3B, *Environmental Commitments*, such as *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan* would guide rapid and effective response in the case of inadvertent spills of hazardous materials. This species' natural tolerance to turbidity, would likely avoid the risk of any adverse turbidity effects resulting from project construction. Construction would not be expected to increase predation rates relative to baseline conditions. Construction will result in both temporary and permanent alteration of rearing and migratory habitats used by steelhead. However, Alternative 4A includes Environmental Commitment 4 to restore tidal habitat and Environmental Commitment 6 to restore channel margin habitat. The direct effects of underwater construction noise on steelhead that may be present could be adverse if steelhead are exposed. However, implementation of Mitigation Measures AQUA-1a and AQUA-1b, combined with the in-water work window that would minimize exposure, would reduce the potential for effects from underwater noise and this effect would not be adverse.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-91, the impact of the construction of water conveyance facilities on steelhead would not be significant except for construction noise associated with pile driving. Construction of Alternative 4A involves several elements with the potential to affect steelhead. However, these turbidity and hazardous material spill effects will be effectively avoided and/or minimized through implementation of environmental commitments (see Impact AQUA-1 and Appendix 3B, *Environmental Commitments*: *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan*). 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-92: Effects of Maintenance of Water Conveyance Facilities on Steelhead

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 steelhead. 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 steelhead 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 water conveyance facilities under Alternative 4A would be the same as those described for Alternative 4, Impact AQUA-92. As concluded in Impact AQUA-92, the impact would not be adverse for steelhead.

CEQA Conclusion: As described in Alternative 4, Impact AQUA-92, the impact of the maintenance of water conveyance facilities on steelhead would be less than significant and no mitigation is required. Once constructed, Alternative 4A structures and facilities will require ongoing periodic maintenance that includes in-water work activities with the potential to affect steelhead. 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 steelhead from maintenance activities would be avoided and minimized through the same methods and rationale described for Impact AQUA-1.

Operations of Water Conveyance Facilities

Impact AQUA-93: Effects of Water Operations on Entrainment of Steelhead

Water Exports from SWP/CVP South Delta Facilities

Under Alternative 4A, entrainment loss at the south Delta export facilities, as estimated by the salvage density method, would be reduced by about 52% (~4,800 fish; Table 11-4A-77) across all years compared to NAA_ELT. Losses under Scenario H3_ELT would be greatest in below normal (~7,300 fish) and lowest in wet water years (~2,100 fish). Conditions under Scenario H4_ELT would further reduce entrainment loss at the south Delta facilities due to decreased exports.

Table 11-4A-77. Juvenile Steelhead Annual Entrainment Index at the SWP and CVP Salvage Facilities—Differences between Model Scenarios for Alternative 4A (Scenario H3_ELT)

	Absolute Difference (Percent Difference)	
Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	-4,143 (-66%)	-4,443 (-68%)
Above Normal	-7,358 (-57%)	-7,752 (-58%)
Below Normal	-4,529 (-38%)	-4,674 (-39%)
Dry	-1,750 (-23%)	-1,517 (-21%)
Critical	-1,007 (-17%)	-917 (-16%)
All Years	-4,620 (-51%)	-4,810 (-52%)

Shading indicates 10% or greater increased entrainment.

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

Water Exports from SWP/CVP North Delta Intake Facilities

The impact would be similar in type to Alternative 1A, Impact AQUA-93, but the degree would be less because Alternative 4A would have fewer intakes, therefore, under Alternative 4A there would be about a 40% reduction in impingement and predation risk relative to Alternative 1A.

Predation Associated with Entrainment

Entrainment-related predation loss at the south Delta facilities would be no greater and may be lower than baseline (NAA_ELT), due to a reduction in entrainment. Conditions under Scenario H4_ELT would further reduce entrainment-related predation loss compared to Scenario H3_ELT.

Predation at the north Delta would be increased due to the construction of the proposed SWP/CVP water export facilities on the Sacramento River. It is assumed that per capita steelhead predation losses would be similar to those predicted for spring-run Chinook salmon, although slightly reduced because of the larger size of steelhead outmigrants. Bioenergetics modeling with a median predator density of 0.12 predators per foot (0.39 predators per meter) of intake predicts a predation loss of about 0.2% of the juvenile spring-run juvenile population (Table 11-4A-30).

NEPA Effects: In conclusion, operations under Alternative 4A under both flow scenarios (H3_ELT and H4_ELT) would reduce entrainment at the south Delta facilities and minimize or avoid entrainment with screens at the north Delta intakes. Predation loss at the south Delta would be reduced and predation at the north Delta intakes would likely have a very minor impact on the overall steelhead population. The overall effect under Alternative 4A would not be adverse.

CEQA Conclusion: As described above, entrainment losses of juvenile steelhead would decrease under Alternative 4A (H3_ELT) compared to Existing Conditions at the south Delta export facilities (Table 11-4A-77). The screened intakes of the north Delta diversion, as designed, would exclude juvenile salmonids. The impact of predation associated with entrainment would be the same as described above as predation loss at the south Delta (no greater and possibly lower compared with Existing Conditions), but increased slightly at the north Delta intakes. There may be a minor increase in predation loss under Alternative 4A associated with the north Delta intakes, but this is uncertain and the population-level effect would likely be small. Entrainment loss under Scenario H4_ELT is expected to be less compared to Scenario H3_ELT. Overall, the impact would be less than significant and no mitigation is required.

Impact AQUA-94: Effects of Water Operations on Spawning and Egg Incubation Habitat for Steelhead

In general, Alternative 4A would have negligible effects on spawning and egg incubation habitat for steelhead relative to the NAA_ELT.

H3_ELT/ESO_ELT

Sacramento River

The primary steelhead spawning and egg incubation period extends from January through April. Results of the CALSIM analyses of instream flows within the reach where the majority of steelhead spawning occurs (Keswick Dam to upstream of RBDD) were summarized by month and water-year type based on estimated flows at Keswick and upstream of RBDD (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Mean flows under H3_ELT would generally be similar to those under NAA_ELT,. Overall results indicate negligible project-related effects on flow.

SacEFT predicts that there would be no effects between NAA_ELT and H3_ELT in spawning metrics including percentage of years with good spawning availability, measured as weighted usable area, redd scour risk, percentage of years with good (lower) egg incubation conditions, and redd dewatering risk (Table 11-4A-78). Results indicate negligible project-related effects on steelhead habitat metrics related to spawning and egg incubation in the Sacramento River.

Mean water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary steelhead 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 at either location. Based on negligible effects on mean flow, SacEFT metrics related to spawning and egg incubation, and water temperature conditions compared to NAA_ELT, project-related effects of H3_ELT on flow would not affect steelhead spawning conditions in the Sacramento River.

Table 11-4A-**78. Difference and Percent Difference in Percentage of Years with "Good" Conditions** for Steelhead Habitat Metrics in the Upper Sacramento River (from SacEFT)

Metric	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Spawning WUA	0 (0%)	0 (0%)
Redd Scour Risk	-3 (-4%)	0 (0%)
Egg Incubation	0 (0%)	0 (0%)
Redd Dewatering Risk	-1 (-2%)	0 (0%)
Juvenile Rearing WUA	1 (2%)	-3 (-7%)
Juvenile Stranding Risk	-9 (-26%)	-4 (-14%)

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

The primary spawning and egg incubation period for Clear Creek is January through April. Results of the CALSIM analyses of instream flows for the Clear Creek were summarized by month and water-year type for January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality.

Mean flows in Clear Creek during January through April under H3_ELT would be similar to those under NAA_ELT. Therefore, H3_ELT would have negligible effects on mean flows in Clear Creek for the primary steelhead spawning and egg incubation period of January to April.

Redd dewatering risk was evaluated for Clear Creek based on flow reductions for each month during the incubation period (January through April); results are summarized in Table 11-4A-79. The greatest monthly reduction in flows under H3_ELT would be no different than that under NAA_ELT.

No water temperature modeling was conducted in Clear Creek.

Based on mean monthly flows and flow reductions, there would be no effects of H3_ELT on steelhead spawning and egg incubation habitat conditions.

Table 11-4A-79. Comparisons of Greatest Monthly Reduction (Percent Change) in Instream Flow under Model Scenarios in Clear Creek during the January–April Steelhead Spawning and Egg Incubation Period[a]

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	-25 (-38%)	0 (0%)
Above Normal	0 (NA)	0 (NA)
Below Normal	0 (NA)	0 (NA)
Dry	0 (NA)	0 (NA)
Critical	0 (NA)	0 (NA)

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 the month 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

Steelhead spawning and egg incubation on the Feather River occurs primarily in Hatchery Ditch and the low-flow channel in the general vicinity of the Feather River Hatchery. Effects of H3_ELT on flow during the spawning and egg incubation period (January through April) in the Feather River were evaluated using the results of CALSIM analyses of instream flows within the reach where the majority of steelhead spawning occurs (low-flow channel) based on estimated flows above Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Although recent surveys have found that very few steelhead (0 to 28%) spawn in the high-flow channel, (J. Kindopp pers. comm.), flows were also evaluated in the high-flow channel based on information in the Feather River at Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality.

Mean flows in the Feather River high-flow channel during January through April under H3_ELT would generally be similar to flows under NAA_ELT, except for occasional increases (up to 30% higher) and decreases (up to 17% lower) that, due to their low magnitude and frequency, would not amount to a biologically meaningful effect to steelhead.

Instream flows affect physical habitat quality and availability through changes in wetted channel width, water depth, and water velocities. Results of IFIM studies (WUA versus flow relationships) provide information on the spawning habitat conditions in the low-flow channel. Results of CALSIM modeling show that instream flows in the Feather River low-flow channel were the same for NAA_ELT and H3_ELT regardless of month and water year type and range from 700 to 800 cfs under all conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, H3_ELT is not expected to affect physical habitat conditions for steelhead spawning and egg incubation within the Feather River low-flow channel.

Water temperatures in the low-flow channel of the Feather River are determined largely by cold water pool storage in Oroville Reservoir and instream flow releases. Because instream flows in the low-flow channel would be the same under H3_ELT and NAA_ELT, any simulated changes in water temperatures under H3_ELT would be attributed to changes in reservoir storage. Reservoir storage in May and September provides an indicator of cold water pool availability. Mean May Oroville storage volume under H3_ELT would be similar to storage under NAA_ELT in all water year types (Table 11-4A-45). September Oroville 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).

Effects of H3_ELT on water temperature-related spawning and egg incubation conditions for steelhead in the Feather River were analyzed by comparing the percent of months between January through April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold in the low-flow channel (above Thermalito Afterbay) (Table 11-4A-80). Differences in the percent of months exceeding the threshold between NAA_ELT and H3_ELT would be negligible (<5% on an absolute scale).

Table 11-4A-80. 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 above Thermalito Afterbay Exceed the 56°F Threshold, January through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H3_ELT					
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 (NA)	1 (NA)	1 (NA)	0 (NA)
April	12 (143%)	5 (100%)	4 (NA)	1 (NA)	0 (NA)
NAA_ELT vs. H3_ELT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-1 (-50%)	1 (NA)	1 (NA)	1 (NA)	0 (NA)
April	1 (6%)	-1 (-11%)	0 (0%)	0 (0%)	0 (NA)

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 steelhead in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 56°F NMFS threshold during the January through April steelhead spawning period for all 82 years (Table 11-4A-81). There would be no difference (<5% on an absolute scale) in total degree-months exceeded between NAA_ELT and H3_ELT for any month or water year type.

Table 11-4A-81. 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 above Thermalito Afterbay, January through April

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
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	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	3 (300%)	2 (100%)
	All	3 (300%)	2 (100%)
April	Wet	0 (NA)	0 (NA)
	Above Normal	2 (100%)	1 (33%)
	Below Normal	3 (75%)	0 (0%)
	Dry	6 (120%)	-1 (-8%)
	Critical	7 (NA)	0 (0%)
	All	18 (164%)	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.

Overall for the Feather River, these similarity of flows and water temperature results indicate that H3_ELT would not affect flow and water temperatures conditions for steelhead spawning in the Feather River.

American River

The primary steelhead spawning and egg incubation period for the American River extends from January through April. Results of the CALSIM analyses of instream flows within the lower American River at the confluence with the Sacramento River were summarized by month and water-year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation and rapid reductions in flow can dewater redds leading to mortality. Mean flows under H3_ELT would be similar to flows under NAA_ELT during all months and water year types, with few exceptions.

Mean water temperatures in the American River at the Watt Avenue Bridge were evaluated during the January through April steelhead 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 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). Steelhead spawn and eggs incubate in the American River between January and April. During this period, the percent of months exceeding the threshold under H3_ELT would similar to (absolute difference) 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-65). During the January through April steelhead spawning and egg incubation period, total degree-months would be similar between NAA_ELT and H3_ELT.

Based on mean monthly flows and water temperature effects, effects under H3_ELT in the American River would consist primarily of negligible effects (<5%) on mean monthly flows and water temperatures and would not have biologically meaningful effects on steelhead spawning and egg incubation conditions in the American River.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT throughout this period would be nearly identical to flows under NAA_ELT.

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

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT throughout this period would be the same as flows under NAA_ELT.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT/HOS_ELT

Sacramento River

Flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April under H4_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 Keswick and Red Bluff were examined during the January through April primary steelhead 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 at either location. Based on negligible effects on mean flow and water temperature conditions compared to NAA_ELT, project-related effects of H4_ELT on flow would not affect steelhead spawning conditions in the Sacramento River.

Clear Creek

Mean flows in the Clear Creek during January through April under H4_ELT would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature modeling was conducted in Clear Creek.

Feather River

Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through April under H4_ELT would be the same as flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Feather River below Thermalito Afterbay (high-flow channel) during January through April under H4_ELT would generally be similar to or up to 548% greater than flows under NAA_ELT, with mean flow in April for all water year types combined 87% greater under H4_ELT.

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

Differences in the percent of months exceeding the 56°F threshold in the Feather River at Gridley between NAA_ELT and H4_ELT would generally be negligible (<5% on an absolute scale) during January through March (Table 11-4A-69). The percent of months exceeding the threshold under H4_ELT during April would be up to 20% lower (absolute difference) than the percent under NAA_ELT. This represents a small benefit of H4_ELT to steelhead spawning habitat conditions in the Feather River.

Differences in the percent of months exceeding the 56°F threshold in the Feather River above Thermalito Afterbay between NAA_ELT and H4_ELT would be negligible during January through March (Table 11-4A-82). During April, the percent of months exceeding the threshold under H4_ELT would be similar to or up to 6% lower (absolute difference) than the percent under NAA_ELT. This represents a small benefit of H4_ELT to steelhead spawning habitat conditions in the Feather River.

Table 11-4A-82. 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 above Thermalito Afterbay Exceed the 56°F Threshold, January through April

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H4_ELT					
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 (NA)	0 (NA)	0 (NA)	0 (NA)
April	7 (86%)	0 (0%)	1 (NA)	1 (NA)	0 (NA)
NAA_ELT vs. H4_ELT					
January	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
February	0 (NA)	0 (NA)	0 (NA)	0 (NA)	0 (NA)
March	-1 (-50%)	1 (NA)	0 (NA)	0 (NA)	0 (NA)
April	-4 (-19%)	-6 (-56%)	-2 (-67%)	0 (0%)	0 (NA)

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 (all water year types combined) above the 56°F threshold in the Feather River at Gridley under H4_ELT would be the same as those under NAA_ELT during January and February (Table 11-4A-70). During March and April, degree-months under H4_ELT would be 4% and 41% lower, respectively. The reductions in degree-months during March under H4_ELT would be too small and infrequent to have a biologically meaningful effect on steelhead spawning habitat conditions in the Feather River, although the reductions during April would represent a moderate benefit to steelhead. Total degree-months above the 56°F threshold in the Feather River above Thermalito Afterbay under H4_ELT would be similar to those under NAA_ELT during January through April (Table 11-4A-83).

Table 11-4A-83. 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 above Thermalito Afterbay, January through April

Month	Water Year Type	EXISTING CONDITIONS vs. H4_ELT	NAA_ELT vs. H4_ELT
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	0 (NA)	0 (NA)
	Above Normal	0 (NA)	0 (NA)
	Below Normal	0 (NA)	0 (NA)
	Dry	0 (NA)	0 (NA)
	Critical	2 (200%)	1 (50%)
	All	2 (200%)	1 (50%)
April	Wet	0 (NA)	0 (NA)
	Above Normal	1 (50%)	0 (0%)
	Below Normal	0 (0%)	-3 (-43%)
	Dry	7 (140%)	0 (0%)
	Critical	8 (NA)	1 (14%)
	All	15 (136%)	-3 (-10%)

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

Mean flows in the American River at the confluence with the Sacramento River during January through April under H4_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 American River at the Watt Avenue Bridge were evaluated during the January through April steelhead 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 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). Steelhead spawn and eggs incubate in the American River between January and April. During January through April period, the percent of months exceeding the threshold under H4_ELT would be similar to or up to 9% 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). During the January through April steelhead spawning and egg incubation period, total degree-months would be similar between NAA_ELT and H4_ELT.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT throughout this period would be about the same as those under NAA_ELT.

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

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT throughout this period would be identical to flows under NAA_ELT.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these modeling results indicate that the effects of Alternative 4A on flow would not be adverse because they would not substantially reduce suitable spawning habitat or substantially reduce the number of fish as a result of egg development. There would be negligible effects on Alternative 4A on mean monthly flows, water temperatures, and reservoir storage in all rivers analyzed. Further, the SacEFT model predicts that there would be no effects to spawning and egg incubation habitat in the Sacramento River.

CEQA Conclusion: In general, Alternative 4A would degrade the quantity and quality of spawning and egg incubation habitat for steelhead 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 steelhead relative to the CEQA conclusion.

H3_ELT /ESO_ELT

Sacramento River

The primary steelhead spawning and egg incubation period extends from January through April. Results of the CALSIM analyses of instream flows within the reach where the majority of steelhead spawning occurs (Keswick Dam to upstream of RBDD) were summarized by month and water-year type based on estimated flows at RBDD (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality. Mean flows under H3_ELT would generally be similar to those under Existing Conditions, except for February, in which flows would be up to 14% higher, depending on the water year type.

SacEFT predicts little or no change in spawning habitat, egg incubation, redd dewatering risk, and redd scour risk for H3_ELT compared to Existing Conditions (Table 11-4A-78).

Mean water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary steelhead 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 at either location. Based on negligible effects on mean flow, SacEFT metrics related to spawning and egg incubation, and water temperature conditions compared to Existing Conditions, project-related effects of H3_ELT on flow would not affect steelhead spawning conditions in the Sacramento River.

Clear Creek

The primary spawning and egg incubation period for Clear Creek is January through April. Results of the CALSIM analyses of instream flows for the Clear Creek were summarized by month and water-year type for January through April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality.

Mean flows under H3_ELT would be similar to or greater than flows under Existing Conditions for all months, including 40% greater flow for January of wet years and 10% greater flow for all four months in critical water years. Increases in flow would have a beneficial effect on spawning conditions.

Redd dewatering risk was evaluated for Clear Creek based on flow reductions for each month during the incubation period (January through April); results are summarized in Table 11-4A-79. The greatest monthly reduction in flows under H3_ELT would be similar to that under Existing Conditions, except for a 25% increase (absolute difference) in the greatest monthly flow reduction in wet years under H3_ELT.

No water temperature modeling was conducted in Clear Creek.

Based on mean flows and increased maximum flow reductions only in wet years, there would be no effects of H3_ELT on steelhead spawning and egg incubation habitat conditions.

Feather River

Effects of H3_ELT on flow during the spawning and egg incubation period (January through April) in the Feather River were evaluated using the results of CALSIM analyses of instream flows within the reach where the majority of steelhead spawning occurs (low-flow channel) based on estimated flows above Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows in the high-flow channel were characterized based on information in the Feather River at Thermalito Afterbay (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation, and rapid reductions in flow can expose redds leading to mortality.

Results of CALSIM modeling show that instream flows in the Feather River low-flow channel were the same for Existing Conditions and H3_ELT regardless of month and water year type and range from 700 to 800 cfs under all conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Therefore, H3_ELT is not expected to affect physical habitat conditions for steelhead spawning and egg incubation within the Feather River low-flow channel.

Mean flows in the Feather River high-flow channel during under H3_ELT would generally be similar to or up to 48% lower than flows under Existing Conditions in January through March, with minor exceptions, and would be similar to or up to 29% greater in April. The reductions in flow would adversely affect spawning and egg incubation habitat.

Mean May Oroville storage volume under H3_ELT would generally be similar to storage under Existing Conditions in wet and above normal water year types and 5% to 12% lower in below normal, dry, and critical water year types (Table 11-4A-42). Mean September Oroville storage volume under H3_ELT would be 5% to 29% lower than volume under Existing Conditions in wet, above normal, below normal, and dry water years and would be similar in critical water years (Table 11-4A-33).

Mean water temperatures in the Feather River low-flow channel (above Thermalito Afterbay) and high-flow channel (below Thermalito Afterbay) were examined during the January through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, there would be no differences (<5%) in mean water temperatures between H3_ELT and Existing Conditions for all months and water year types throughout the period.

Effects of H3_ELT on water temperature-related spawning and egg incubation conditions for steelhead in the Feather River were analyzed by comparing the percent of months between January through April over the 82-year CALSIM modeling period that exceed a 56°F temperature threshold in the low-flow channel (above Thermalito Afterbay) (Table 11-4A-80). Differences in the percent of months exceeding the threshold between Existing Conditions and H3_ELT would be negligible (<5% on an absolute scale), except for a 12% increase (absolute difference) for the >1.0°F above the threshold in April.

The effects of H3_ELT on water temperature-related spawning and egg incubation conditions for steelhead in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 56°F NMFS threshold in the low-flow channel (above Thermalito Afterbay) during the January through April steelhead spawning period for all 82 years (Table 11-4A-81). There would be no difference (<5% on an absolute scale) for January through March in total degree-months exceeded between Existing Conditions and H3_ELT for any water year type, and an 18 degree-month increase (164% higher on a relative scale) in April for all water year types combined.

Overall, the effects of H3_ELT on flows in the Feather River below Thermalito Afterbay would include substantial decreases in mean flow during some months and water year types. There would be minor increases in the exceedance of water temperature thresholds in the low-flow channel during April, coupled with reductions in coldwater pool availability in the Oroville Reservoir, especially in September.

American River

The primary steelhead spawning and egg incubation period for the American River extends from January through April. Results of the CALSIM analyses of instream flows within the lower American River at the confluence with the Sacramento River were summarized by month and water-year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for spawning and egg incubation and rapid reductions in flow can dewater redds leading to mortality. Combining water year types, mean flows under H3_ELT would be higher than those under Existing Conditions during January and February and would be similar during March and April.

Mean water temperatures in the American River at the Watt Avenue Bridge were evaluated during the January through April steelhead 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 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). Steelhead spawn and eggs incubate in the American River between January and April. During January and February, the percent of month exceeding the threshold under Existing Conditions and H3 would be similar. During March and April, the percent of months exceeding the threshold under H3 would be up to 17% greater (absolute difference) than the percent under Existing Conditions.

Total degree-months (all water year types combined) exceeding 56°F were summed by month and water year type at the Watt Avenue Bridge during November through April (Table 11-4A-65). During January and February, there would be no difference in total degree-months above the threshold between Existing Conditions and H3_ELT. During March and April, total degree-months under H3_ELT would be 16 and 80 degree-months greater, respectively, than under Existing Conditions.

The effect of H3_ELT on mean flow and water temperature in the American River would be negligible although increased exceedances of the 56°F temperature threshold indicate a negative effect to steelhead spawning and egg incubation conditions.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT throughout this period would generally be similar to or up to 29% lower than flows under Existing Conditions.

Water temperatures throughout the Stanislaus River would be the same under Existing Conditions and H3_ELT throughout the January through April steelhead spawning and egg incubation period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT throughout this period would be similar to flows under Existing Conditions, with minor exceptions.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT/HOS_ELT

Sacramento River

Mean flows in the Sacramento River at Keswick and upstream of Red Bluff during January through April under H4_ELT would generally be similar to flows under Existing Conditions, with minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River at Keswick and Red Bluff were examined during the January through April primary steelhead 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 H4_ELT in any month or water year type throughout the period at either location.

Clear Creek

Mean flows in the Clear Creek during January through April under H4_ELT would generally be similar to or up to 40% greater than flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature modeling was conducted in Clear Creek.

Feather River

Flows in the Feather River above Thermalito Afterbay (low-flow channel) during January through April under H4_ELT would be identical to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4_ELT would be up to 36% lower than flows under Existing Conditions during January and February, similar during March, and up to 509% greater during April.

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

Mean water temperatures in the Feather River low-flow channel (upstream of Thermalito Afterbay) and high-flow channel (at Thermalito Afterbay) were examined during the January through April steelhead 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 temperatures between H4_ELT and Existing Conditions for all months and water year types at either location throughout the period.

Differences in the percent of months exceeding the 56°F threshold between Existing Conditions and H4_ELT would generally be negligible (<5% on an absolute scale) during January through April, except for the >1.0 degree category for April, in which the percent of months exceeding the threshold would be 7% higher (absolute difference) (Table 11-4A-82).

Total degree-months (all water years combined) above the 56°F threshold under H4_ELT would be similar to those under Existing Conditions during January and February, and would be 19 and 80 degree-days higher for March and April, respectively(Table 11-4A-83). These increases, although large when expressed as percentages, constitute a small proportion with respect to the 82-year period of analysis.

American River

Mean flows in the American River at the confluence with the Sacramento River during January through April under H4_ELT would generally be similar to flows under Existing Conditions, with a number of minor exceptions especially in February (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the Watt Avenue Bridge were evaluated during the January through April steelhead 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 temperatures between H4_ELT and Existing Conditions for all months and water year types 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). Steelhead spawn and eggs incubate in the American River between January and April. During January and February, there would be no differences in the percent of month exceeding the threshold between Existing Conditions and H4_ELT. During March and April, the percent of months exceeding the threshold under H4_ELT would be up to 11% greater (absolute difference) than the percent under Existing Conditions.

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). During the January and February, there would be no difference in total degree-months above the threshold between Existing Conditions and H4_ELT. During March and April, total degree-months for all water year types combined under H4_ELT would be 19 and 80 degree-months, respectively, greater than under Existing Conditions.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined during the January through April steelhead spawning and egg incubation period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean Flows under H4_ELT would be lower than those under Existing Conditions for about half of the water year means within the four month period, with up to 29% lower flows under in February of critical water years.

Water temperatures in the Stanislaus River at the confluence with the San Joaquin River was evaluated during the January through April steelhead 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 temperatures between H4_ELT and Existing Conditions for all months and water year types throughout the period.

San Joaquin River

The mainstem San Joaquin River does not provide habitat for steelhead spawning or egg incubation.

Mokelumne River

Flows in the Mokelumne River at the Delta were examined during the January through April steelhead 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, with minor exceptions.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Under Alternative 4A, there are flow and cold water pool availability reductions in the Feather, American, and Stanislaus Rivers, as well as temperature increases in the Feather and American rivers that would lead to biologically meaningful increases in egg mortality and overall reduced habitat conditions for spawning steelhead and egg incubation, as compared to Existing Conditions. Alternative 4A would not have significant effects on steelhead spawning conditions in the Sacramento River, Clear Creek, San Joaquin River, or the Mokelumne River. 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 steelhead 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 negligible effects on mean monthly flows, water temperatures, and reservoir storage. Further, the SacEFT model predicts that there would be no effects to spawning and egg incubation habitat in the Sacramento River. 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-95: Effects of Water Operations on Rearing Habitat for Steelhead

In general, the effects of Alternative 4A on steelhead rearing conditions would be negligible relative to the NAA_ELT.

H3_ELT/ESO_ELT

Sacramento River

Juvenile steelhead rear within the Sacramento River and its tributaries throughout the year because juveniles inhabit upstream areas for a period of 1 to 2 years before migrating downstream to the ocean. Results of the CALSIM analyses of instream flows within the reach where the majority of steelhead spawning occurs (Keswick Dam to upstream of Red Bluff) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were evaluated for effects of H3_ELT. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry and juveniles, leading to mortality.

In general, mean flows under H3_ELT would be similar to flows under NAA_ELT throughout the year, except during November when the mean flows under H3_ELT would be up to 23% lower at Keswick and up to 18% lower at Red Bluff. These small and isolated reductions would not have biologically meaningful effects on steelhead fry and juvenile rearing habitat.

Mean water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead 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 at either location.

SacEFT predicts that there would be a 7% reduction in years classified as good juvenile rearing habitat conditions under H3_ELT compared to NAA_ELT, and a 14% reduction in the percentage of years classified "good" with respect to juvenile stranding risk (Table 11-4A-78). On an absolute scale, these changes to rearing WUA and stranding risk would be 3% and 4%, respectively, which would be negligible to juvenile steelhead.

Based on mean monthly flows, SacEFT rearing metrics, and water temperature effects, project-related effects under Alternative 4A in the Sacramento River would not have biologically meaningful negative effects on steelhead rearing conditions. Effects of H3_ELT consist primarily of negligible effects that would not have biologically meaningful effects on rearing success.

Clear Creek

Steelhead rear in Clear Creek throughout the year. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry and juveniles leading to mortality.

Instream flows estimated from the modeling each month and water-year type were used to compare among model scenarios (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). In general, flows under H3_ELT would be similar to those under NAA_ELT, with minor exceptions.

Evaluation of the minimum instream flows in Clear Creek indicates that H3_ELT would have no effect (0%) on minimum instream flows in any water year type, except for a decrease (-50 cfs or -100%) for dry water years (Table 11-4A-84).

Table 11-4A-84. Minimum Monthly Instream Flow (cfs) for Model Scenarios in Clear Creek during the Year-Round Juvenile Steelhead Rearing Period

Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
Wet	0 (0%)	0 (0%)
Above Normal	0 (0%)	0 (0%)
Below Normal	-70 (-100%)	0 (NA)
Dry	-50 (-100%)	-50 (-100%)
Critical	-50 (-100%)	0 (NA)

Note: Minimum flows occurred between October and March.
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.

Denton (1986) developed flow recommendations for steelhead in Clear Creek using IFIM (Figure 11-1A-4). The current Clear Creek management regime uses flows slightly lower than those recommended by Denton. Results from a new IFIM study on Clear Creek are currently being analyzed. Depending on results of this study the flow regime could be adjusted in the future. It is expected that the modeled flows will be suitable for the existing steelhead populations in Clear Creek. No change in effect on steelhead in Clear Creek is anticipated.

No water temperature modeling was conducted in Clear Creek.

These results indicate that effects of H3_ELT on flows would not affect juvenile steelhead rearing habitats in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead for spawning and rearing. Although there is relatively little natural steelhead production in the river, most steelhead spawning and rearing appears to occur in the low-flow channel in habitats associated with well-vegetated side channels (Cavallo et al. 2003; California Department of Water Resources unpublished data). Because these habitats are relatively uncommon they could limit natural steelhead production. Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry and juveniles leading to mortality.

There would be no change in flows for H3_ELT relative to NAA_ELT in the low-flow channel. Flow in the low-flow channel is projected to remain between 700 and 800 cfs except during occasional flood control releases. This flow is less than pre-dam levels during all months of the year as a result of water diversions through the Thermalito Afterbay. The significance of these flow conditions for steelhead spawning and rearing is uncertain. Feather River screw trap data indicate that Chinook salmon initiate emigration regardless of flow regime (i.e., they do not wait for a high-flow pulse). This is likely true for steelhead as well.

Mean May storage at Oroville under H3_ELT would be similar to that under NAA_ELT for all water year types (Table 11-4A-45). September Oroville storage under H3_ELT would be similar to or up to 15% greater than storage under NAA_ELT (Table 11-4A-39).

The river channel downstream of Thermalito (high-flow channel) offers few of the habitat types upon which steelhead appear to rely in the low-flow channel. Experiments and fish observations also indicate that predation risk for juvenile steelhead is higher downstream of the Thermalito outlet (California Department of Water Resources 2004). Increased predation risk is likely a function of water temperature, where warm water nonnative species such as striped bass, largemouth bass, and smallmouth bass are more prevalent, and in general, predators have greater metabolic requirements. Thus, summer temperatures that exceed 65°F and the absence of preferred steelhead habitat currently appear to limit steelhead rearing in the river downstream of the Thermalito outlet. Comparisons of CALSIM data by month and water year type (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate that mean flows under H3_ELT would generally be similar to or greater than (up to 106% greater for June of below normal water years) those under NAA_ELT in the high-flow channel in all months except July through September. During July through September, flows under H3_ELT would be up to 48% lower than those under NAA_ELT depending on month and water-year type.

Mean monthly water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead 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.

Effects of H3_ELT on water temperature-related juvenile rearing conditions for steelhead in the Feather River were analyzed by comparing the percent of months between May through August over the 82-year CALSIM modeling period that exceed a 63°F temperature threshold in the low-flow channel (above Thermalito Afterbay) and by comparing the percent of months between October and April that exceed a 56°F threshold at Gridley. Results for the low-flow channel (above Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at Gridley, there would generally be only minor differences between NAA_ELT and H3_ELT in the percent of months exceeding the threshold, except in the low-flow channel in June, for which there would be up to a 9% reduction (absolute difference) in the percent of months under H3_ELT.

The effects of H3_ELT on water temperature-related juvenile rearing conditions for steelhead in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 63°F NMFS threshold during May through August in the low-flow channel and the 56°F threshold during October through April at Gridley. Results for the low-flow channel (above Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low flow channel and at Gridley, there would be small increases and decreases in exceedances above the thresholds, but overall no biologically meaningful effects.

American River

Flows in the American River at the confluence with the Sacramento River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to or up to 25% greater than flows under NAA_ELT in all months except August, September, and November. Flows during these months would be up to 25% lower under H3_ELT than under NAA_ELT. Because these reductions would occur only during these months and would be generally low to moderate, they are not expected to cause biologically meaningful effects on steelhead juvenile rearing habitat.

Mean water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead 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.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-4A-85). During May through July, and October, the percent of months exceeding the threshold under H3_ELT would be similar to or up to 9% lower (absolute difference) than the percent under NAA_ELT. During August and September, the percent of months exceeding the threshold would increase up to 11% (absolute difference) under H3_ELT.

Table 11-4A-85. 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 65°F Threshold, May through October

	Degrees Above Threshold				
Month	>1.0	>2.0	>3.0	>4.0	>5.0
EXISTING CONDITIONS vs. H3_ELT					
May	26 (131%)	20 (133%)	11 (100%)	6 (100%)	4 (75%)
June	27 (42%)	22 (42%)	17 (42%)	15 (48%)	14 (65%)
July	0 (0%)	1 (1%)	30 (47%)	21 (59%)	25 (143%)
August	0 (0%)	2 (3%)	17 (21%)	49 (103%)	57 (184%)
September	11 (13%)	37 (70%)	32 (100%)	30 (185%)	22 (300%)
October	17 (350%)	10 (400%)	9 (NA)	2 (NA)	1 (NA)
NAA_ELT vs. H3_ELT					
May	-1 (-3%)	-2 (-7%)	-1 (-5%)	0 (0%)	0 (0%)
June	0 (0%)	-2 (-3%)	-5 (-8%)	-7 (-14%)	-9 (-20%)
July	0 (0%)	0 (0%)	-2 (-3%)	-9 (-13%)	-5 (-11%)
August	0 (0%)	0 (0%)	0 (0%)	5 (5%)	11 (15%)
September	2 (3%)	9 (11%)	6 (11%)	7 (19%)	4 (14%)
October	-1 (-5%)	-1 (-9%)	2 (40%)	1 (100%)	1 (NA)

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 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-4A-86). Total degree-months (all water year types combined) exceeding the threshold would be similar between NAA_ELT and H3_ELT or up to 38 degree-months lower under H3_ELT in all months except August and September, in which degree-months would be 28 degree-months higher under H3_ELT.

Table 11-4A-86. Differences between Baseline and H3_ELT Scenarios in Total Degree-Months (°F-Months) by Month and Water Year Type for Water Temperature Exceedances above 65°F in the American River at the Watt Avenue Bridge, May through October

Month	Water Year Type	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
May	Wet	9 (150%)	0 (0%)
	Above Normal	7 (NA)	-2 (-22%)
	Below Normal	7 (233%)	-2 (-17%)
	Dry	22 (100%)	1 (2%)
	Critical	13 (68%)	-1 (-3%)
	All	58 (116%)	-4 (-4%)
June	Wet	31 (182%)	-7 (-13%)
	Above Normal	12 (50%)	-8 (-18%)
	Below Normal	21 (72%)	-7 (-12%)
	Dry	10 (15%)	-17 (-18%)
	Critical	33 (66%)	1 (1%)
	All	107 (57%)	-38 (-13%)
July	Wet	32 (41%)	-16 (-13%)
	Above Normal	9 (33%)	1 (3%)
	Below Normal	12 (35%)	-4 (-8%)
	Dry	35 (56%)	7 (8%)
	Critical	30 (37%)	4 (4%)
	All	118 (42%)	-8 (-2%)
August	Wet	69 (87%)	7 (5%)
	Above Normal	19 (46%)	2 (3%)
	Below Normal	29 (52%)	2 (2%)
	Dry	63 (93%)	15 (13%)
	Critical	40 (51%)	2 (2%)
	All	220 (68%)	28 (5%)
September	Wet	35 (146%)	12 (26%)
	Above Normal	14 (88%)	4 (15%)
	Below Normal	26 (93%)	7 (15%)
	Dry	35 (83%)	5 (7%)
	Critical	25 (51%)	0 (0%)
	All	135 (85%)	28 (11%)
October	Wet	6 (600%)	1 (17%)
	Above Normal	5 (NA)	0 (0%)
	Below Normal	3 (NA)	1 (50%)
	Dry	9 (NA)	0 (0%)
	Critical	9 (180%)	0 (0%)
	All	32 (533%)	2 (6%)

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.

These results indicate that effects of H3_ELT on flow and water temperatures would not reduce juvenile rearing conditions in the American River.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing 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.

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

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing 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

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be the same as flows under NAA_ELT throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT /HOS_ELT

Sacramento River

Mean flows in the Sacramento River at Keswick and upstream of Red Bluff under H4_ELT would generally be similar to flows under NAA_ELT year-round, except during November (11% to 20% lower) at Keswick (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These small and isolated reductions would not have biologically meaningful effects on steelhead fry and juvenile rearing habitat.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead 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 H4_ELT in any month or water year type throughout the period at either location.

Clear Creek

Year-round flows in the Clear Creek under H4_ELT would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature modeling was conducted in Clear Creek.

Feather River

Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H4_ELT would be the same as flows under H3_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4_ELT would be similar to or up to 548% higher than (April of below normal water years) flows under NAA_ELT during October through June. During July through September, mean flows would be lower for every water year type (up to 60% lower for September of below normal years), except for critical years during August and September, in which flows under H4_ELT would be 48% and 52% higher.

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead 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 H4_ELT in any month or water year type throughout the period at either location.

The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that there would be small to moderate benefits (i.e., reduced percent of months exceeding the threshold) of H4_ELT relative to NAA_ELT in the low-flow channel and at Gridley.

The analysis evaluating the total degree-months exceeding water temperature thresholds from NMFS (63°F for the low flow channel and 56°F at Gridley) presented in Impacts AQUA-59 and AQUA-76 indicates that exceedances under H4_ELT would generally be similar to or lower than those under NAA_ELT in the low flow channel and at Gridley during spring and early summer months, but higher during fall months.

Mean May storage would be 11% to 16% lower under H4_ELT relative to NAA_ELT in wet, above normal, and below normal water years, similar in dry years, and 24% higher in critical years (Table 11-4A-45). September Oroville storage under H4_ELT would be similar to or up to 44% greater than storage under NAA_ELT (Table 11-4A-39).

American River

Year-round flows in the American River at the confluence with the Sacramento River under H4_ELT would generally be similar to flows under NAA_ELT, except during August and September, for which mean flows would be up to 33% lower under H4_ELT depending on water year type, and October, for which flows would be up to 24% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean monthly water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead 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 H4_ELT in any month or water year type throughout the period.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-4A-87). The percent of months exceeding the threshold under H4_ELT would be similar to or up to 20% lower (absolute difference) than the percent under NAA_ELT for all months.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-4A-88). Total degree-months exceeding the threshold would be similar between NAA_ELT and H4_ELT throughout the period, except during July and August, in which total degree-months under H4_ELT would be 11% and 24% lower, and during September, in which total degree-months under H4_ELT would be 11% higher.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H4_ELT would be similar to flows under NAA_ELT throughout the period.

Mean monthly water temperatures throughout the Stanislaus River would be similar under NAA_ELT and H4_ELT throughout the year-round period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*).

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). 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

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be the same as flows under NAA_ELT throughout the period.

Water temperature modeling was not conducted in the Mokelumne River.

NEPA Effects: Collectively, these modeling results indicate that the effect of Alternative 4A is not adverse because it would not substantially reduce rearing habitat or substantially reduce the number of fish as a result of fry and juvenile mortality. Effects of Alternative 4A on flows and water temperatures would be small and infrequent in the Sacramento River and Clear Creek, and effects in the Feather River and the American River would be more variable, but in general, the overall effects are expected to be slightly beneficial, despite the increased flow variations. Water temperatures in the Sacramento, Feather, American and Stanislaus Rivers would not be affected by Alternative 4A. Overall, Alternative 4A is not expected to have biologically meaningful negative effects on steelhead rearing conditions.

CEQA Conclusion: In general, Alternative 4A would degrade the quantity and quality of rearing habitat for steelhead 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 rearing habitat for steelhead relative to the CEQA conclusion.

H3_ELT/ESO_ELT

Sacramento River

Comparisons of CALSIM outputs of mean flow by month and water year type for the Sacramento River at Red Bluff (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were used to evaluate effects of H3_ELT compared to Existing Conditions. Results for H3_ELT at Keswick were generally similar to those for Existing Conditions, except for September, in which flows were up to 34% higher and up to 24% lower, depending on water year type, and October and November, in which flows were up to 20% lower. The results for mean flows at Red Bluff were similar to those for flows at Keswick, except that the differences between H3_ELT and Existing Conditions were generally smaller. The most substantial effects on juvenile rearing habitats would occur from flow reductions in dry and critical water years, including those in September, as well as moderate reductions in dry and or critical years in August, October and November. Based on the overall infrequency and small size of these decreases, and negligible differences or beneficial increases in flow in most of the year, the flow reductions are not expected to have biologically meaningful negative effects on juvenile steelhead rearing conditions in the Sacramento River.

Mean water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations, mean water temperatures under H3_ELT would generally be similar to those under Existing Conditions, except during July through October at Keswick, when temperatures for critical years would range from 7% to 14% higher under H3_ELT, and for other water year types when temperatures would be up to 8% higher under H3_ELT.

SacEFT predicts that there would be a 2% increase in the percentage of years with good juvenile rearing habitat under H3_ELT compared to Existing Conditions (Table 11-4A-78). SacEFT predicts there would be a decrease of 26% in occurrence of years with "good" conditions for juvenile stranding risk (Table 11-4A-78). The increased stranding risk would contribute to the potential for juvenile mortality due to stranding.

Based on the incremental effects of reductions in mean monthly flows (up to 24% lower) for several months during drier water year types, including the warmer summer/ fall months of August through November, and increased risk of juvenile stranding (26%), effects of H3_ELT on flows would have biologically meaningful negative effects on juvenile rearing conditions in the Sacramento River.

Clear Creek

Comparisons of mean flows for Clear Creek were used to evaluate effects of H3_ELT relative to Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry and juveniles leading to mortality. Effects of H3_ELT year-round would consist primarily of or small changes with respect to Existing Conditions, except that in critical water years during December through April mean flows would increase by 10%, in wet years during January flows would increase 40%, and in critical years during September they would fall 19%. The decreases in flow would not be of sufficient frequency and magnitude to cause biologically meaningful negative effects.

Evaluation of minimum instream flows for H3_ELT relative to Existing Conditions (Table 11-4A-84) indicates no effect (0%) for wet and above normal, and decreases for the remaining water year types (-50 to -70 cfs or -100%). These reductions corresponds to substantial decreases in total flow during drier water years based on relatively small quantities of flow (e.g., as low as 85 cfs in the summer months in drier water years, and more typically between 150 and 200 in other months). The reductions in minimum instream flows would affect juvenile rearing habitat and could increase stranding risk, particularly in drier water years.

No water temperature modeling was conducted in Clear Creek.

While effects of H3_ELT on mean monthly flow would consist predominantly of negligible effects, there would be moderate to substantial reductions in minimum instream flows, particularly during drier water years, that would affect juvenile rearing habitat and increase stranding risk in Clear Creek.

Feather River

The low-flow channel is the primary reach of the Feather River utilized by steelhead spawning and rearing. There would be no change in flows for H3_ELT relative to Existing Conditions in the low-flow channel (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Comparisons using CALSIM data by month and water year type for the Feather River at Thermalito (high-flow channel) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) indicate variable effects of H3_ELT relative to Existing Conditions. H3_ELT would cause substantial changes in mean flows for a number of months and water year types. With some exceptions for specific water year types, there would be increases in mean flows of up to 140% during April through June, as well as for wetter years during July through September (up to 192% higher under H3_ELT)). However, for dry and/or critical years during July through September, flows would be up to 52% lower under H3_ELT than under Existing Conditions. H3_ELT would also cause reductions in flow during January through March, especially for below normal water years, of up to 48%, and during many other months and water year types. The flow changes would have a fairly broad range of effects on rearing habitat throughout the year, with reductions occurring in drier water years having the most adverse effects on juvenile rearing conditions.

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). In the low-flow channel, mean water temperatures under H3_ELT would be similar (<5%) to those under Existing Conditions for all months and water year types,. In the high-flow channel, mean water temperatures under H3_ELT would be 5% and 6% higher than those under Existing Conditions during July of critical water years and August of dry water years, respectively, and would be similar for the remaining months and water year types.

Effects of H3_ELT on water temperature-related juvenile rearing conditions for steelhead in the Feather River were analyzed by comparing the percent of months between May through August over the 82-year CALSIM modeling period that exceed a 63°F temperature threshold in the low-flow channel (above Thermalito Afterbay) and by comparing the percent of months between October and April that exceed a 56°F threshold at Gridley. Results for the low-flow channel (above Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at Gridley, there would be no differences, small increases, and moderate to large increases (absolute difference), in the percent of months exceeding the threshold between H3_ELT and Existing Conditions. This comparison includes the effects of climate change.

The effects of H3_ELT on water temperature-related juvenile rearing conditions for steelhead in the Feather River were also analyzed by comparing the total degree-months for months that exceed the 63°F NMFS threshold during May through August in the low-flow channel and the 56°F threshold during October through April at Gridley. Results for the low-flow channel (above Thermalito Afterbay) and Gridley are presented for spring-run rearing and fall-run spawning and egg incubation in Impacts AQUA-59 and AQUA-76, respectively. In the low-flow channel and at Gridley, there would be moderate increases in total degree-months (all water years combined) exceeding the temperature threshold during several months. These comparisons include the effects of climate change.

Mean May storage at Oroville would be similar or up to 12% lower under H3_ELT relative to Existing Conditions (Table 11-4A-45). Mean September Oroville storage under H3_ELT would be 19% to 29% lower than storage under Existing Conditions for wet, above normal and below normal water years, and would be similar for dry and critical water years (Table 11-4A-39).

Overall in the Feather River, effects of H3_ELT on mean flow would consist of substantial increases and decreases for various months and water year types. There would be relatively frequent, substantial flow reductions in drier water years that would affect juvenile rearing habitat conditions and contribute to stranding risk. Further, there would be moderate to large increases in the exceedance of temperature thresholds in the low-flow channel and at Gridley.

American River

CALSIM outputs were used to compare mean flows by month and water year type for H3_ELT for the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Lower flows can reduce the instream area available for rearing and rapid reductions in flow can strand fry and juveniles leading to mortality. Comparisons of H3_ELT to Existing Conditions indicate highly variable results, with moderately lower or higher flows for many months and water year types. There would be relatively large reductions in flow (up to 52%) for all water year types during August, September, and November, with the largest reductions occurring in the drier water year types. Flows in June would increase 25% in dry water years and would decrease up to 36% in critical and wet water years. The prevalent, substantial reductions inflow, particularly during drier water years, would have biologically meaningful negative effects on juvenile rearing conditions in the American River.

Mean water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead 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 6% to 7% higher than those under Existing Conditions during October of all but critical water years, but would be similar in the remaining months and water year types.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-4A-85). The percent of months under H3_ELT would be greater by up to 57% (absolute difference) than those under Existing Conditions during all months examined.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-4A-86). Total degree-months exceeding the threshold under H3_ELT would be 32 to 220 degree-months greater than those under Existing Conditions.

These results indicate that effects of H3_ELT on flows and water temperatures would affect juvenile steelhead rearing conditions in the American River throughout most of the year, particularly during drier water years.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows would generally be similar under H3_ELT relative to Existing Conditions except during February and March, when flows would be up to 29% lower (dry water year type).

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead 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 temperatures between H3_ELT and Existing Conditions.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead 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 during June through August, when flows would be up to 23% lower.

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

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead rearing 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 during January through May and October and November, with exceptions depending on water year type, would be up to 28% greater than flows under Existing Conditions during December, and up to 35% lower than flows under Existing Conditions during June through September.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT/HOS_ELT

Sacramento River

Year-round flows in the Sacramento River at Keswick under H4_ELT would generally be similar to flows under Existing Conditions except during September, when flows would be 28% and 53% higher in wet and above normal water years, respectively, and 20% and 14% lower in dry and critical water years, respectively (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows would also be up to 19% lower in November of dry and critical year types. Differences in mean flows between H4_ELT and Existing conditions at Red Bluff would be similar to but smaller than those at Keswick, except during October, in which mean flow would be up to 16% lower.

Mean monthly water temperatures in the Sacramento River at Keswick and Bend Bridge were examined during the year-round steelhead 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 temperatures between H4_ELT and Existing Conditions for any month or water year types at either location.

Clear Creek

Year-round flows in the Clear Creek under H4_ELT would generally be similar to flows under Existing Conditions, except that in critical water years during December through April mean flows would increase 10%, and in wet years during January flows would increase 40%. (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). No water temperature modeling was conducted in Clear Creek.

Feather River

Year-round flows in the Feather River above Thermalito Afterbay (low-flow channel) under H4_ELT would be the same as flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the Feather River below Thermalito Afterbay (high-flow channel) under H4_ELT would generally be similar to or up to 509% greater than flows under Existing Conditions during April through June, and would generally be lower than flows under Existing Conditions (up to 54% lower) during July and August, as well as September of below normal and dry water years. During September of wet, above normal, and critical water years and August of critical years, flows under H4_ELT would be up to 166% higher than flows under Existing Conditions. During the other six months of the year, flows under H4_ELT and Existing Conditions would generally be similar, with many exceptions for individual water year types.

Mean water temperatures in the Feather River in both above (low-flow channel) and at Thermalito Afterbay (high-flow channel) were examined during the year-round steelhead juvenile rearing period (Appendix 11D, *Sacramento River Water Quality Model and Reclamation Temperature Model Results utilized in the Fish Analysis*). At both locations there would be no differences (<5%) in mean water temperatures for any month or water year type.

The analysis evaluating the percent of months exceeding water temperature thresholds from NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that there would be a number of small to moderate increases in the percent of months exceeding the NMFS temperature thresholds underH4_ELT relative to Existing Conditions in the low flow channel and at Gridley. These comparisons include the effects of climate change.

The analysis evaluating the total degree-months exceeding water temperature thresholds from NMFS presented in Impacts AQUA-59 and AQUA-76 indicates that there would be small to moderate negative effects of H4_ELT relative to Existing Conditions in August in the low flow channel and October and November at Gridley, and no, small or positive effects in the other months at both locations. These comparisons include the effects of climate change.

Mean May storage at Oroville would be up to 19% lower under H4_ELT relative to Existing Conditions except in critical years, in which storage would be 15% greater (Table 11-4A-45). Mean September Oroville storage under H4_ELT would be about 24% lower than storage under Existing

Conditions for wet, above normal and below normal water years, 32% greater for critical years, and similar for dry years (Table 11-4A-39).

American River

Year-round flows in the American River at the confluence with the Sacramento River under H4_ELT would generally be similar to flows under Existing Conditions during October and December through April, with minor exceptions, and would be up to 47% lower during May through September and November (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River and the Watt Avenue Bridge were examined during the year-round steelhead rearing 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 6% to 7% higher than those under Existing Conditions during October of all but critical water years, and would be similar in the remaining months and water year types.

The percent of months exceeding a 65°F temperature threshold in the American River at the Watt Avenue Bridge was evaluated during May through October (Table 11-4A-87). The percent of months under H4_ELT would be greater by up to 37% (absolute difference) than those under Existing Conditions during all months examined.

Total degree-months exceeding 65°F were summed by month and water year type at the Watt Avenue Bridge during May through October (Table 11-4A-88). Total degree-months (all water years combined) exceeding the threshold under H4_ELT would be 32 to 168 degree-months greater than those under Existing Conditions for all months.

Stanislaus River

Flows in the Stanislaus River at the confluence with the San Joaquin River were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows would generally be similar under H4_ELT relative to Existing Conditions, but with some flow reductions (up to 29%), especially for dry and critical water years during February and March.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the year-round juvenile steelhead 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 temperatures throughout the year.

San Joaquin River

Flows in the San Joaquin River at Vernalis were examined for the year-round steelhead rearing period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be up to 23% lower during June through August, depending on water year type, than flows under Existing Conditions and would generally be similar in other months, with minor exceptions.

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

Mokelumne River

Flows in the Mokelumne River at the Delta were examined for the year-round steelhead 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 Existing Conditions during January through May and October and November, with minor exceptions. Flows would generally be lower (up to 34% lower) during June through September, primarily in wet, above normal, and below normal water year types, and would be up to 28% higher in December of the same three water year types.

Water temperature modeling was not conducted in the Mokelumne River.

Summary of CEQA Conclusion

Under Alternative 4A, there are flow reductions in the Feather, American, Stanislaus, San Joaquin, and Mokelumne Rivers and temperature increases in the Sacramento, Feather, American, and Stanislaus Rivers that would lead to reductions in quantity and quality of fry and juvenile steelhead rearing habitat relative to Existing 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 rearing habitat and substantially reduce the number of steelhead as a result of fry and juvenile 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, *Effects and Mitigation Approaches*, in the Draft EIR/EIS, 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 the 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, effects of Alternative 4A on flows would be small and infrequent in the Sacramento River, Clear Creek, and Mokelumne River. Effects in the Feather and American rivers would be variable, but overall effects are expected to be slightly beneficial. Despite the increased flow variations, water temperatures in the Sacramento, Feather, American, and Stanislaus Rivers would not be affected by Alternative 4A. These modeling results represent the increment of change attributable to the alternative, demonstrating the similarities in flows and water temperatures under Alternative 4A and the NAA_ELT, and addressing the limitations of the CEQA baseline (Existing Conditions). Therefore, the impact would be less than significant and no mitigation is required.

Impact AQUA-96: Effects of Water Operations on Migration Conditions for Steelhead

In general, the effects of Alternative 4A on steelhead migration conditions relative to the NAA_ELT would not be adverse.

Upstream of the Delta

H3_ELT/ESO_ELT

Sacramento River

Juveniles

Sacramento River flow upstream of Red Bluff during the juvenile steelhead migration period (October through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) is used to represent flow conditions in the mainstem of the upper river below Keswick Dam. Mean flows under H3_ELT during this period would generally be similar to flows under NAA_ELT, except during November, during which flows would be 6% to 18% lower than flows under NAA_ELT. These reductions would not have a biologically meaningful effect on steelhead juvenile migration because they would occur during only one of eight months of the period and are small to moderate in magnitude.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead 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.

Overall, these results indicate that H3_ELT would not have biologically meaningful effects on juvenile migration conditions.

Adults

Instream flows upstream of Red Bluff were compared monthly over the period from September through March under H3_ELT and NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows under H3_ELT during this period would generally be similar to flows under NAA_ELT, except during November, during which flows would be up to 18% lower than flows under NAA_ELT. These reductions would not have a biologically meaningful effect on steelhead adult migration because they would occur during only one of seven months of the period and are small to moderate in magnitude.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead 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.

Kelts

Mean Sacramento River flows upstream of Red Bluff under H3_ELT during the March through April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the*

Fish Analysis) would generally be similar to flows under NAA_ELT. Therefore, H3_ELT would not affect kelt migration in the Sacramento River.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream 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.

Overall in the Sacramento River, these results indicate that H3_ELT would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration in the Sacramento River.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Juveniles

Flows in Clear Creek at Whiskeytown were evaluated for the juvenile steelhead migration period (October through May) (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. These results indicate that H3_ELT would not affect flow conditions for juvenile steelhead migration in Clear Creek.

Adults

Flows in Clear Creek at Whiskeytown were evaluated for the September through March adult steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to or greater than flows under NAA_ELT throughout the period. These results indicate that H3_ELT would not affect flow conditions for adult steelhead migration in Clear Creek.

Kelts

Flows in Clear Creek at Whiskeytown were evaluated for the March and April kelt steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would be similar to or greater than flows under NAA_ELT for both months of the period. These results indicate that H3_ELT would not affect flow conditions for kelt steelhead migration in Clear Creek.

Overall in Clear Creek, these results indicate that effects of H3 on flows would not affect juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Flows in the Feather River at Thermalito Afterbay (high-flow channel) and at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the high-flow channel under H3_ELT would generally be similar to or up to 30% greater than flows under

NAA_ELT during the period. Increases in flow would have a beneficial effect on migration conditions, particularly in drier water years during some months.

Flows under H3_ELT in the Feather River at the confluence with the Sacramento River during October through May would generally be similar to flows under NAA_ELT, with minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These isolated reduction would not have biologically meaningful effects on juvenile steelhead migration conditions.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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.

Overall, there would be no biologically meaningful effects H3 on juvenile migration conditions in the Feather River.

Adults

Flows in the Feather River at Thermalito Afterbay (high-flow channel) and at the confluence with the Sacramento River were evaluated during the September through March adult migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in the high-flow channel under H3_ELT would generally be similar to or up to 30% greater than flows under NAA_ELT except during September. During September, flows would be up to 43% lower for all water year types except critical, in which flows would be 52% greater. These flow reductions would be limited to one month of the seven month migration period and would, therefore, not have a biologically meaningful effect on adult steelhead migration conditions. Mean flows in the Feather River at the confluence with the Sacramento River under H3_ELT would generally be similar to or greater than flows under NAA_ELT, except during September, in which flows would be up to 27% lower for all but critical water years and would be 14% higher for critical years. The flow reductions would be isolated and would, therefore, not have a biologically meaningful effect on adult steelhead migration conditions.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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.

Kelts

Flows in the Feather River at the Thermalito Afterbay and at the confluence with the Sacramento River were evaluated during the March and April kelt migration period. Flows at Thermalito under H3_ELT during March and April would generally be similar to or, in dry and critical water years, up to 16% greater than flows under NAA_ELT. Flows at the confluence with the Sacramento River would generally be similar to those under NAA_ELT. These results indicate that H3_ELT would not affect kelt steelhead migration conditions in the Feather River.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream 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.

Overall in the Feather River, H3_ELT would not have biologically meaningful effects on juvenile, adult, or kelt steelhead migration.

American River

Juveniles

Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were evaluated for the juvenile steelhead migration period (October through May). Mean flows under H3_ELT would generally be similar to flows or up to 25% greater than flows under NAA_ELT, except during November, in which flows would be up to 15% lower depending on water year type. Appreciable differences in flow would be too infrequent to have biologically meaningful effects on juvenile steelhead migration.

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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.

Based on its generally small and infrequent effects on mean flow and negligible effects on water temperature, H3_ELT would not affect juvenile steelhead migration in the American River.

Adults

Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were evaluated for the September through March adult migration period. Flows under ELT would generally be similar to or up to 25% greater than flows under NAA_ELT, except during September and November, in which flows would be up to 25% lower, depending on month and water year type. These reductions would be too infrequent to cause biologically meaningful effects on adult steelhead migration.

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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.

Kelts

Flows in the American River at the confluence with the Sacramento River (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) were evaluated for the March through April kelt migration period. Mean flows under H3_ELT would be similar to flows under NAA_ELT during this period for all water year types.

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream 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 of the period.

Overall in the American River, the effects of H3_ELT on flows would not affect juvenile, adult, or kelt migration conditions.

Stanislaus River

Mean flows in the Stanislaus River at the confluence with the San Joaquin River for H3_ELT are essentially no different from flows under NAA_ELT for any month. Therefore, there would be no effect of H3_ELT on juvenile, adult, or kelt migration in the Stanislaus River.

Further, mean monthly water temperatures in the Stanislaus River at the confluence with the San Joaquin River for H3_ELT are not different from flows under NAA_ELT for any month. Therefore, there would be no effect of H3_ELT on juvenile, adult, or kelt migration in the Stanislaus River.

San Joaquin River

Mean flows in the San Joaquin River at Vernalis for H3_ELT are little different from flows under NAA_ELT for any month. Therefore, there would be no effect of H3_ELT on juvenile, adult, or kelt migration in the San Joaquin River.

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

Mokelumne River

Mean flows in the Mokelumne River at the Delta for H3_ELT are not different from flows under NAA_ELT for any month. Therefore, there would be no effect of H3_ELT on juvenile, adult, or kelt migration in the Mokelumne River.

Water temperature modeling was not conducted in the Mokelumne River.

H4_ELT / HOS_ELT

Sacramento River

Juveniles

Mean flows under H4_ELT in the Sacramento River upstream of Red Bluff during the October through May juvenile steelhead migration period would generally be similar to flows under NAA_ELT, except during November, in which flows would be lower for all water year types (9% to 15% lower) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These reductions would not have a biologically meaningful effect on steelhead juvenile migration because they would occur during only one of eight months of the period and are small to moderate in magnitude.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead 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.

Adults

Mean flows under H4_ELT in the Sacramento River upstream of Red Bluff during the September through March adult steelhead migration period would generally be similar to flows under NAA_ELT, except during November, in which flows would be 9% to 15% lower (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). These reductions would not have a biologically meaningful effect on steelhead adult migration because they would occur during only one of eight months of the period and are small to moderate in magnitude.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead 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 H4_ELT in any month or water year type throughout the period.

Kelts

Mean flows under H4_ELT in the Sacramento River upstream of Red Bluff during the March through April adult steelhead migration period would 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 upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream 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.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Juveniles

Mean flows under H4_ELT in Clear Creek at Whiskeytown during the October through May juvenile migration period would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Mean flows under H4_ELT in Clear Creek at Whiskeytown during the September through March adult migration period would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Mean flows under H4_ELT in Clear Creek at Whiskeytown during the March through April kelt migration period would generally be similar to flows under NAA_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Feather River

Juveniles

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay and the confluence with the Sacramento River during the October through May juvenile migration period would generally be similar to flows under NAA_ELT during October through March, with a few exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows during April and May would be greater (up to 548% greater at Thermalito Afterbay location) than flows under NAA_ELT except in critical water years, for which flows would be similar.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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.

Adults

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay and the confluence with the Sacramento River during the September through March adult migration period would generally be similar to flows under NAA_ELT, except during September (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). During September of critical water years, mean flow under H4_ELT at Thermalito Afterbay would be 52% higher and at the confluence with the Sacramento River it would be 34% higher During September of the other water year types, mean flows at the two locations would be up to 60% and 38% lower, respectively.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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 H4_ELT in any month or water year type throughout the period.

Kelts

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay and the confluence with the Sacramento River during the March through April kelt migration period would generally be similar to or up to 18% greater than flows under NAA_ELT during March and up to 548% higher than flows under NAA_ELT during April (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 evaluated during the March through April steelhead kelt downstream 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.

American River

Juveniles

Mean flows under H4_ELT in the American River at the confluence with the Sacramento River during the October through May juvenile migration period would generally be similar to flows under

NAA_ELT except during October of below normal and critical water years, in which flows under H4_ELT would be 17% and 24% higher, respectively(Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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.

Adults

Mean flows under H4_ELT in the American River at the confluence with the Sacramento River during the September through March adult migration period would generally be similar to flows under H3_ELT except during September of below normal years, in which flows would be 22% lower, and October of below normal and critical water years, in which flows would be 17% and 24% higher (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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 H4_ELT in any month or water year type throughout the period.

Kelts

Mean flows under H4_ELT in the American River at the confluence with the Sacramento River during the March through April kelt migration period 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 American River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream 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.

Stanislaus River

Mean flows in the Stanislaus River at the confluence with the San Joaquin River for H4_ELT are essentially the same as flows under NAA_ELT in all months. Therefore, there would be no effect of H4_ELT on juvenile, adult, or kelt migration in the Stanislaus River.

Further, mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River for H4_ELT are not different from flows under NAA_ELT for any month. Therefore, there would be no effect of H4_ELT on juvenile, adult, or kelt migration in the Stanislaus River.

San Joaquin River

Mean flows in the San Joaquin River at Vernalis for H4_ELT are little different from flows under NAA_ELT for all months. Therefore, there would be no effect of H4_ELT on juvenile, adult, or kelt migration in the San Joaquin River.

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

Mokelumne River

Mean flows in the Mokelumne River at the Delta for H4_ELT are not different from flows under NAA_ELT for any month. Therefore, there would be no effect of H4_ELT on juvenile, adult, or kelt migration in the Mokelumne River.

Water temperature modeling was not conducted in the Mokelumne River.

Through-Delta

Sacramento River

Juveniles

Alternative 4A operations would generally reduce OMR reverse flows under all flow scenarios, with a corresponding increase in net positive downstream flows, during the outmigration period of steelhead through the interior Delta channels (Appendix B, Supplemental Modeling for Alternative 4A). Conditions under Scenario H4_ELT would further improve overall average OMR flows relative to other flow scenarios under Alternative 4A. These improved net positive downstream flows would be substantial benefits of the proposed operations.

As noted under Predation Associated with Entrainment above, predation at the north Delta would be increased due to the construction of the proposed SWP/CVP water export facilities on the Sacramento River. It is assumed that per capita steelhead predation losses would be similar to those predicted for spring-run Chinook salmon, although slightly reduced because of the larger size of steelhead outmigrants. Bioenergetics modeling predicts a predation loss of about 0.2% of the juvenile spring-run population (Table 11-4A-26).

Based on DPM results for spring-run Chinook salmon (Impact AQUA-60 for Alternative 4A), changes in steelhead survival relative to NAA_ELT would be expected to be limited under Alternative 4A. Also, steelhead juveniles are larger than Chinook salmon juveniles in general, and therefore may be less vulnerable to predation during migration. The DPM analysis of Alternative 4A on juvenile spring-run Chinook salmon migration suggests a potential adverse effect of small magnitude. As noted for spring-run Chinook salmon, this adverse effect would be minimized through the bypass flow criteria and real-time operations outlined above, as well as inclusion within Alternative 4A of specific important conservation measures. These conservation measures 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 spring-run Chinook salmon juveniles into the low-survival interior Delta. Therefore the effect on juvenile steelhead outmigration success through the Delta under Alternative 4A would not be adverse.

Adults

The upstream adult steelhead migration occurs from September–March, peaking during December-February. The steelhead kelt downstream migration occurs from January–April. The proportion of Sacramento River water in the Delta under Alternative 4A would be similar (8% or less difference) to NAA_ELT throughout the adult steelhead upstream migration (Table 11-4A-89). Under

Alternative 4A's Scenario H3_ELT, mean monthly Sacramento River flows at Rio Vista averaged over all water years would be reduced compared to NAA_ELT, ranging from 46% less in September to 7.5% less in December. For H4_ELT, the range is from about 1% less in April to 30% less in October and November. These differences are less than those observed under Alternative 1A and so, because the effect under Alternative 1A would not be adverse, Alternative 4A would also not have an adverse effect on adult and kelt steelhead migration through the Delta.

San Joaquin River

Juveniles

The only changes to San Joaquin River flows at Vernalis would result from the modeled effects of climate change on inflows to the river downstream of Friant Dam and reduced tributary inflows. There are no flow changes associated with Alternative 4A Alternative 4A would have no effect on steelhead migration success through the Delta from the perspective of changing inflows into the Delta. However, juvenile steelhead migration success would be aided by the inclusion in the water conveyance facilities of an operable barrier at the head of Old River, which would keep flow and fish in the mainstem San Joaquin River.

Adults

Alternative 4A Scenario H3_ELT would slightly increase the proportion of San Joaquin River water in the Delta in September through March by 1.3 to 4.4 % (compared to NAA_ELT) (Table 11-4A-89). The proportion of San Joaquin River water under Scenario H3_ELT would be similar or slightly more than NAA_ELT. Conditions under Scenario H4_ELT are expected to increase the proportion of San Joaquin River water (relative to the change under Scenario H3_ELT) because it would involve fewer exports from the north Delta during spring.

Table 11-4A-89. Percentage (%) of Water at Collinsville that Originated in the Sacramento River and San Joaquin River during the Adult Steelhead Migration Period for Alternative 4A

Month	EXISTING CONDITIONS	NAA_ELT	H3_ELT	EXISTING CONDITIONS vs. H3_ELT	NAA_ELT vs. H3_ELT
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
January	76	75	73	-2	-2
February	75	74	69	-6	-4
March	78	77	69	-9	-8
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
January	1.6	1.7	2.9	1.3	1.3
February	1.4	1.5	3.6	2.2	2.2
March	2.6	2.6	5.7	3.1	3.1
	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).

NEPA Effects: Upstream of the Delta, these modeling results indicate that the effect is not adverse because it would not substantially reduce the amount of suitable habitat or substantially interfere with the movement of fish. Effects of Alternative 4A in all locations analyzed would consist primarily of negligible effects on mean monthly flow and water temperatures for the juvenile, adult, and kelt migration periods. In the Feather River, higher flows during spring months may provide some benefits to migrating steelhead. Effects of Alternative 4A on upstream water temperatures would be negligible.

Near-field effects of Alternative 4A NDD on Sacramento River steelhead related to impingement and predation associated with three new intake structures could result in negative effects on juvenile migrating steelhead, 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 (~ 12% 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, as described in the adaptive management and monitoring program in Section 4.1, 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 to inform real-time operations of the NDD, intended to provide adequate migration conditions for downstream-migrating juvenile salmonids. 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 other salmonids, 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, although these modeling results focused on juvenile Chinook salmon as opposed to steelhead. As noted for winter-run and spring-run Chinook salmon above, the elements of Alternative 4A related to reduced interior Delta entry (Environmental Commitment 16) and reduced south Delta entrainment may offset the far-field effects of reduced flow. As noted for the various Chinook salmon runs, 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 will be investigated as part of the adaptive management and monitoring program.

Adverse effects of the water conveyance facilities operations at the NDD would be minimized through the bypass flow criteria and real-time operations described for other salmonids (e.g., winter-run Chinook salmon), as well as inclusion within Alternative 4A of specific important conservation measures: *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 juvenile salmonids into the low-survival interior Delta.

CEQA Conclusion: In general, Alternative 4A would reduce the quantity and quality of migration habitat for steelhead 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 migration habitat for steelhead relative to Existing Conditions.

Upstream of the Delta

H3_ELT/ESO_ELT

Sacramento River

Juveniles

Flows in the Sacramento River just upstream of Red Bluff Diversion Dam were evaluated for the juvenile migration period (October 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, except during October and November, in which flows would be up to 16% lower than those under Existing Conditions. These reductions in flow would be too small and infrequent to have biologically meaningful negative effects on migration conditions.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead 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.

Adults

Mean flows under H3_ELT during the adult migration period (September through March) would generally be similar to those under Existing Conditions, except during September through November October, in which flows would be up to 22% lower than those under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*) The changes in flow due to H3_ELT would be frequent enough (3 of 7 months), large enough (up to 22% lower), and occur during all water year types to be considered biologically meaningful negative effects on adult migration conditions.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead 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 Existing Conditions and H3_ELT in all months except September and October, in which temperatures under H3_ELT would be 6% greater than those under Existing Conditions.

Kelts

Mean flows under H3_ELT during the kelt migration period (March and April) would be similar to those under Existing Conditions for all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream 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 or water year type throughout the period.

Overall in the Sacramento River, H3_ELT would not affect flow or water temperature conditions for juvenile, adult, or kelt steelhead migration.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Juveniles

Flows under H3_ELT in Clear Creek at Whiskeytown during the October through May juvenile migration period would generally be similar to flows under Existing Conditions, except for 40% higher flow in January of wet years and 10% higher flows in December through April of critical water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows under H3_ELT in Clear Creek at Whiskeytown during the September through March adult migration period would generally be similar to flows under Existing Conditions, except for 40% higher flow in January of wet water years, 10% higher flows in December through March of critical years, and 19% lower flow in September of critical years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows under H3_ELT in Clear Creek at Whiskeytown during the March through April kelt migration period would generally be similar to flows under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, H3_ELT would not affect flow or water temperature conditions for juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Mean flows were evaluated in the Feather River at Thermalito Afterbay during the October through May juvenile migration period. Flows under H3_ELT would be similar to flows under Existing Conditions during October through December and March, up to 48% lower than flows under Existing Conditions during January and February, and up to 33% greater than flows under Existing Conditions during April and May (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Flows at the confluence with the Sacramento River under H3_ELT would generally be similar to those under Existing Conditions throughout the period.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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 all months and water year types of the migration period.

Adults

Mean flows were examined in the Feather River at Thermalito Afterbay during the September through March adult migration period. Flows under H3_ELT would be up to 192% greater than flows under Existing Conditions during September, similar to flows under Existing Conditions during October through December and March, and up to 48% lower than flows under Existing Conditions during January and February (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The mean flows at the confluence with the Sacramento River under H3_ELT would generally be similar or up to 19% lower than those under Existing Conditions during November through March and similar or up to 21% higher during October, while flows in September would range from 28% lower to 100% higher, depending on water year type.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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 Existing Conditions and H3_ELT in all months and water year types of the period.

Kelts

Mean flows under H3_ELT in the Feather River at Thermalito Afterbay during the March through April kelt migration period would be similar to flows under Existing Conditions during March and up to 29% higher than flows under Existing Conditions during April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows for March and April at the confluence with the Sacramento River would generally be similar between H3_ELT and Existing Conditions.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream 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 or water year type throughout the period.

Overall in the Feather River, the effect of H3_ELT on flows would include frequent substantial reductions in flows that would affect juvenile and adult migration conditions, particularly in drier water years, but would generally not affect kelt migration.

American River

Juveniles

Mean flows under H3_ELT in the American River at the confluence with the Sacramento River during the October through May juvenile migration period would generally be similar to or up to 15% higher than flows under Existing Conditions, except during November, January, and May, in which flows would be up to 24% lower under H3_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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 no different (<5%) from those under Existing Conditions, except in October, for which the water temperatures would 5% to 6% higher for all but critical water years.

Adults

Flows under H3_ELT in the American River at the confluence with the Sacramento River during the September through March adult migration period would generally be similar to or up to 15% higher than flows under Existing Conditions, except during September, November, and January, in which flows would be up to 47% lower (September of critical water years) than under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult 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 no different (<5%) from those under Existing Conditions, except in October, for which the water temperatures would 5% to 6% higher for all but critical water years.

Kelts

Flows under H3_ELT in the American River at the confluence with the Sacramento River during the March through April kelt migration period would generally be similar to flows under Existing

Conditions, except for March of critical water years, in which the mean flow would be 12% lower under H3_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March and April steelhead kelt downstream 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 no different (<5%) from those under Existing Conditions.

Overall in the American River, the effect of H3_ELT on flows would include frequent moderate reductions in flows that would affect juvenile and adult migration conditions, particularly in drier water years, but would generally not affect kelt migration

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the October through May steelhead juvenile downstream 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 during October through January and up to 29% lower than flows under Existing Conditions during February through May.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May steelhead juvenile downstream 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 temperatures between H3_ELT and Existing Conditions.

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be similar to or up to 29% lower (February of critical water years) than flows under Existing Conditions depending on month and water year type.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead 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 temperatures between H3_ELT and Existing Conditions.

Kelt

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows during the period under H3_ELT would be up to 23% over than flows under Existing Conditions.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the March and April steelhead kelt downstream 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 temperatures between H3_ELT and Existing Conditions.

San Joaquin River

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

Juveniles

Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead juvenile downstream 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 minor exceptions.

Adults

Flows in the San Joaquin River at Vernalis were evaluated for the September through March steelhead adult 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, with minor exceptions.

Kelt

Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt downstream 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 minor exceptions.

Mokelumne River

Water temperature modeling was not conducted in the Mokelumne River.

Juveniles

Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H3_ELT would generally be lower than flows under Existing Conditions during April and May (up to 11% lower), similar to flows under Existing Conditions during October, November, and January through March, and higher than flows under Existing Conditions during December (up to 28% higher).

Adults

Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead adult 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, except during December, in which mean flow would be up to 28% higher, and during September, when flows would be up to 22% lower.

Kelt

Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt downstream 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 during both months of the period.

H4_ELT /ESO_ELT

Sacramento River

Juveniles

Flows in the Sacramento River just upstream of Red Bluff Diversion Dam were evaluated for the juvenile migration period (October through May) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be similar to those under Existing Conditions.

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the October through May juvenile steelhead 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 or water year type throughout the period.

Adults

Mean flows under H4_ELT during the adult migration period (September through March) would generally be similar to those under Existing Conditions except during September, in which flows would be up to 49% higher for wet and above normal water years and up to 18% lower for dry and critical water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). The changes in flow would be too infrequent to have biologically meaningful negative effects on migration conditions.

Mean temperatures in the Sacramento River upstream of Red Bluff were evaluated during the September through March steelhead 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 Existing Conditions and H4_ELT in any month or water year type throughout the period.

Kelts

Mean flows under H4_ELT during the kelt migration period (March and April) would generally be similar to those under Existing Conditions for all water year types (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the Sacramento River upstream of Red Bluff were evaluated during the March through April steelhead kelt downstream 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 or water year type in the period.

Overall in the Sacramento River, H4_ELT would not affect flow or water temperature conditions for juvenile, adult, or kelt steelhead migration.

Clear Creek

No water temperature modeling was conducted in Clear Creek.

Juveniles

Flows under H4_ELT in Clear Creek at Whiskeytown during the October through May juvenile migration period would generally be similar to flows under Existing Conditions, except for 40% higher flow in January of wet years, 10% higher flows in December through April of critical water years, and other minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Adults

Flows under H4_ELT in Clear Creek at Whiskeytown during the September through March adult migration period would generally be similar to flows under Existing Conditions, except for 40% higher flow in January of wet water years, 10% higher flows in December through March of critical years, and other minor exceptions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Kelts

Flows under H4_ELT in Clear Creek at Whiskeytown during the March through April kelt migration period would generally be similar to flows under Existing Conditions, except for 13% higher flows in March of below normal water years and 10% higher flows in March and April of critical water years (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Overall in Clear Creek, H4_ELT would not affect flow or water temperature conditions for juvenile, adult, or kelt steelhead migration.

Feather River

Juveniles

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay during the October through May juvenile migration period would generally be lower (up to 36% lower) than flows under Existing Conditions during October through March and would be much higher for all water year types except critical during April and May (up to 509% higher) (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flow for April with all water years combined would be 92% greater than that under Existing Conditions. The flows at the confluence with the Sacramento River under H4_ELT would generally be similar or up to 26% lower (December of critical water years) than those under Existing Conditions during October through March and up to 112% higher in April and May.

Mean temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead 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 all months and water year types of the migration period.

Adults

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay during the September through March adult migration period would generally be lower (up to 36% lower) than flows under Existing Conditions during October through March (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows in September under H4_ELT would be up to 166% higher for wet, above normal and critical water years, and up to 49% lower for below normal and dry water years. The flows at the confluence with the Sacramento River under H4_ELT would generally be similar or up to 26% lower than those under Existing Conditions during October through March, while flows in September would range from 29% lower to 87% higher depending on water year type.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the September through March steelhead 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 Existing Conditions and H4_ELT in all months and water year types of the period.

Kelts

Mean flows under H4_ELT in the Feather River at Thermalito Afterbay during the March and April kelt migration period would range from 22% lower to 16% higher in March and from 4% to 509% higher in April (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows at the confluence with the Sacramento River for March would generally be similar between H4_ELT and Existing Conditions, while flows in April would be up to 112% higher under H4_ELT.

Mean water temperatures in the Feather River at the confluence with the Sacramento River were evaluated during the March through April steelhead kelt downstream 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 or water year type throughout the period.

Overall in the Feather River, the effect of H4_ELT on flows would include persistent and/or substantial reductions in flows that would affect juvenile and adult migration conditions, particularly in drier water years.

American River

Juveniles

Mean flows under H4_ELT in the American River at the confluence with the Sacramento River during the October through May juvenile migration period would generally be similar to or up to 15% higher than flows under Existing Conditions, except during November and May, in which flows would be up to 25% lower under H4_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the October through May juvenile steelhead migration 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%) from those under Existing Conditions, except in October, for which the water temperatures would 5% to 6% higher for all but critical water years.

Adults

Flows under H4_ELT in the American River at the confluence with the Sacramento River during the September through March adult migration period would generally be similar to or up to 15% higher than flows under Existing Conditions, except during September and November, in which flows would be up to 47% lower (September of critical water years) than under Existing Conditions (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the September through March steelhead adult upstream migration 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%) from those under Existing Conditions, except in October, for which the water temperatures would 5% to 6% higher for all but critical water years.

Kelts

Flows under H4_ELT in the American River at the confluence with the Sacramento River during the March through April kelt migration period would generally be similar to flows under Existing Conditions, except for March of critical years, during which the mean flow would be 12% lower under H4_ELT (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*).

Mean water temperatures in the American River at the confluence with the Sacramento River were evaluated during the March and April steelhead kelt downstream migration 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%) from those under Existing Conditions.

Overall in the American River, reductions inflows would be too small and infrequent to affect migration conditions for steelhead.

Stanislaus River

Juveniles

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the October through May steelhead juvenile downstream 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 during October through January and up to 29% lower than flows under Existing Conditions during February through May.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the October through May steelhead juvenile downstream 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 temperatures between H4_ELT and Existing Conditions.

Adults

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the September through March steelhead adult 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 during September through January and up to 29% lower than flows under Existing Conditions during February and March.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the September through March steelhead 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 temperatures between H4_ELT and Existing Conditions.

Kelt

Flows in the Stanislaus River at the confluence with the San Joaquin River were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be lower (by up to 23%) than flows under Existing Conditions in both months.

Mean water temperatures in the Stanislaus River at the confluence with the San Joaquin River were evaluated during the March and April steelhead kelt downstream 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 temperatures between H4_ELT and Existing Conditions.

San Joaquin River

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

Juveniles

Flows in the San Joaquin River at Vernalis were evaluated for the October through May steelhead juvenile downstream 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, except during March and April (up to 12% lower).

Adults

Flows in the San Joaquin River at Vernalis were evaluated for the September through March steelhead adult 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, except during March (up to 12% lower)

Kelt

Flows in the San Joaquin River at Vernalis were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be lower than flows under Existing Conditions (up to 12% lower)

Mokelumne River

Water temperature modeling was not conducted in the Mokelumne River.

Juveniles

Flows in the Mokelumne River at Delta were evaluated for the October through May steelhead juvenile downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be lower than flows under Existing Conditions during April and May (up to 11% lower), similar to flows under Existing Conditions during October, November, and January through March, and higher than flows under Existing Conditions during December (up to 28% higher).

Adults

Flows in the Mokelumne River at Delta were evaluated for the September through March steelhead adult upstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would generally be lower than flows under Existing Conditions during September (up to 22% lower), similar to flows under Existing Conditions during October, November, and January through March, and higher than flows under Existing Conditions during December (up to 28% higher).

Kelt

Flows in the Mokelumne River at Delta were evaluated for the March and April steelhead kelt downstream migration period (Appendix 11C, *CALSIM II Model Results utilized in the Fish Analysis*). Mean flows under H4_ELT would be similar to flows under Existing Conditions during March and up to 7% lower than flows under Existing Conditions during April.

Through-Delta

Based on DPM results for spring-run Chinook salmon, which do not assume any adjustments in operations based on fish presence, steelhead survival would not be expected to decrease more than 1%. Assuming similar effects on steelhead, Alternative 4A would have a minimal effect on steelhead migration success through the Delta. Therefore, the impact on juvenile steelhead migration through the Delta would be small, particularly given the inclusion in Alternative 4A of Environmental Commitments 6, 15, and 16 (see additional discussion in the *Summary of CEQA Conclusion* below).

The proportion of Sacramento River water in the Delta under Alternative 4A Scenario H3_ELT would be similar to Existing Conditions (<10% difference) during the entire adult steelhead upstream migration (Table 11-4A-89). As discussed in more detail for Alternative 4, because of the overall similarity in olfactory cues and Rio Vista flows between Alternative 1A and Alternative 4A during the entire adult and kelt migration periods, effects on migration success would be expected to be similar to Alternative 1A. Olfactory cues and flows in the San Joaquin River basin would be improved or similar to Alternative 1A and Existing Conditions. Overall, the impact to steelhead adult and kelt migration under Alternative 4A is considered negligible.

Summary of CEQA Conclusion

Under Alternative 4A, there would be reductions in flow in the Sacramento, Feather, American, Stanislaus, and Mokelumne Rivers that would lead to biologically meaningful reductions in juvenile and adult migration conditions, thereby reducing survival relative to Existing Conditions. Reduced migration conditions would delay or eliminate successful migration necessary to complete the steelhead life cycle. Alternative 4A would not affect migration conditions for steelhead in Clear Creek or the San Joaquin River. Water temperatures under Alternative 4A would generally be similar to those under Existing Conditions in all rivers examined. There would be minimal effects on through-Delta migration conditions because changes in juvenile survival and adult olfactory cues would be small. 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 migration conditions for steelhead.

However, 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, *Effects and Mitigation Approaches*, in the Draft EIR/EIS, because of differences between the CEQA and NEPA baselines, it is sometimes possible for CEQA and NEPA significance conclusions to differ from 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 in 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 negligible effects on mean monthly flow and water temperatures for the juvenile, adult, and kelt migration periods. Effects of. Near-field effects of Alternative 4A NDD on Sacramento River steelhead related to impingement and predation associated with the intake structures could result in negative effects on juvenile migrating steelhead, although there is high uncertainty regarding overall effects.

As noted for other salmonids such as winter-run Chinook salmon, similar or slightly lower survival than for Existing Conditions based on the water conveyance facilities operations would be offset by the inclusion of bypass flow criteria, real-time operational adjustments, *Environmental Commitment 6 Channel Margin Enhancement*, *Environmental Commitment 15 Localized Reduction of Predatory Fishes*, and *Environmental Commitment 16 Nonphysical Barriers*. Overall, it is concluded that the impact to steelhead would be less than significant and no mitigation would be required.

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 4A and Alternative 1A. The mechanisms of impacts of habitat restoration discussed for winter-run Chinook salmon would be similar for steelhead. However, as noted for Alternative 1A, juvenile steelhead migrants are typically older and larger than Chinook salmon migrants, making them less susceptible to effects from restoration construction activities. As larger migrants, steelhead pass through the river more quickly, resulting in lower risks of exposure to increased turbidity, methylmercury, accidental spills, disturbed contaminated sediments, or predation.

The following impacts are those presented under Alternative 4A and Alternative 1A that are anticipated to be similar in nature for Alternative 4A, but would occur to a lesser extent because of the reduced extent of the restoration measures under Alternative 4A.

Impact AQUA-97: Effects of Construction of Restoration Measures on Steelhead

The effects of construction of restoration measures on steelhead under Alternative 4A are similar in nature to those discussed in more detail under Alternative 1A: temporary increases in turbidity; increased exposure to mercury and methylmercury; accidental spills; disturbance of contaminated sediments; in-water work activities; and predation. In-water and shoreline restoration construction activities may result in short-term effects on steelhead through direct disturbance, short-term water quality impacts, and increased exposure to contaminants associated with the incidental disturbance of contaminated sediments. Overall and as noted for Alternative 1A, the effect of restoration construction activities on the bioavailability of contaminants is expected to be minimal, as they would likely be localized, sporadic, and of low magnitude. Implementation of the environmental commitments described in Appendix 3B, *Environmental Commitments*, would minimize or eliminate effects on steelhead. The relevant environmental commitments are: *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1 for delta smelt under Alternative 1A. Given the greatly reduced extent of restoration under Alternative 4A relative to Alternative 1A, the effects of construction of restoration measures on steelhead would be expected to be less than for Alternative 1A.

NEPA Effects: The effects of short-term construction activities would not be adverse to winter-run Chinook salmon. Implementation of the environmental commitments described in Appendix 3B, *Environmental Commitments*, would minimize or eliminate effects on steelhead. The relevant environmental commitments are: *Environmental Training; Stormwater Pollution Prevention Plan; Erosion and Sediment Control Plan; Hazardous Materials Management Plan; Spill Prevention, Containment, and Countermeasure Plan; and Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*. Pertinent details of these plans are provided under Impact AQUA-1.

CEQA Conclusion: As discussed for Alternative 1A, habitat restoration activities could result in short-term effects on steelhead but would be localized, sporadic, and of low magnitude; such effects would be avoided by limiting the frequency, duration, and spatial extent of in-water work and with implementation of environmental commitments (see Appendix 3B, *Environmental Commitments*). The potential impact of habitat restoration activities is considered less than significant because it would not substantially reduce steelhead habitat, restrict its range, or interfere with its movement. No additional mitigation would be required.

Impact AQUA-98: Effects of Contaminants Associated with Restoration Measures on Steelhead

As also noted for winter-run Chinook salmon, Alternative 4A habitat restoration actions could result in the disturbance or mobilization of upland and aquatic contaminants that could affect steelhead. As noted above, steelhead tend to pass through the Delta more quickly than other salmonids such as winter-run Chinook salmon, so that any overlap with contaminant effects of restoration measures would be limited. A detailed analysis of the potential effects based on the larger extent of tidal habitat restoration proposed under Alternative 4A can be found in the *BDCP Effects Analysis – Appendix 5D, Contaminants (hereby incorporated by reference)*. Potential impacts on steelhead from effects of methylmercury, selenium, copper, ammonia, and pesticides associated with habitat restoration activities would be similar to those discussed for delta smelt (see Impact AQUA-8). Within the relatively small extent of habitat restored under *Environmental Commitment 4 Tidal Natural Communities Restoration*, it is anticipated that any potential effects of methylmercury on steelhead will be addressed through implementation of Environmental Commitment 12. Environmental Commitment 12 is intended to minimize methylmercury exposure associated with restoration measures for juvenile Chinook salmon. Additional analysis and tools may be developed to further reduce methylmercury exposure as the habitat restoration conservation measures are refined and analyzed in site-specific documents.

NEPA Effects: The effect of restoration measures on chemical contaminants is not adverse to steelhead with respect to selenium, copper, ammonia, pesticides, and methylmercury (with implementation of Environmental Commitment 12).

CEQA Conclusion: Alternative 4A restoration actions are likely to result in slightly increased production, mobilization, and bioavailability of methylmercury. However, implementation of *Environmental Commitment 12 Methylmercury Management* would help to minimize the increased mobilization of methylmercury from restoration areas. Therefore, the impact of contaminants is considered less than significant because it would not substantially affect steelhead either directly or through habitat modifications. Consequently, no mitigation would be required.

Impact AQUA-99: Effects of Restored Habitat Conditions on Steelhead

Restored habitat under *Environmental Commitment 4 Tidal Natural Communities Restoration* and *Environmental Commitment 6 Channel Margin Enhancement* is intended to offset habitat loss/modification caused by construction and operation of the water facilities proposed under Alternative 4A.

NEPA Effects: The effects of restored habitat conditions on steelhead would not be adverse because they would provide potentially suitable habitat for steelhead.

CEQA Conclusion: As described above, habitat restoration would be undertaken to offset loss/modification of habitat from water facility construction and operation. The effects of restored habitat conditions on steelhead would be less than significant. Consequently, no 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 for steelhead remains the same.

Impact AQUA-100: Effects of Methylmercury Management on Steelhead (Environmental Commitment 12)

The impact discussion for winter-run Chinook salmon (Impact AQUA-46) is also applicable to steelhead.

NEPA Effects: The effects of methylmercury management on steelhead 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 on steelhead would be less than significant. Consequently, no mitigation is required.

Impact AQUA-103: Effects of Localized Reduction of Predatory Fish on Steelhead (Environmental Commitment 15)

Environmental Commitment 15 Localized Reduction of Predatory Fish would involve efforts to reduce predation by predatory fish at the proposed north Delta intakes and at the south Delta export facilities, including Clifton Court Forebay.

NEPA Effects: To the extent that localized predator control efforts of *Environmental Commitment 15 Localized Reduction of Predatory Fish* reduce the local abundance of fish predators at the north Delta diversions and near the south Delta export facilities (e.g., in Clifton Court Forebay), it is possible, but not assured, that there would be some reduction in losses to predation of juvenile steelhead (predation of adults is not a concern). This is of relevance given the potential effects on steelhead juveniles because of operations of the NDD (see Impact AQUA-93). Due to the uncertainty in the effectiveness of Environmental Commitment 15, there would be no demonstrable effect of this conservation measure on steelhead.

CEQA Conclusion: Due to the uncertainties associated with this Environmental Commitment, there would be no demonstrable effect on steelhead. This impact is considered less than significant. Consequently, no mitigation would be required.

Impact AQUA-104: Effects of Nonphysical Fish Barriers on Steelhead (Environmental Commitment 16)

As noted for winter-run Chinook salmon, under Alternative 4A, an NPB at the divergence of Georgiana Slough from the Sacramento River would be intended to guide juvenile salmonid fish such as steelhead away from Georgiana Slough and the interior Delta, wherein survival is relatively low compared to the Sacramento River (Singer et al. 2013). As noted for spring-run Chinook salmon, exploration with the DPM of the potential effects of an NPB at this location suggests that with effectiveness similar to that observed during a pilot study in 2011 (Perry et al. 2012), through-Delta survival of juvenile Chinook salmon would not differ greatly between Alternative 4A and Existing Conditions or NAA_ELT (see Table 5.C.5.3-41 in the *BDCP Effects Analysis Appendix 5.C hereby incorporated by reference*). These results, which are assumed to also be applicable to steelhead given similar life histories, suggest that Environmental Commitment 16 could offset negative effects of the water conveyance facilities. As discussed for Alternative 1A, the physical structure of an NPB may provide habitat for piscivorous fish in the area and increase localized predation risk.

NEPA Effects: The effects of NPB would not be adverse because it is intended to improve migration survival.

CEQA Conclusion: As discussed above, the NPB at the divergence of Georgiana Slough from the Sacramento River has the potential to reduce the proportion of steelhead entering the low-survival interior Delta. The impacts of *Environmental Commitment 16 Nonphysical Fish Barriers* are expected to be less than significant. Consequently, no mitigation would be required.

Sacramento Splittail

Construction and Maintenance of Water Conveyance Facilities

The discussion of potential effects to delta smelt from construction and maintenance of the water conveyance facilities under Alternative 4A is also relevant to Sacramento splittail. As discussed for Alternative 1A, various life stages of Sacramento splittail would have the potential to overlap construction and maintenance to varying degrees (Table 11-8).

Impact AQUA-109: Effects of Construction of Water Conveyance Facilities on Sacramento Splittail

The potential effects of construction of the water conveyance facilities on Sacramento splittail would be the same as described for Alternative 4 (Impact AQUA-109). This section provides additional detail on underwater noise impacts which are also applicable to Impact AQUA-109 in Alternative 4.

Table 11-8 presents the life stages of Sacramento splittail and the months of their potential presence in the north, east, and south Delta during the proposed in-water construction window (June 1–October 31). Under Alternative 4A, underwater noise generated by impact pile driving in or near open waters of the Delta can reach levels associated with potential injury of fish, including Sacramento splittail. The potential exists for relatively large numbers of young-of-the-year to occur in the vicinity of pile driving activities at the north Delta intakes, barge unloading facilities, Clifton Court Forebay, and Head of Old River operable barrier as larvae and juveniles disperse from upstream spawning and early rearing areas (riparian margins and floodplains) to the estuary in April-August. However, because of the relatively small area of open water affected by noise exceeding the injury thresholds (Table 4.3.7-1 under Delta Smelt), the limited duration of pile driving activities (Table 4.3.7-1 under Delta Smelt), and the lack of suitable rearing habitat in the affected areas, adverse effects would be limited to a small proportion of the population. Implementation of Mitigation Measures AQUA-1a and AQUA-1b would further reduce these impacts. No significant population-level effects are expected.

NEPA Effects: As concluded for Alternative 4, Impact AQUA-109, the effect would not be adverse for Sacramento splittail. Implementation of the measures described in Appendix 3B, *Environmental Commitments*, such as *Environmental Training*; *Stormwater Pollution Prevention Plan*; *Erosion and Sediment Control Plan*; *Hazardous Materials Management Plan*; *Spill Prevention, Containment, and Countermeasure Plan; Disposal of Spoils, Reusable Tunnel Material, and Dredged Material*; *Fish Rescue and Salvage Plan*; and *Barge Operations Plan* would guide rapid and effective response in the case of inadvertent spills of hazardous materials. Construction would not be expected to increase predation rates relative to baseline conditions. Construction will result in both temporary and permanent alteration of rearing and migratory habitats used by splittail. However, Alternative 4A includes Environmental Commitment 4 to restore tidal habitat and Environmental Commitment 6 to restore channel margin habitat. Underwater noise produced by impact pile driving could result in adverse