Appendix C

Priority 2 Recovery Actions and Implementation Schedule

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List of Acronyms

AFRP	Anadromous Salmonid Restoration Program
Bay/Delta	San Francisco Bay/Sacramento-San Joaquin Delta
BRT	Biological Resource Team
CALFED	CALFED Bay-Delta Program
CAMP	Comprehensive Assessment and Monitoring Program
CCWD	Contra Costa Water District
CCWMG	Cow Creek Watershed Management Group
CDFG	California Department of Fish and Game
CESA	California Endangered Species Act
CMARP	Comprehensive Monitoring Assessment and Research Program
cm	centimeters
cm/sec	centimeters per second
CNFH	Coleman National Fish Hatchery
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement act
CVSEPWT	Central Valley Salmonid Escapement Project Work Team
CWT	Coded Wire Tag
Delta	Sacramento-San Joaquin Delta
DPS	Distinct Population Segment
DWR	Department of Water Resources
ERP	Ecosystem Restoration Program
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
EWA	Environmental Water Account
FRFH	Feather River Fish Hatchery
ft/sec	feet per second
IEP	Interagency Ecological Program
m	meters
m/sec	millimeters per second
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
QC	Quality Control
RBDD	Red Bluff Diversion Dam
Reclamation	Bureau of Reclamation
RM	River Mile
RST	Rotary Screw Trap
SEWD	Stockton East Water District
TRT	Technical Review Team
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WSRCD	Western Shasta Resource Conservation District

1.0 INTRODUCTION

This Recovery Plan maintains a consistent strategic framework for the establishment of recovery goals and criteria, the identification and prioritization of threats, and the identification of recovery actions. As described in Chapter 4, the framework for ESU or DPS recovery includes goals and criteria directed at the diversity group (recovery units) and population (management units) levels. Similarly, the threats assessment framework for each ESU or DPS also was organized by diversity groups and populations. For winter-run Chinook salmon, threats were prioritized within the Sacramento River population, whereas for spring-run Chinook salmon and steelhead, threats were prioritized within each diversity group as well as within each population.

Results from the threats assessment and prioritization process (described in Appendix B) were used to guide the identification of watershed- and site-specific recovery actions for each diversity group and population. In that process, threat/stressor matrices were used to structure diversity group, population, life stage, and stressor information into hierarchically-related tiers so that stressors to each ESU or DPS could be prioritized. Although the matrices provide a semi-quantitative means of comparatively ranking individual stressors within a diversity group or population, it is important to avoid attributing unwarranted specificity to the prioritized stressor list. As such, the prioritized stressor list was distributed into four separate quartiles which represent four tiers of stressor importance, identified as "Very High", "High", "Medium", or "Low" importance.

In an effort to focus and direct energy at the most significant threats (i.e., threats in the "Very High" or "High" quartiles) to the Sacramento River winter-run Chinook salmon ESU, the Central Valley spring-run Chinook salmon ESU, and the Central Valley steelhead DPS, watershed- or site-specific recovery actions for the threats ranked in the "Medium" or "Low" quartiles have not been described in this recovery plan. Although such actions would certainly contribute to ESU or DPS recovery, considering the number of specific threats that ranked in the "Very High" or "High" quartiles for each diversity group[1], we believe an efficient recovery strategy should address the most important threats first.

An additional effort to prioritize recovery actions was undertaken through consideration of specific actions that benefit multiple species and populations. The initial step in this prioritization process was to organize recovery actions according to prioritized identified threats by geographic location throughout the Central Valley Domain.

The geographic locations are organized by specific areas that are most commonly used by multiple species and populations for some part of their life-history, specifically including juvenile rearing, juvenile emigration, and adult upstream migration. For example, the Delta is used by all anadromous salmonid populations at some stage(s) of their life cycles. Therefore, recovery actions in the Delta would have the highest priority in terms of providing multiple species and populations benefits because they affect all species and populations. Consequently, in consideration of potential benefits to multiple species and populations resulting from implementation of a specific recovery action, the descending order of geographic prioritization includes the Delta, lower Sacramento River, middle Sacramento River, upper Sacramento River, and the individual diversity groups (i.e., Northern Sierra Nevada, Basalt and Porous Lava, Northwestern California and Southern Sierra Nevada).

[1] Nearly 250 specific threats were identified in the "Very High" quartile for the Northern Sierra Nevada steelhead diversity group alone.

For each geographic area, recovery actions are organized in descending order of priority for species based on the priority assigned to Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Therefore, because winter-run Chinook salmon is identified as having the highest priority, recovery actions associated with winter-run Chinook salmon are given highest priority in Tables 2-1 through 2-6. Although spring-run Chinook salmon and steelhead are considered to have the same priority, spring-run Chinook salmon were assigned the next highest priority because only three remaining natural populations with consistent spawning exist, and they are in geographic proximity to each other. Consequently, due to the geographic and ESU/DPS-specific prioritization format, there are some occasions when a "very high" and "high" priority action for a given species/population also addresses a "low" or "medium" action identified for an additional species/population, and therefore are incorporated into the recovery action prioritization matrices.

A cross-referencing procedure was developed so that the relationship between prioritized threats, recovery actions, and threat abatement recovery criteria addressed by recovery actions could be tracked. This cross-referencing procedure is represented in matrix format in Tables 2-1 through 2-10, described as follows.

Species and populations were identified for each prioritized threat. A number was assigned to each threat so that individual prioritized threats could be identified. Recovery actions addressing each individually identified (numbered) threat were specified, and numerically differentiated corresponding to the identified threat. For example, if a threat was numerically identified as 2.1.1, then the recovery action corresponding to that threat would be identified as 2.1.1.1, and if more than one recovery action corresponded to a numerical threat then it would be sequentially numerically represented (e.g., 2.1.1.2, 2.1.1.3, 2.1.1.4, etc). Further, Chapter 4 of this Recovery Plan numerically identified individual threat abatement recovery criteria associated with specific listing factors and threats for winter-run Chinook salmon, spring-run Chinook salmon and steelhead. The threat abatement criteria associated with each identified threat and numbered recovery actions also were specified in Tables 2-1 through 2-10.

By linking specific recovery actions to the highest ranked threats, those recovery actions also become prioritized in importance to the diversity group or population. This structure provides the opportunity to consider recovery actions at multiple levels. Hence, recovery actions can be examined for the Central Valley Domain in its entirety, or for specific geographic areas, diversity groups or populations. For example, if a stakeholder or project proponent were interested in identifying recovery actions for a particular species/population in a given stream or watershed, the Stressor Matrix (Attachment A of Appendix B) and Appendix C could be used in combination to identify recovery actions for a specific area of interest (e.g., an individual stream or population). While Appendix C can be used to identify threats and associated recovery actions prioritized by species within each geographic area or diversity group, as described above, Attachment A of Appendix B could be used to identify the suite of life-stage specific stressors (i.e., characterized as threats in Appendix C) for a particular population or diversity group. Information contained in Attachment A and Appendix C could be used to cross-reference prioritized stressors identified in Attachment A with associated threats and recovery actions identified in Appendix C for a "priority of interest".

According to NMFS' 1990 Endangered and Threatened Species Listing and Recovery Priority Guidelines (55 FR 24296), recovery actions identified in a Recovery Plan are to be assigned priorities of 1 to 3, as follows.

Priority 1 – An action that must be taken to prevent extinction or to identify those actions necessary to prevent extinction

Priority 2 – An action that must be taken to prevent a significant decline in population numbers, habitat quality, or other significant negative impacts short of extinction

Priority 3 – All other actions necessary to provide for full recovery of the species

Priority 1 actions are described in Chapter 6 (Recovery Actions) and an implementation schedule for those critical actions is presented in Chapter 8 (Implementation). All of the remaining recovery actions identified in this Recovery Plan are considered Priority 2 actions, because they were identified to alleviate threats that ranked as "High" or "Very High" in the threats assessment and can be considered necessary to prevent a significant decline in population numbers, habitat quality or other significant negative impacts, directly or indirectly (e.g., through public outreach). Priority 2 actions are described in Tables 2-1 through 2-10 below. No Priority 3 recovery actions have been identified because there are numerous Priority 1 and Priority 2 actions that should be implemented first. As these higher priority actions are implemented over time and the status of winter-run Chinook salmon, spring-run Chinook salmon, and/or steelhead improves, it may be necessary to identify and prioritize remaining threats and associated actions, including actions necessary to provide full recovery (i.e., Priority 3 actions). However, at this time, recovery efforts should be directed at implementing the Priority 1 and Priority 2 actions.

The status of the recovery actions identified in Tables 2-1 through 2-10 will be assessed periodically through the adaptive management program of the recovery plan. During these assessments, the threats identification and prioritization process could be re-initiated to account for threats that have been alleviated and for changes in environmental and biotic conditions, which may have altered the distribution of stressors in terms of importance. Such alterations would result in a re-prioritization of recovery actions. Nonetheless, implementation of the prioritized recovery actions presented herein represent the first step at eliminating or alleviating the factors believed to be most detrimental to the viability of the Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon ESUs, and the Central Valley steelhead DPS.

Tables 2-1 through 2-10 function to describe the site- and watershed- specific recovery actions that were developed to alleviate threats identified and prioritized during the threats assessment process (Appendix B) and the implementation schedule associated with those actions, including involved parties, time frames, and cost estimates.

The cost of many of the actions in Tables 2-1 through 2-10 was not estimated due to a lack of information upon which to base the estimates. It is anticipated that recovery action implementation costs that are not yet determinable will be periodically assessed and updated through the Recovery Plan's adaptive management program. The cost of certain habitat restoration actions was based on information presented in a NOAA Tech Memo titled, "*Habitat Restoration Cost References for Salmon Recovery Planning*" (Thomson and Pinkerton 2008). That Tech Memo is included in this Recovery Plan as Appendix E.

Because: (1) the threats assessment was focused on watersheds and areas where winter-run, spring-run, or steelhead currently occur; and (2) the development of watershed- and site-specific recovery actions was limited to actions that address those threats, detailed threats information and associated recovery actions have not been identified in this Recovery Plan for watersheds that are currently unoccupied by those species. As described in Chapter 3, one component of the recovery strategy is to explore opportunities to reintroduce winter-run, spring-run, and steelhead into historic holding, spawning, and rearing habitats above large dams. This will involve detailed habitat assessments that will subsequently allow for the identification and prioritization of threats and associated recovery actions.

2.0 Priority 2 Recovery Actions

2.1 Ocean Recovery Actions

Table 2-1. Ocean Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.1.1 Poor water quality in the ocean	2.1.1.1 Enhance water quality in the ocean, and along the coast by promoting and implementing sustainable practices on land in ways that will improve the health of ocean water quality	2.1: Threats to water quality	Long-term	NMFS, USFWS	CDFG, WDFW, ODFW	Pacific Fisheries Management Council	N/A	TBD	TBD	TBD	
			2.1.1.2 CDFG and National Marine Santuary Program should consider the ecological requriements of salmon and steelhead when designating santuaries										
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Yuba River, Butte Creek, Feather River, Antelope Creek, Big Chico Creek, Battle Creek, Sacramento River, Beegum Creek, Thomes Creek, Clear Creek.		2.1.1.3 Establish and implement an integrated ecosystem protection and restoration strategy that is science-based and aligns conservation and restoration goals at the Federal, state, tribal, local, and regional levels.										
Steelhead	Beegum Creek, Thomes Creek, Stony Creek, Clear Creek, Big Chico Creek, Antelope Creek, Feather River, Yuba River, Mill Creek, Deer Creek, Sacramento River, Battle Creek, Upper Sacramento River tributaries, Cow Creek, San Joaquin River, Tuolumne River, Merced River, Calaveras River, Stanislaus River, Mokelumne River, Putah Creek.		2.1.1.4 Implement recommended actions from the White House Council on Environmental Quality, Interim Report of the Interagency Ocean Policay Task Force, September, 10, 2009.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	

2.2 Bay Recovery Actions

Table 2-2. Bay Threats and Associated Recovery Actions

Winter-run Chinook Salmon Spring-run Chinook Salmon Steelhead	Sacramento River Butte Creek, Yuba River, Feather River, Mill Creek, Battle Creek, San Joaquin River, Calaveras River, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Stanislaus River, Tuolumne River, Merced River, Mokelumne River, Putah Creek, Clear Creek, Thomes Creek, Stony Creek, Beegum Creek,	2.2.1 Agricultural, urban, and industrial inputs to the Bays affecting juveniles	2.2.1.1 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	5 Years		SWRCB		N/A	N/A	N/A	N/A	
Winter-run Chinook Salmon Spring-run Chinook Salmon	Sacramento River Butte Creek, Yuba River, Feather River, Mill Creek,	2.2.2 Agricultural, urban, and industrial inputs to the Bays affecting juveniles	2.2.2.2 Implement the water quality and reliability improvements of the Delta Improvements Package (CALFED 2007).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	CBDA, SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	
Steelhead	Battle Creek, San Joaquin River, Calaveras River, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Stanislaus River, Tuolumne River, Merced River, Mokelumne River, Putah Creek, Clear Creek, Thomes Creek, Stony Creek, Beegum Creek,		2.2.2.3 Implement projects that would reduce anthropogenic inputs of NH4 to help achieve concentrations below 4 µmol L-1 in order to promote increased primary and secondary production (Dugdale *et al* . 2007).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.2.2.4 Implement tidal marsh restoration projects to promote nitrification and retention of NH4 (Dugdale *et al* . 2007).	1.2: Threats to Water Quality	Long-term	Corps, USFWS, NMFS	DWR, CDFG	Various NGOs		TBD	TBD	TBD	Tidal wetland restoration in San Francisco Bay/Estuary cost between $5,000 and $100,000 per acre. Source: Thomson and Pinkerton 2008.
Winter-run Chinook Salmon	Sacramento River.	2.2.3 Predation on juveniles in San Francisco, San Pablo, and Suisun bays.	2.2.3.1 Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	1 million	1 million	1 million	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Feather River.												
Steelhead	Sacramento River, American River, Battle Creek, Cow Creek, Upper Sacramento River tributaries, San Joaquin River, Tuolumne River, Calaveras River, Merced River, Stanislaus River, Mokelumne River, Stony Creek, Clear Creek, Putah Creek, Beegum Creek, Thomes Creek.		2.2.3.2 Develop and implement studies to: (1) Identify and evaluate the significance of marine mammal predation on anadromous salmonids; and (2) Identify locations where high rates of marine mammal predation occurs.	3.2: Threats from Predation	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	A proposal to evaluate marine mammal predation on salmonids in the Columbia River cost $500,000 annually. Source: Columbia Basin Fish and Wildlife Authority Website 1997.
		2.2.3 Predation on juveniles in San Francisco, San Pablo, and Suisun bays.	2.2.3.3 Implement studies to develop quantitative estimates of predation on salmonids by non-native species throughout the Bays. The steelhead predation study being conducted by DWR et al. in Clifton Court Forebay is one example of such a study.	3.2: Threats from Predation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	800,000	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.2.3.4 Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	3.2: Threats from Predation	Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR			TBD	TBD	TBD	Cost of nearshore restoration in the Bays could range from approximately $100 per lineal foot to $1250 per lineal foot, depending on the type of restoration and transportation costs. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	

2.3 Sacramento-San Joaquin Delta Recovery Actions

Table 2-3. Sacramento-San Joaquin Delta Threats and Associated Recovery Actions

Winter-run Chinook Salmon	Sacramento River.	2.3.1 Loss of natural morphology and function in the Delta affecting juveniles.	2.3.1.1 Implement the Dutch Slough Tidal Marsh Restoration Project and similar restoration projects throughout the Delta (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	Long-term		DWR, State Coastal Conservancy, CBDA	City of Oakley, National Heritage Institute		TBD	TBD	TBD	Wetland restoration in San Francisco Bay cost approximately $20,000 to 30,000 per acre, and up to $80,000 per acre. Source: Thomson and Pinkerton 2008.
Steelhead	Sacramento River, Battle Creek, Cow Creek, Yuba River, Mill Creek, Deer Creek, Feather River, Antelope Creek, Big Chico Creek, Butte Creek, American River, Dry Creek, Auburn Ravine/Coon Creek, Bear River, Beegum Creek, Clear Creek, Thomes Creek, Stony Creek, Merced River, Calaveras River, Tuolumne River, Stanislaus River, Upper Sacramento River tributaries, San Joaquin River, Mokelumne River, Putah Creek.		2.3.1.2 Make set-back levees and ecosystem restoration in the Delta integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	1.3: Threats to Habitat Quality and Complexity	year 2 through year 10	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA			TBD	TBD	TBD	Levee setback and planting on Twitchell Island cost $3.5 – 4 million per mile. Source: Nuedeck 2000.
			2.3.1.3 - Revise FloodSAFE plan		Year 2 through year 5								
			2.3.1.4 - begin bank revetment removal programs		Year 2 through year 5								
		2.3.1 Loss of natural morphology and function in the Delta affecting juveniles.	2.3.1.5 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA			TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16. Cost range of $5,000 - $135,000 per acre.
			2.3.1.6 Curtail further development in active Delta floodplains through zoning restrictions, county master plans and other Federal, State, and county planning and regulatory processes, and land protection agreements.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.3.1.6 Increase monitoring and enforcement of illegal rip rap applications.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.3.1.7 Develop and implement education and outreach programs to encourage river stewardship.	1.3: Threats to Habitat Quality and Complexity	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.3.2 Loss of riparian habitat and instream cover in the Delta affecting juveniles.	2.3.2.1 Implement the Dutch Slough Tidal Marsh Restoration Project and identify and implement similar restoration projects throughout the Delta (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	Long-term		DWR, State Coastal Conservancy, CBDA	City of Oakley, National Heritage Institute		TBD	TBD	TBD	Wetland restoration in San Francisco Bay cost approximately $20,000 to 30,000 per acre, and up to $80,000 per acre. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Yuba River, Butte Creek, Antelope Creek, Feather River, Mill Creek, Deer Creek, Big Chico Creek, Beegum Creek, Clear Creek, Battle Creek, Sacramento River, Thomes Creek .		2.3.2.2 Develop and implement boat wake restrictions along primary migration corridors in the Delta to prevent bank erosion and promote riparian recruitment and growth, and conduct outreach activities targeting boaters.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Year 2 through year 5	Coast Guard	DWR, CDFG	Local law enforcement agencies	N/A	N/A	N/A	N/A	
Steelhead	Sacramento River, Yuba River, Bear River, Feather River, American River, Merced River, Mokelumne River, San Joaquin River, Stanislaus River, Battle Creek, Antelope Creek, Mill Creek, Deer Creek, Butte Creek, Beegum Creek, Clear Creek, Thomes Creek, Stony Creek, Calaveras River, Tuolumne River, Putah Creek.		2.3.2.3 Develop and implement State and National levee vegetation policies to maintain and restore riparian corridors (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Various NGOs		TBD	TBD	TBD	Levee planting on Twitchell Island cost $1 – 1.5 million per mile of levee. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.3.2.4 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
		2.3.2 Loss of riparian habitat and instream cover in the Delta affecting juveniles.	2.3.2.5 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA			TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16. Cost range of $5,000 - $135,000 per acre.
			2.3.2.6 Increase monitoring and enforcement of illegal rip rap applications.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.3.2.7 Curtail further development in active Delta floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.3.2.8 Promote native riparian (e.g., willows) species through eradication of non-native species (e.g., *Arundo* , tamarisk).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities		TBD	TBD	TBD	$12,000 per acre estimate for invasive species eradication program on the Napa River. Source: CDFG-072, as cited in Thomson and Pinkerton 2008.
			2.3.2.9 Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated and/or leveed reaches of the Delta.	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities		TBD	TBD	TBD	Levee planting on Twitchell Island cost $1 – 1.5 million per mile of levee. Source: Nuedeck 2000.
			2.3.2.10 Permanently protect riparian habitat through easements and/or land acquisition	1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.3.3 Predation on juveniles in the Delta.	2.3.3.1 Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.	3.2: Threats from Predation	Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR			TBD	TBD	TBD	Cost of nearshore restoration in the Delta could range from approximately $100 per lineal foot to $1250 per lineal foot, depending on the type of restoration and transportation costs. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Spring-run Chinook Salmon	Sacramento River, Yuba River, Feather River, Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Big Chico Creek, Beegum Creek, Clear Creek, and Thomes Creek.		2.3.3.2 Eradicate wherever possible Egeria and other non-native aquatic vegetation that have been demonstrated to provides habitat non-native fish predators, primarily sunfish and striped bass	3.2: Threats from Predation									
Steelhead	Sacramento River, Battle Creek, Yuba River, Feather River, American River, Calaveras River, San Joaquin River, Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Big Chico Creek, Auburn Ravine/Coon Creek, Clear Creek, Thomes Creek, Cottonwood/Beegum Creek, Putah Creek, Stony Creek, Cow Creek, Upper Sacramento River tributaries, Mokelumne River, Tuolumne River, Merced River, Stanislaus River.	2.3.3 Predation on juveniles in the Delta.	2.3.3.3 Discourage habitat restoration projects that are likely to result in increased habitat for non-native predators	3.2: Threats from Predation									
Winter-run Chinook Salmon	Sacramento River.	2.3.4 Entrainment of juveniles at individual diversions in the Delta.	2.3.4.1 Develop an entrainment monitoring program to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	year 2 through year 5	NMFS, Reclamation	CDFG, DWR, CALFED	Irrigation districts, Water districts		TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.3.5 Loss of floodplain habitat in the Delta affecting juveniles.	2.3.5.1 Implement habitat improvement projects throughout the Delta including, but not limited to: (1) Western Cache Slough Project and Hastings Tract Restoration Project; (2) Little Holland Tract Restoration Project; and (3) Eastern Egbert Tract Restoration Project (see Four Pumps Delta Fish Agreement Amendment – Ongoing Actions to Address State Water Project Impacts).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	5,000 - 100,000 per acre	TBD	TBD	TBD	Tidal wetland restoration in the San Francisco Bay / Estuary cost between $5,000 and $100,000 per acre. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Sacramento River, Yuba River, Feather River, Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Big Chico Creek Beegum Creek, Clear Creek, and Thomes Creek.	2.3.5 Loss of floodplain habitat in the Delta affecting juveniles.	2.3.5.2 Restore floodplains and establish floodplain habitat in Snodgrass and Georgiana sloughs, near the mouths of the Cosumnes and Mokelumne rivers, and in the McCormick-Williamson Tract (CDFG *et al* . 2008).		Long-term	Corps, USFWS, NMFS	DWR, CDFG	Various NGOs		TBD	TBD	TBD	$5,000 - $80,000 per acre cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003.
Steelhead	Sacramento River, Yuba River, Feather River, American River, San Joaquin River, Merced River, Stanislaus River, Tuolumne River, Battle Creek, Cow Creek, Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Butte Creek, Clear Creek, Beegum Creek, Stony Creek, Thomes Creek, Putah Creek, Upper Sacramento River tributaries, Calaveras River, Mokelumne River.		2.3.5.3 Implement restoration projects for Lindsey and Barker sloughs (CDFG *et al* . 2008).		Long-term	Corps, USFWS, NMFS	DWR, CDFG	Various NGOs	5,000 - 100,000 per acre	TBD	TBD	TBD	Tidal wetland restoration in the San Francisco Bay / Estuary cost between $5,000 and $100,000 per acre. Source: Thomson and Pinkerton 2008.
		2.3.5 Loss of floodplain habitat in the Delta affecting juveniles.	2.3.5.4 Evaluate the potential effects of reconnecting Elk Slough to the Sacramento River, and if the evaluation suggests that habitat conditions for salmonids would improve, then implement a project to carry out the reconnection (Siegel 2007).		Long-term	USFWS, NMFS, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	It is anticipated that his action would be included in the Bay-Delta Conservation Plan, which is currently in development.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.3.5.5 Manage Elk, Sutter, and Steamboat Sloughs for salmon passage and habitats (Siegel 2007).		Long-term	USFWS, NMFS, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	
			2.3.5.6 Re-establish hydrologic connectivity between historical Stone Lakes floodplain and the Sacramento River with a design that minimizes juvenile stranding (Delta Vision Stakeholder Coordination Group 2007).		Long-term	Reclamation, NMFS, USFWS	DWR, CDFG		5,000 - 80,000 per acre	TBD	TBD	TBD	$5,000 - $80,000 per acre cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003.
			2.3.5.7 Make set-back levees integral components of the Corp's authorized bank protection (including bank relocation) and ecosystem restoration efforts (NMFS 2006). Implement the California State Plan for flood control (FloodSAFE).		year 2 through year 5								
			2.3.5.8 Replace and modify the Lisbon Weir to improve fish habitats (and passage) and management flexibility (CDFG *et al* . 2008).		5 Years	Reclamation, NMFS, USFWS	DWR, CDFG		N/A	TBD	TBD	TBD	Cost would be project-specific (e.g., proposed minimal cost for preliminary engineering design of the Iron Canyon and Bear Hole Fish Passage Project on Big Chico Creek was $145,000)
		2.3.5 Loss of floodplain habitat in the Delta affecting juveniles.	2.3.5.9 Restore tidal wetlands and associated habitats at Brannan Island State Park, northeast tip of Sherman Island, along Seven-Mile slough, and the southwest tip of Twitchell Island (CDFG *et al.* 2008).		Long-term	NMFS, USFWS	DWR, CDFG, CDPR		5,000-100,000 per acre	TBD	TBD	TBD	$5,000 - $100,000 cost per acre estimate from San Francisco Bay / Estuary. Annual monitoring costs were estimated at $500 per acre per year. Source: Steere, p231-233.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.3.5.10 Implement projects to restore native riparian vegetation along channel margins and set-back levees (*CDFG et al. 2008*).		Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	12,000 per acre	TBD	TBD	TBD	$12,000 per acre cost estimate for invasive species eradication program on the Napa River. Source: CDFG-072, as cited in Thomson and Pinkerton 2008.
Winter-run Chinook Salmon Spring-run Chinook Salmon Steelhead	Sacramento River. Yuba River, Big Chico Creek, Beegum Creek, Thomes Creek, Feather River, Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Battle Creek, Sacramento River, Clear Creek, American River, Bear River, Yuba River, Feather River, San Joaquin River, Merced River, Stanislaus River, Big Chico Creek, Thomes Creek, Beegum Creek, Putah Creek, Stony Creek, Battle Creek, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Tuolumne River, Mokelumne River, Calaveras River, Clear Creek.	2.3.6 Aquatic invasive species (e.g., Asian clam, A. aspera, microcystis, water hyacinth) and associated food web disruption in the Delta affecting the juvenile rearing and outmigration life stage.	2.3.6.1 Implement the management actions for addressing invasive aquatic species described in the California Aquatic Invasive Species Management Plan (CDFG 2008).	5.4: Threats Resulting from Invasive Aquatic Species	Long-term	Corps, Reclamation, USFWS, NMFS, Coast Guard	DWR, CDFG	Various NGOs, Universities	N/A	TBD	TBD	TBD	
Winter-run Chinook Salmon	Sacramento River.	2.3.7 Loss of tidal marsh habitat in the Delta affecting juveniles.	2.3.7.1 Restore and protect tidal wetlands and associated habitats throughout the Delta including:	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	DWR, CDFG, CDPR			TBD	TBD	TBD	$5,000-$100,000 per acre cost per acre estimate from San Francisco Bay / Estuary. Annual monitoring costs were estimated at $500 per acre per year. Source: Steere, p231-233.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Yuba River, Butte Creek, Big Chico Creek, Mill Creek, Deer Creek, Beegum Creek, Thomes Creek, Feather River, Antelope Creek, Battle Creek, Sacramento River, Clear Creek, .		2.3.7.2 (1) at Brannon Island State Park; (2) along the northeast tip of Sherman Island; (3) along Seven-mile Slough; (4) at the southwest tip of Twitchell Island; (5) within Sherman Lake; (6) in the Hotchkiss and Veale Tracts; (7) around Decker Island; (8) at Dutch Slough; (9) at Big Break; (10) at Franks Tract; (11) along the north shore of the Sacramento River along the Montezuma Hills; and (12) in Sand Mound Slough (CDFG et al. 2008)									
Steelhead	Beegum Creek, American River, Yuba River, Dry Creek (Sacramento Region), Auburn Ravine/Coon Creek, Feather River, Butte Creek, Big Chico Creek, San Joaquin River, Thomes Creek, San Joaquin River, Battle Creek, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Merced River, Stanislaus River, Tuolumne River, Mokelumne River, Calaveras River, Stony Creek, Putah Creek, Clear Creek.												
Winter-run Chinook Salmon	Sacramento River	2.3.8 Agricultural, urban, and industrial inputs to the Delta affecting water quality during the juvenile outmigration life-stage.	2.3.8.1 Implement projects that improve wastewater and stormwater treatment throughout the Delta and surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments	N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
Spring-run Chinook Salmon	Yuba River, Feather River, Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Sacramento River, Beegum Creek, Clear Creek, Thomes Creek.		2.3.8.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the Delta.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.3.8 Agricultural, urban, and industrial inputs to the Delta affecting water quality during the juvenile outmigration life-stage.	2.3.8.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	5 Years		SWRCB		N/A	N/A	N/A	N/A	
Steelhead	Stony Creek, Feather River, Yuba River, Battle Creek, San Joaquin River, Stanislaus River, Calaveras River, Tuolumne River, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Merced River, Mokelumne River, Putah Creek, Clear Creek, Thomes Creek, Beegum Creek.		2.3.8.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.3.8.5 Implement the water quality and reliability improvements of the Delta Improvements Package (CALFED 2007).		Long-term	NMFS, USFWS	CBDA, SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	
			2.3.8.6 Implement projects that would reduce anthropogenic inputs of NH4 to help achieve concentrations below 4 µmol L-1 in order to promote increased primary and secondary production (Dugdale *et al* . 2007).		Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
			2.3.8.7 Implement tidal marsh restoration projects to promote nitrification and retention of NH4 (Dugdale *et al* . 2007).		Long-term	Corps, USFWS, NMFS	DWR, CDFG	Various NGOs	5,000 - 100,000 per acre	TBD	TBD	TBD	Tidal wetland restoration in the San Francisco Bay / Estuary cost between $5,000 and $100,000 per acre. Source: Thomson and Pinkerton 2008.
Winter-run Chinook Salmon Spring-run Chinook Salmon	Sacramento River Stony Creek, Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Battle Creek, Clear Creek, Beegum Creek, Thomes Creek, Sacramento River, Big Chico Creek, Yuba River, Feather River.	2.3.9 Agricultural, urban, and industrial inputs to the Delta affecting water quality during the adult immigration life-stage.	2.3.9.1 Implement projects that improve wastewater and stormwater treatment throughout the Delta and surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments	N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Beegum Creek, Clear Creek, Deer Creek, Mill Creek, Battle Creek, Sacramento River, Stanislaus River, San Joaquin River, Calaveras River, Tuolumne River, Merced River, Thomes Creek, Upper Sacramento River tributaries, Cow Creek, Mokelumne River, Putah Creek		2.3.9.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the Delta.
			2.3.9.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	5 Years		SWRCB		N/A	N/A	N/A	N/A	
		2.3.9 Agricultural, urban, and industrial inputs to the Delta affecting water quality during the adult immigration life-stage.	2.3.9.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.3.9.5 Implement the water quality and reliability improvements of the Delta Improvements Package (CALFED 2007).		Long-term	NMFS, USFWS	CBDA, SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	
			2.3.9.6 Implement projects that would reduce anthropogenic inputs of NH4 to help achieve concentrations below 4 µmol L-1 in order to promote increased primary and secondary production (Dugdale *et al* . 2007).		Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
			2.3.9.7 Implement tidal marsh restoration projects to promote nitrification and retention of NH4 (Dugdale *et al* . 2007).		Long-term	Corps, USFWS, NMFS	DWR, CDFG	Various NGOs	5,000 - 100,000 per acre	TBD	TBD	TBD	Tidal wetland restoration in the San Francisco Bay / Estuary cost between $5,000 and $100,000 per acre. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.3.10 Passage impediments/barriers in the Sacramento Deep Water Ship Channel affecting adult immigration.	2.3.10.1 Design and implement a project(s) to eliminate the adverse effects on anadromous species related to the Sacramento Deep Water Ship Channel. Such projects could include providing upstream passage at the lock gates and/or eliminating flow through the lock gates.	5.4: Threats Resulting from Migration Obstructions and Impediments	5 Years	Corps, USFWS, NMFS	CDFG	Port of Sacramento	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Battle Creek, Beegum Creek, Yuba River, Butte Creek, Big Chico Creek, Feather River, Sacramento River, Clear Creek, Thomes Creek.	2.3.10 Passage impediments/barriers in the Sacramento Deep Water Ship Channel affecting adult immigration.											
Steelhead	Mill Creek, Deer Creek, Dry Creek, (Sacramento Region), Antelope Creek, Battle Creek, Beegum Creek, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Clear Creek, Thomes Creek, Putah Creek, Stony Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.3.11 Passage impediments/barriers at the Suisun Marsh Salinity Control	2.3.11.1 Continue to operate the SMSCS with the boat lock open in order to allow fish passage in and out of Suisun Marsh.	5.4: Threats Resulting from Migration Obstructions and	Long-term	USFWS, NMFS	CDFG, DWR		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Beegum Creek, Yuba River, Butte Creek, Big Chico Creek, Feather River, Sacramento River, Clear Creek, Thomes Creek.	Structure affecting adult immigration.		Impediments									
Steelhead	Mill Creek, Deer Creek, Dry Creek (Sacramento Region), Antelope Creek, Beegum Creek, Battle Creek, Calaveras River, San Joaquin River, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Merced River, Tuolumne River, Mokelumne River, Stanislaus River, Clear Creek, Thomes Creek, Putah Creek, Stony Creek.	2.3.11 Passage impediments/barriers at the Suisun Marsh Salinity Control Structure affecting adult immigration.											
Winter-run Chinook Salmon	Sacramento River	2.3.12 Water temperature in the Delta affecting adult immigration	2.3.12.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Clear Creek, Beegum Creek, Thomes Creek, Big Chico Creek, Yuba River, Feather River, Sacramento River.		2.3.12.2 Implement actions designed to decrease water temperatures in the Sacramento and San Joaquin rivers and tributaries during late-spring through early fall, thereby decreasing thermal loading to the Delta.		Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Thomes Creek, Beegum Creek, Clear Creek, Stony Creek, Battle Creek, Calaveras River, Stanislaus River, Tuolumne River, Merced River, San Joaquin River, Sacramento River, Mokelumne River, Putah Creek	2.3.12 Water temperature in the Delta affecting adult immigration		1.3: Threats to Habitat Quality and Complexity									
Winter-run Chinook Salmon	Sacramento River	2.3.13 Water temperature in the Delta affecting juvenile outmigration.	2.3.13.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Yuba River, Feather River, Battle Creek, Sacramento River, Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Big Chico Creek, Clear Creek, Beegum Creek, Thomes Creek.		2.3.13.2 Implement actions designed to decrease water temperatures in the Sacramento and San Joaquin rivers and tributaries during late-spring through early fall, thereby decreasing thermal loading to the Delta.	1.3: Threats to Habitat Quality and Complexity	year 2 through year 10	NMFS, USFWS	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
Steelhead	Stony Creek, Yuba River, Battle Creek, Sacramento River, Stanislaus River, San Joaquin River, Tuolumne River, Calaveras River, Upper Sacramento River tributaries, Cow Creek, Mokelumne River, Merced River, Putah Creek, Clear Creek, Beegum Creek, Thomes Creek.												
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Yuba River, Battle Creek, Feather River, Butte Creek, Big Chico Creek, Sacramento River, .		2.3.13.3 Maintain the Old and Middle River at less than negative 5,000 cfs.		Long-term	Reclamation, NMFS, USFWS	DWR, CDFG		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Sacramento River, Mill Creek, Deer Creek, Antelope Creek, Yuba River, Auburn Ravine/Coon Creek, Calaveras River, Merced River, San Joaquin River, and Mokelumne River.		2.3.13.4 Implement a 35 percent Export to Inflow Ratio in January.		Long-term	Reclamation, NMFS, USFWS	DWR, CDFG		N/A	TBD	TBD	TBD	
			2.3.13.5 Utilize the head of Old River barrier to minimize entrainment at the Jones and Banks pumping plants.		Long-term	Reclamation, NMFS, USFWS	DWR, CDFG		N/A	TBD	TBD	TBD	
Winter-run Chinook Salmon	Sacramento River.	2.3.14 Hatchery effects (i.e., competition and predation) in the Delta affecting juveniles.	2.3.14.1 Develop HGMPs and control hatchery release timing, numbers and locations to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.
Spring-run Chinook Salmon	Butte Creek, Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Feather River, Yuba River, Sacramento River, Beegum Creek, Clear Creek, Thomes Creek.	2.3.14 Hatchery effects (i.e., competition and predation) in the Delta affecting juveniles.											
Steelhead	American River, Battle Creek, Sacramento River, Bear River, Butte Creek, Mokelumne River, Cow Creek, Upper Sacramento River tributaries, San Joaquin River, Tuolumne River, Clear Creek, Thomes Creek, Beegum Creek, Putah Creek, Stony Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.3.15 Harvest/angling in the Delta affecting adults	2.3.15.1 Modify sport-fishing regulations to further minimize harvest of anadromous salmonids in the Delta.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG, CBDA		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Beegum Creek, Thomes Creek, Clear Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Calaveras River, Mokelumne River, Thomes Creek, Beegum Creek, Upper Sacramento River tributaries, Cow Creek, Sacramento River, Battle Creek, San Joaquin River, Stanislaus River, Tuolumne River, Merced River, Clear Creek, Stony Creek, Putah Creek.												
Steelhead	Calaveras River, San Joaquin River, Merced River, Stanislaus River, Mokelumne River, Tuolumne River,	2.3.16 Stockton Deep Water Ship Channel affecting adults	2.3.16.1 Design and implement a project(s) to eliminate the adverse effects on anadromous species related to the Stockton Deep Water Ship Channel.	5.4: Threats Resulting from Migration Obstructions and Impediments	Long-term	Corps, NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

2.4 Lower Sacramento River Recovery Actions

Table 2-4 Lower Sacramento River Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.4.1 Loss of natural river morphology and function in the lower Sacramento River affecting juveniles	2.4.1.1 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	$5,000 - $135,000 per acre cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Sacramento River. Feather River, Yuba River, Battle Creek, Beegum Creek, Clear Creek and Thomes Creek.		2.4.1.2 Curtail further development in active lower Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
		2.4.1 Loss of natural river morphology and function in the lower Sacramento River affecting juveniles	2.4.1.3 Increase monitoring and enforcement of illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Yuba River, Feather River, Butte Creek, Big Chico Creek, Bear River, Auburn Ravine and Coon Creek, Sacramento River, Cow Creek, Battle Creek, Clear Creek, Beegum Creek, Thomes Creek, Stony Creek, Cow Creek, Upper Sacramento Tributaries.		2.4.1.4 Develop and implement education and outreach programs to encourage river stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.4.2 Loss of riparian habitat and instream cover in the lower Sacramento River affecting juveniles.	2.4.2.1 Develop and implement State and National levee vegetation policies to maintain and restore riparian corridors (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Various NGOs	1-1.5 million per mile of levee	TBD	TBD	TBD	Levee planting on Twitchell Island cost $1 – 1.5 million per mile of levee. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Yuba River, Big Chico Creek, Feather River, Sacramento River, Battle Creek, Beegum Creek, Clear Creek, and Thomes Creek.		2.4.2.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring, and creating river riparian corridors within their jurisdiction.		Long-term	Corps, USFWS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Yuba River, Feather River, Butte Creek, Dry Creek, Auburn Ravine/Coon Creek, Bear River, Sacramento River, Battle Creek, Clear Creek, Thomes Creek, Beegum Creek, Stony Creek, Cow Creek, Upper Sacramento Tributaries.	2.4.2 Loss of riparian habitat and instream cover in the lower Sacramento River affecting juveniles.	2.4.2.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	$5,000 - $135,000 per acre cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.4.2.4 Increase monitoring and enforcement efforts to eliminate illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.4.2.5 Curtail further development in active lower Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.4.2.6 Promote native riparian (e.g., willows) species through eradication of non-native species (e.g., *Arundo* , tamarisk).		Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	12,000 per acre	TBD	TBD	TBD	$12,000 per acre cost estimate for invasive species eradication program on the Napa River. Source: CDFG-072, as cited in Thomson and Pinkerton 2008.
			2.4.2.7 Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the lower Sacramento River especially between Colusa and Verona.		Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	1-1.5 million per mile of levee	TBD	TBD	TBD	Levee planting on Twitchell Island cost $1 – 1.5 million per mile of levee. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.4.2 Loss of riparian habitat and instream cover in the lower Sacramento River affecting juveniles.	2.4.2.8 Restore a continuous 85-mile stretch of riparian habitat of an appropriate width to flood-prone lands along both banks of the river between Colusa and Sacramento.		Long-term	USFWS	CDFG	The Nature Conservancy, California Wildlife Conservation Board, landowners	1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
			2.4.2.9 Permanently protect riparian habitat through easements and/or land acquisition										
Winter-run Chinook Salmon	Sacramento River.	2.4.3 Predation on juveniles in the lower Sacramento River.	2.4.3.1 Implement a study designed to develop quantitative estimates of predation on winter-run Chinook salmon, spring-run Chinook salmon, and steelhead by non-native species in the lower Sacramento River.	3.2: Threats from Predation	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	500,000+	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Yuba River, Feather River, Big Chico Creek, Sacramento River, and Battle Creek.		2.4.3.2 Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Yuba River, Butte Creek, Feather River, Big Chico Creek, American River, Auburn Ravine/Coon Creek, Sacramento River, Battle Creek, Clear Creek, Thomes Creek, Stony Creek, Cow Creek, .Upper Sacramento Tributaries.	2.4.3 Predation on juveniles in the lower Sacramento River.	2.4.3.3 Implement projects to minimize predation at weirs, diversion dams, and related structures.		Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Integrated Non-Lethal Electric Barrier and Sonar demonstration project in the Columbia River (to prevent marine mammal predation) was estimated at approximately $1.4 million. Source: Northwest Power and Conservation Council Website 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.4.3.4 Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Winter-run Chinook Salmon Spring-run Chinook Salmon Steelhead	Sacramento River. Mill Creek, Deer Creek, Yuba River, Antelope Creek, Feather River, Butte Creek, Big Chico Creek, Battle Creek, Sacramento River, Beegum Creek, Clear Creek, Thomes Creek. Battle Creek,Cow Creek, Upper Sacramento Tributaries, Sacramento River, Clear Creek, Beegum Creek,Thomes Creek.	2.4.4 Low flow conditions in the lower Sacramento River limiting habitat availability during the juvenile rearing and outmigration life stage.	2.4.4.1 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	48 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Beegum Creek, Butte Creek, Antelope Creek, Mill Creek, and Deer Creek, Big Chico Creek, Feather River, Yuba River, Sacramento River.	2.4.5 Low flows (attraction and migratory cues) and flood flows (non-natal area attraction) in the lower Sacramento River affecting adult immigration.	2.4.5.1 Increase integration of the State and Federal water projects through shared storage and conveyance agreements.	1.3: Threats to Habitat Quality and Complexity	Long-term	Reclamation, USFWS, NMFS, Corps	DWR, CDFG, DPC, CBDA	Water agencies	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Auburn Ravine/Coon Creek, Dry Creek, Butte Creek, Bear River, Big Chico Creek, Mill Creek, Stony Creek, Thomes Creek, Beegum Creek, Clear Creek, Antelope Creek.	2.4.5 Low flows (attraction and migratory cues) and flood flows (non-natal area attraction) in the lower Sacramento River affecting adult immigration.	2.4.5.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	48 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.4.5.3 Implement projects that improve fish passage between the Sacramento River and flood bypasses.		Long-term	NMFS, USFWS, Corps, Reclamation	DWR, CDFG		N/A	TBD	TBD	TBD	
			2.4.5.4 Evaluate pulse flow benefits for steelhead attraction and passage; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.		Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
Winter-run Chinook Salmon	Sacramento River.	2.4.6 Entrainment of juveniles at diversions in the lower Sacramento River.	2.4.6.1 Develop an entrainment monitoring program to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Yuba River, Mill Creek, Deer Creek, Butte Creek, Big Chico Creek, Antelope Creek, Feather River, Battle Creek, Sacramento River, Beegum Creek and Thomes Creek.		2.4.6.2 Develop and increase application of alternative diversion technologies that eliminate entrainment.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
Steelhead	Yuba River, Mill Creek, Antelope Creek, and Big Chico Creek, Auburn Ravine/Coon Creek, Butte Creek, Deer Creek, Battle Creek, Sacramento River, Stony Creek.	2.4.6 Entrainment of juveniles at diversions in the lower Sacramento River.	2.4.6.3 Implement projects that consolidate and screen existing diversions meeting NMFS criteria where feasible..		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Costs would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.4.7 Water temperature in the lower Sacramento River affecting the juvenile rearing and outmigration life stage.	2.4.7.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Yuba River, Feather River, Mill Creek, Deer Creek, Antelope Creek, Butte Creek.Big Chico Creek, Sacramento River, Beegum Creek, Thomes Creek.		2.4.7.2 Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Resource Conservation Districts	CDFG, DWR, SWRCB		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
Steelhead	Sacramento River, Yuba River, Feather River, Bear River, Mill Creek, Dry Creek, Big Chico Creek, Antelope Creek, Deer Creek, Battle Creek, Stony Creek, Clear Creek, Beegum Creek, Thomes Creek, Upper Sacramento Tributaries, Cow Creek, Stony Creek, Beegum Creek, Thomes Creek.	2.4.7 Water temperature in the lower Sacramento River affecting the juvenile rearing and outmigration life stage.											
Winter-run Chinook Salmon	Sacramento River.	2.4.8 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.4.8.1 Implement projects that improve wastewater and stormwater treatment in Sacramento and in residential, commercial, and industrial areas surrounding the watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
Spring-run Chinook Salmon	Butte Creek, Yuba River, Feather River, Big Chico Creek, Mill Creek., Deer Creek, Antelope Creek, Big Chico Creek, Beegum Creek, Clear Creek, Thomes Creek.		2.4.8.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).		Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the lower Sacramento River.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Cow Creek, Upper Sacramento Tributaries, Clear Creek, Beegum Creek, Thomes Creek.	2.4.8 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.4.8.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	5 Years		SWRCB		N/A	N/A	N/A	N/A	
			2.4.8.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.4.8.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.4.8 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.4.8.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would be dependent on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.4.8.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Winter-run Chinook Salmon	Sacramento River	2.4.9 Loss of floodplain habitat in the lower Sacramento River affecting juveniles.	2.4.9.1 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		3.5 - 4 million per mile of levee	TBD	TBD	TBD	Levee setback and planting on Twitchell Island cost $3.5 – 4 million per mile of levee. Source: Nuedeck 2000.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Yuba River, Big Chico Creek, Feather River, Sacramento River, Battle Creek, Beegum Creek, Clear Creek, and Thomes Creek.	2.4.9 Loss of floodplain habitat in the lower Sacramento River affecting juveniles.	2.4.9.2 Curtail further development in active lower Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Yuba River, Big Chico Creek, Feather River, Butte Creek, Dry Creek, Bear River, Sacramento River, Battle Creek, Cow Creek, Clear Creek, Beegum Creek, Thomes Creek, Stony Creek, Upper Sacramento Tributaries.		2.4.9.3 Implement projects that acquire strategic floodplain easements to re-establish floodplain connectivity in areas constricted by levees.		Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Landowners, Local governments, NGOs	$1800 - $4800 per acre	TBD	TBD	TBD	$1800 - $4800 per acre cost would be dependent on the land's zoning, its proximity to an urban area, and its development potential. Source: Thomson and Pinkerton 2008.
			2.4.9.4 Develop education and outreach programs to encourage floodplain stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.4.9 Loss of floodplain habitat in the lower Sacramento River affecting juveniles.	2.4.9.5 Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa (The Nature Conservancy Website).		Long-term	USFWS	CDFG	The Nature Conservancy, California Wildlife Conservation Board, local farmers	1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Winter-run Chinook Salmon	Sacramento River.	2.4.10 Water temperature in the lower Sacramento River affecting the adult immigration life stage.	2.4.10.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Yuba River, Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Battle Creek, Big Chico Creek, Feather River, Sacramento River, Feather River.		2.4.10.2 Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Resource Conservation Districts	CDFG, DWR, SWRCB		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
Steelhead	Yuba River, Sacramento River, Dry Creek, Deer Creek, Antelope Creek, Mill Creek, Battle Creek, Stony Creek, Clear Creek, Beegum Creek, Thomes Creek, Cow Creek, Upper Sacramento Tributaries.												
Winter-run Chinook Salmon	Sacramento River.	2.4.11 Sacramento Deep Water Ship Channel impeding and/or delaying adults attempting to return to the Sacramento River, Mill, Deer, and Antelope creeks.	2.4.11.1 Design and implement a project(s) to eliminate the adverse effects on anadromous species related to the Sacramento Deep Water Ship Channel. Such projects could include providing upstream passage at the lock gates and/or eliminating flow through the lock gates.	5.4: Threats Resulting from Migration Obstructions and Impediments	5 Years	Corps, USFWS, NMFS	CDFG	Port of Sacramento	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Battle Creek, and Dry Creek (Sacramento Region).												
Steelhead	Antelope Creek, Battle Creek, and Beegum Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.4.12 Sutter Bypass (Tisdale Weir) impeding and/or delaying adult immigration.	2.4.12.1 Install effective adult fish passage facilities at Sutter Bypass weirs that currently impede adult passage (e.g., Tisdale Weir).	5.4: Threats Resulting from Migration Obstructions and Impediments	5 Years	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	2,177,000	TBD	TBD	Preliminary cost estimate for design and construction of the Willow Slough Fish Passage Project. Source: DWR 2005.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, and Battle Creek.												
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Battle Creek, Cow Creek, and Beegum Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.4.13 Yolo Bypass (FremontWeir) impeding and/or delaying adult immigration.	2.4.13.1 Install effective adult fish passage facilities at Yolo Bypass weirs that impede adult passage (e.g., FremontWeir).	5.4: Threats Resulting from Migration Obstructions and Impediments	5 Years	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Yolo Basin Working Group	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Butte Creek, Antelope Creek, and Big Chico Creek, Battle Creek, and Beegum Creek.												
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Butte Creek, Big Chico Creek, Battle Creek, Clear Creek, Beegum Creek, and Thomes Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.4.14 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the adult immigration life stage.	2.4.14.1 Implement projects that improve wastewater and stormwater treatment in Sacramento and in residential, commercial, and industrial areas surrounding the watershed (NMFS 2007b).	1.2: Threats to Water Quality									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Butte Creek, Antelope Creek, Yuba River, Feather River, Battle Creek, Beegum Creek, Clear Creek, Sacramento River.	2.4.14 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the adult immigration life stage.	2.4.14.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms									
Steelhead	Upper Sacramento Tributaries, Cow Creek.		2.4.14.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		5 Years		SWRCB		N/A	N/A	N/A	N/A	
	Mill Creek, Butte Creek, Deer Creek, Battle Creek, Sacramento River. Clear Creek, Beegum Creek, Thomes Creek, and Stony Creek.		2.4.14.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
		2.4.14 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the adult immigration life stage.	2.4.14.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.4.14.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would be dependent on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
		2.4.14 Agricultural and urban runoff/return flows in the lower Sacramento River affecting water quality during the adult immigration life stage.	2.4.14.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Winter-run Chinook Salmon Spring-run Chinook Salmon	Sacramento River. Butte Creek, Battle Creek, Mill Creek, Deer Creek, Antelope Creek, Yuba River, Feather River, Big Chico Creek, Sacramento River, Beegum Creek, Thomes Creek, Clear Creek.	2.4.15 Hatchery effects (i.e., competition and predation) in the lower Sacramento River affecting juveniles.	2.4.15.1 Develop HGMPs and control hatchery release timing, numbers and locations to minimize adverse effects to wild stock.	5.1: Threats from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	American River, Butte Creek, Battle Creek, Sacramento River, Cow Creek, Upper Sacramento Tributaries, Thomes Creek, Clear Creek, Beegum Creek, Stony Creek.												

2.5 Middle Sacramento River Recovery Actions

Table 2-5. Middle Sacramento River Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.5.1 Predation on juveniles in the middle Sacramento River.	2.5.1.1 Implement a study designed to develop quantitative estimates of predation on winter-run Chinook salmon, spring-run Chinook salmon, and steelhead by non-native species in the middle Sacramento River.	3.2: Threats from Predation	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	500,000+	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Beegum Creek, Clear Creek, Sacramento River, and Battle Creek.		2.5.1.2. Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Sacramento River, Battle Creek, Cow Creek, Clear Creek, Thomes Creek, Beegum Creek, Upper Sacramento Tributaries, Stony Creek.		2.5.1.3 Implement projects to minimize predation at weirs, diversion dams, and related structures.		Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.5.1 Predation on juveniles in the middle Sacramento River.	2.5.1.4 Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.5.2 Loss of natural river morphology and function in the middle Sacramento River affecting the juvenile rearing and outmigration life stage.	2.5.2.1 Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa (The Nature Conservancy Website).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS	CDFG	The Nature Conservancy, California Wildlife Conservation Board, local farmers	1.9 - 2.3 million per mile	TBD			Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, and Big Chico Creek.		2.5.2.2 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Sacramento River, Battle Creek, Clear Creek, Thomes Creek, Beegum Creek, Cow Creek, .Upper Sacramento Tributaries, Stony Creek.		2.5.2.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.5.2.4 Curtail further development in active middle Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.5.2.5 Increase monitoring and enforcement of illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.5.2 Loss of natural river morphology and function in the middle Sacramento River affecting the juvenile rearing and outmigration life stage.	2.5.2.6 Develop education and outreach programs to encourage river stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.5.3 Middle Sacramento River water temperatures affecting the juvenile rearing and outmigration life stage.	2.5.3.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, .Big Chico Creek, Sacramento River, Battle Creek, Beegum Creek, Thomes Creek.		2.5.3.2 Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Resource Conservation Districts	CDFG, DWR, SWRCB		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
Steelhead	Upper Sacramento River tributaries, Clear Creek, Battle Creek, Sacramento River, Stony Creek, Beegum Creek, Thomes Creek, Cow Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.5.4 Entrainment at diversions in the middle Sacramento River affecting juveniles.	2.5.4.1 Develop an entrainment monitoring program to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Big Chico Creek, Antelope Creek, Beegum Creek, and Thomes Creek.		2.5.4.2 Develop and increase application of alternative diversion technologies that eliminate entrainment.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Beegum Creek, Thomes Creek , Clear Creek, Stony Creek, Mill Creek, Antelope Creek, Big Chico Creek, Deer Creek, Cow Creek, Battle Creek, upper Sacramento River tributaries, Sacramento River, Stony Creek.		2.5.4.3 Implement projects that consolidate and screen existing diversions where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Costs would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $))
Winter-run Chinook Salmon	Sacramento River.	2.5.5 Low flow conditions in the middle Sacramento River limiting habitat availability during the juvenile rearing and outmigration life stage.	2.5.5.1 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Battle Creek, Sacramento River, Beegum Creek, Clear Creek, Thomes Creek.	2.5.5 Low flow conditions in the middle Sacramento River limiting habitat availability during the juvenile rearing and outmigration life stage.											
Steelhead	Cow Creek, Battle Creek, Upper Sacramento Tributaries, Sacramento River, Stony Creek, Clear Creek, Beegum Creek, Thomes Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.5.6 Loss of floodplain habitat in the middle Sacramento River affecting the juvenile rearing life stage.	2.5.6.1 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, and Beegum Creek.		2.5.6.2 Curtail further development in active middle Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	2.5.2.4	Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A
Steelhead	Mill Creek, Deer Creek, Antelope Creek, Cow Creek, Sacramento River, Battle Creek, Clear Creek Beegum Creek, Stony Creek, Thomes Creek, Upper Sacramento Tributaries.	2.5.6 Loss of floodplain habitat in the middle Sacramento River affecting the juvenile rearing life stage.	2.5.6.3 Implement projects that acquire strategic floodplain easements to re-establish floodplain connectivity in areas constricted by levees.		Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Landowners, Local governments, NGOs	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g. minimal, moderate or substantial) Source: Evergreen 2003, p. 39
			2.5.6.4 Develop education and outreach programs to encourage floodplain stewardship.										
			2.5.6.5 Restore a continuous 100-mile stretch of ecologically viable riparian habitat to flood-prone lands along the river between Red Bluff and Colusa (The Nature Conservancy Website).										
Winter-run Chinook Salmon	Sacramento River.	2.5.7 Loss of riparian habitat and instream cover in the middle Sacramento River affecting juveniles.	2.5.7.1 Develop State and Federal levee vegetation policies to maintain and restore riparian corridors (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Various NGOs	1-1.5 million per mile of levee	TBD	TBD	TBD	Levee planting on Twitchell Island cost $1 – 1.5 million per mile of levee. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Big Chico Creek, Antelope Creek, Thomes Creek, and Clear Creek.		2.5.7.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction.	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
Steelhead	Mill Creek, Deer Creek, Big Chico Creek, Antelope Creek, Sacramento River, Battle Creek, Cow Creek, Thomes Creek, Clear Creek, Beegum Creek, Upper Sacramento Tributaries, Stony Creek.		2.5.7.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.5.7.4 Increase monitoring and enforcement efforts to eliminate illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.5.7.5 Curtail further development in active middle Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
		2.5.7 Loss of riparian habitat and instream cover in the middle Sacramento River affecting juveniles.	2.5.7.6 Promote native riparian (e.g., willows) species through eradication of non-native species (e.g., *Arundo* , tamarisk).		Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	12,000 per acre	TBD	TBD	TBD	Cost estimate for invasive species eradication program on the Napa River. Source: CDFG-072, as cited in Thomson and Pinkerton 2008.
			2.5.7.7 Modify vegetation maintenance practices to encourage riparian growth and establish a native vegetated corridor in currently unvegetated/leveed reaches of the middle Sacramento River.		Long-term	USFWS, NMFS, Corps, NRCS	CDFG, DWR, CDPR, CDFA	Various NGOs, Universities	1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
			2.5.7.8 Restore a continuous 100-mile stretch of riparian habitat of an appropriate width to flood-prone lands along both banks of the river between Red Bluff and Colusa (The Nature Conservancy Website 2007).										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.5.7.9 Permanently protect riparian habitat through easements and/or land acquisition										
Winter-run Chinook Salmon	Sacramento River.	2.5.8 Agricultural and urban runoff/return flows in the middle Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.5.8.1 Implement projects that improve wastewater and stormwater treatment in residential and commercial areas surrounding the watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention / retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
Spring-run Chinook Salmon	Upper Sacramento Tributaries, Sacramento River, Battle Creek, Mill Creek, Deer Creek, Antelope Creek Big Chico Creek, Clear Creek, Beegum Creek, Thomes Creek.	2.5.8 Agricultural and urban runoff/return flows in the middle Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.5.8.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the middle Sacramento River.
Steelhead	Cow Creek, Upper Sacramento Tributaries, Clear Creek, Beegum Creek, Thomes Creek, Stony Creek.		2.5.8.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		5 Years		SWRCB		N/A	TBD	TBD	TBD	
			2.5.8.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.5.8 Agricultural and urban runoff/return flows in the middle Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.5.8.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.5.8.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
		2.5.8 Agricultural and urban runoff/return flows in the middle Sacramento River affecting water quality during the juvenile rearing and outmigration life stage.	2.5.8.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Winter-run Chinook Salmon	Sacramento River.	2.5.9 Water temperature in the middle Sacramento River affecting the adult immigration life stage.	2.5.9.1 Implement agricultural practices that would eliminate or minimize thermal loading associated with agricultural runoff (e.g., rice water).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local agriculture groups	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Sacramento River.		2.5.9.2 Implement actions designed to decrease water temperatures in Sacramento River tributaries during late-spring through early fall, thereby decreasing thermal loading to the Sacramento River.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Resource Conservation Districts	CDFG, DWR, SWRCB		N/A	TBD	TBD	TBD	Cost would be dependent on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
Steelhead	Big Chico Creek, Mill Creek, Antelope Creek, Deer Creek, Battle Creek, Sacramento River, Stony Creek, Beegum Creek, Clear Creek, Thomes Creek, Cow Creek, Upper Sacramento River tributaries.												
Winter-run Chinook Salmon	Sacramento River.	2.5.10 Low flows in the middle Sacramento River resulting in reduced attraction and migratory cues for adults.	2.5.10.1 Develop and implement pulse flow schedules during peak migration periods for years with low water availability.	1.3: Address Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
Spring-run Chinook Salmon	Antelope Creek, Mill Creek, Deer Creek, Beegum Creek, Big Chico Creek, Sacramento River.		2.5.10.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Steelhead	Stony Creek, Thomes Creek, Beegum Creek, Clear Creek, Battle Creek, Cow Creek, Upper Sacramento Tributaries, .Sacramento River.		2.5.10.3 Evaluate pulse flow benefits for steelhead attraction and passage; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.		Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
Winter-run Chinook Salmon	Sacramento River.	2.5.11 Hatchery effects in the middle Sacramento River affecting juveniles.	2.5.11.1 Develop HGMPs and control hatchery release timing, numbers and locations to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats Resulting from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, Antelope Creek, Big Chico Creek, Beegum Creek, Clear Creek, Thomes Creek.												
Steelhead	Sacramento River Battle Creek, Cow Creek, .Upper Sacramento Tributaries, Clear Creek, Beegum Creek, Stony Creek, Thomes Creek.	2.5.11 Hatchery effects in the middle Sacramento River affecting juveniles.											
Steelhead	Mill Creek, Deer Creek, Big Chico Creek, Clear Creek, Thomes Creek, and Beegum Creek.	2.5.12 Water quality in the middle Sacramento River affecting adult immigration.	2.5.12.1 Implement projects that improve wastewater and stormwater treatment in residential and commercial areas surrounding the watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention / retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
			2.5.12.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website)	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the middle Sacramento River.
			2.5.12.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		5 Years		SWRCB		N/A	TBD	TBD	TBD	
		2.5.12 Water quality in the middle Sacramento River affecting adult immigration.	2.5.12.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.5.12.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.5.12 Water quality in the middle Sacramento River affecting adult immigration.	2.5.12.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
			2.5.12.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	

2.6 Upper Sacramento River Recovery Actions

Table 2-6 Upper Sacramento River Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon Spring-run Chinook Salmon Steelhead	Sacramento River. Sacramento River. Sacramento River.	2.6.1 Keswick/Shasta Dam impeding and/or blocking adults returning to the Sacramento River and limiting the spatial distribution of spawning in the Sacramento River.	2.6.1.1 The winter-run Chinook salmon artificial propagation and captive broodstock programs should continue to be evaluated for the effectiveness in supporting winter-run Chinook population.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.6.1.2 Criteria should be developed for phasing out the program as winter-run recovery criteria are reached.										
			2.6.1.3 Supplementation rates for the lower Sacramento River population should not exceed 10%										
			2.6.1.4 Winter-run Chinook salmon artificial propagation program should be used for winter-run reintroduction efforts to historic habitats necessary to achieve recovery criteria										
Winter-run Chinook Salmon	Sacramento River.	2.6.2 Flow fluctuations in the upper[1] Sacramento River affecting spawning and embryo incubation in the Sacramento River.	2.6.2.1 Implement a river flow management plan that balances carryover storage needs with instream flow needs for winter-run Chinook salmon based on runoff and storage conditions, including flow fluctuation and ramping criteria (USFWS 2001).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps, USGS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.6.3 Predation on juveniles in the upper Sacramento River.	2.6.3.1 Implement a study designed to develop quantitative estimates of predation on Chinook salmon by non-native species in the upper Sacramento River.	3,2: Threats from Predation	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	500,000+	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Spring-run Chinook Salmon	Sacramento River and Clear Creek.		2.6.3.2 Implement programs and measures designed to control non-native predatory fish (NMFS 2007b), including eradication programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Steelhead	Cow Creek, Sacramento River, Upper Sacramento Tributaries, Clear Creek, and Beegum Creek.	2.6.3 Predation on juveniles in the upper Sacramento River.	2.6.3.3 Implement projects to minimize predation at weirs, diversion dams, and related structures.		Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.6.3.4 Improve nearshore refuge cover for salmonids to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.6.4. Water quality affecting embryo incubation in the upper Sacramento River.	2.6.4.1 Implement projects that improve wastewater and stormwater treatment in Redding and in surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source:Center for Urban Forest Research 2002.
Steelhead	Sacramento River.	2.6.4. Water quality affecting embryo incubation in the upper Sacramento River.	2.6.4.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website)	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultral drainage issues in the upper Sacramento River.
			2.6.4.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	
			2.6.4.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
		2.6.4. Water quality affecting embryo incubation in the upper Sacramento River.	2.6.4.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.6.4.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.6.4. Water quality affecting embryo incubation in the upper Sacramento River.	2.6.4.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.6.4.8 Improve and maintain containment of contaminants from Iron Mountain Mine.		Long-term	EPA	DWR		N/A	TBD	TBD	TBD	Continue EPA's cleanup of Iron Mountain Mine. In 2000, a settlement was proposed which included $862 million in funding to clean up Iron Mountain Mine. Source: EPA Website 2008.
Winter-run Chinook Salmon	Sacramento River.	2.6.5 Water temperature affecting embryo incubation in the upper Sacramento River.	2.6.5.1 Implement projects that improve wastewater and stormwater treatment in Redding and in surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source:Center for Urban Forest Research 2002.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Sacramento River.		2.6.5.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultral drainage issues in the upper Sacramento River.
Steelhead	Sacramento River.	2.6.5 Water temperature affecting embryo incubation in the upper Sacramento River.	2.6.5.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	
			2.6.5.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.6.5.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.6.5 Water temperature affecting embryo incubation in the upper Sacramento River.	2.6.5.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
			2.6.5.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.6.5.8 Improve and maintain containment of contaminants from Iron Mountain Mine.		Long-term	EPA	DWR		N/A	TBD	TBD	TBD	Continue EPA's cleanup of Iron Mountain Mine. In 2000, a settlement was proposed which included $862 million in funding to clean up Iron Mountain Mine. Source: EPA Website 2008.
Winter-run Chinook Salmon	Sacramento River.	2.6.6 Loss of natural river morphology and function in the upper Sacramento River affecting juveniles.	2.6.6.1 Modify gravel pits and mounds to ensure full drainage of these features to allow flooding while preventing juvenile salmonid stranding and warm water predator habitat.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	A feasibility project to investigate floodplain and riparian habitat restoration and determine procedures to reclaim a former gravel mining operation along the west bank of the Sacramento River (RM 239.5 to RM 238) at the La Barranca Unit in Tehama County, California cost approximately $51,000. Source: Sacramento River National Wildlife Refuge 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Sacramento River, Battle Creek, Clear Creek.		2.6.6.2 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Sacramento River, Beegum Creek, Upper Sacramento Tributaries, Clear Creek.	2.6.6 Loss of natural river morphology and function in the upper Sacramento River affecting juveniles.	2.6.6.3 Curtail further development in active upper Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.6.6.4 Increase monitoring and enforcement of illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.6.6.5 Develop education and outreach programs to encourage river stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.6.7 Limited spawning habitat availability in the upper Sacramento River.	2.6.7.1 Use the best available data regarding winter-run Chinook salmon spawning habitat availability (USFWS 2006, Appendix G) as a key consideration for determining Keswick Dam releases.	1.1: Threats to Spawning Habitat	Long-term	Reclamation, NMFS, USFWS, Corps	CDFG, DWR		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Sacramento River	2.6.7 Limited spawning habitat availability in the upper Sacramento River.	2.6.7.2 Conduct periodic (e.g., every 5 years) spawning gravel assessments in the upper Sacramento River (i.e., above RBDD) and implement gravel augmentation projects, as necessary.		Long-term	NMFS	CDFG		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento River Tributaries.												of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Winter-run Chinook Salmon	Sacramento River.	2.6.8 Water temperature in the upper Sacramento River affecting spawning.	2.6.8.1 Achieve the daily average water temperature targets described in the Biological Opinion on the Long-Term Central Valley Project Operations Criteria and Plan (NMFS 2004).	1.2: Threats to Water Quality	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Clear Creek		2.6.8.2 Identify and implement meadow and/or riparian habitat restoration projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Resource Conservation Districts	CDFG, DWR	NGOs	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Sacramento River, Battle Creek, Clear Creek, Beegum Creek.	2.6.8 Water temperature in the upper Sacramento River affecting spawning.											
Winter-run Chinook Salmon	Sacramento River.	2.6.9 Loss of riparian habitat and instream cover in the upper Sacramento River affecting juveniles.	2.6.9.1 The Corps, DWR, CDFG, BLM, USFWS, NMFS, private land owners, and Resource Conservation Districts should continue to focus on retaining, restoring and creating continuous riparian corridors within their jurisdictions.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS, BLM, NMFS	DWR, CDFG, CDPR	Local agencies, NGOs, landowners	N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Sacramento River, Battle Creek, Clear Creek.		2.6.9.2 Utilize bio-technical techniques for river bank stabilization instead of conventional rip rap.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Sacramento River, Cow Creek, Battle Creek, Beegum Creek, Upper Sacramento River Tributaries, Clear Creek.		2.6.9.3 Increase monitoring and enforcement of illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.6.9.4 Restore the current Lake Red Bluff footprint to riparian habitat.		Long-term	NMFS, USFWS	CDFG, DWR	Tehama-Colusa Canal Authority, City of Red Bluff	N/A	TBD	TBD	TBD	
			2.6.9.5 Permanently protect riparian habitat through easements and/or land acquisition										
Winter-run Chinook Salmon	Sacramento River.	2.6.10 Harvest/angling impacts in the upper Sacramento River affecting the spawning and embryo incubation (i.e., walking on redds) life stages.	2.6.10.1 Modify sport fishing regulations to minimize the number of anglers wading in the river during winter-run Chinook salmon embryo incubation (i.e., April through October).	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Sacramento River.		2.6.10.2 Implement outreach projects to educate the public regarding the salmon life cycle including how to identify a salmon redd.		Long-term	NMFS, USFWS, Reclamation, Corps, USGS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.6.11 Physical habitat alterations (e.g., Keswick and Shasta dams) limiting the supply of spawning gravels to the upper Sacramento River.	2.6.11.1 Conduct periodic (e.g., every 5 years) spawning gravel assessments in the upper Sacramento River (i.e., above RBDD) and implement gravel augmentation projects, as necessary.	1.1: Threats to Spawning Habitat	Long-term	NMFS	CDFG		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter,

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Sacramento River.												300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Sacramento River.												
Winter-run Chinook Salmon	Sacramento River.	2.6.12 Entrainment of juveniles at diversions in the upper Sacramento River.	2.6.12.1 Develop an entrainment monitoring program to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Clear Creek, Beegum Creek.		2.6.12.2 Develop and increase application of alternative diversion technologies that eliminate entrainment.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
Steelhead	Upper Sacramento Tributaries, Cow Creek, Sacramento River, Clear Creek, Beegum Creek.	2.6.12 Entrainment of juveniles at diversions in the upper Sacramento River.	2.6.12.3 Implement projects that consolidate and screen existing diversions where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Cost would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)
Winter-run Chinook Salmon	Sacramento River.	2.6.13 Low flow conditions in the upper Sacramento River limiting habitat availability during the juvenile rearing and outmigration life stage.	2.6.13.1 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Battle Creek, Sacramento River, Beegum Creek, Clear Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Cow Creek, Upper Sacramento Tributaries, Battle Creek, Sacramento River, Clear Creek, Beegum Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.6.14 Loss of floodplain habitat in the upper Sacramento River affecting the juvenile rearing life stage.	2.6.14.1 Modify gravel pits and mounds to ensure full drainage of these features to allow flooding while preventing stranding and warm water predator habitat.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	A feasibility project to investigate floodplain and riparian habitat restoration and determine procedures to reclaim a former gravel mining operation along the west bank of the Sacramento River (RM 239.5 to RM 238) at the La Barranca Unit in Tehama County, California cost approximately $51,000. Source: Sacramento River National Wildlife Refuge 2000.
Spring-run Chinook Salmon	Sacramento River, Battle Creek.		2.6.14.2 Curtail further development in active upper Sacramento River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
Steelhead	Cow Creek, Battle Creek Sacramento River, Clear Creek, Beegum Creek, Upper Sacramento Tributaries.	2.6.14 Loss of floodplain habitat in the upper Sacramento River affecting the juvenile rearing life stage.	2.6.14.3 Develop education and outreach programs to encourage river stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Winter-run Chinook Salmon	Sacramento River.	2.6.15 Harvest/angling impacts in the upper Sacramento River affecting adults.	2.6.15.1 Modify sport-fishing regulations to further minimize harvest of steelhead in the upper Sacramento River.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Battle Creek, Sacramento River, Clear Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Small tributaries to the Sacramento River, Cow Creek, Beegum Creek, Sacramento River, Battle Creek, Clear Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.6.16 Water quality in the upper Sacramento River affecting juveniles.	2.6.16.1 Implement projects that improve wastewater and stormwater treatment in Redding and in surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source:Center for Urban Forest Research 2002.
Steelhead	Upper Sacramento Tributaries, Sacramento River, Cow Creek, Clear Creek, and Beegum Creek.		2.6.16.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	4.1: Threats Resulting from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultral drainage issues in the upper Sacramento River.
			2.6.16.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	
			2.6.16.4 Increase monitoring and enforcement to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.6.16 Water quality in the upper Sacramento River affecting juveniles.	2.6.16.5 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.6.16.6 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.6.16 Water quality in the upper Sacramento River affecting juveniles.	2.6.16.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.6.16.8 Improve and maintain containment of contaminants from Iron Mountain Mine.		Long-term	EPA	DWR		N/A	TBD	TBD	TBD	Continue EPA's cleanup of Iron Mountain Mine. In 2000, a settlement was proposed which included $862 million in funding to clean up Iron Mountain Mine. Source: EPA Website 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.6.17 Water temperature in the upper Sacramento River affecting adult immigration.	2.6.17.1 Achieve the daily average water temperature targets described in the Biological Opinion on the Long-Term Central Valley Project Operations Criteria and Plan (NMFS 2004).	1.2: Threats to Water Quality	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Battle Creek, Clear Creek, Beegum Creek, Sacramento River,.		2.6.17.2 Identify and implement meadow and/or riparian habitat restoration projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Resource Conservation Districts	CDFG, DWR	NGOs	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Battle Creek, Clear Creek, Beegum Creek, Sacramento River, Cow Creek, Upper Sacramento River tributaries, Battle Creek.												
Winter-run Chinook Salmon	Sacramento River.	2.6.18 Water temperature in the upper Sacramento River affecting juvenile rearing and outmigration	2.6.18.1 Achieve the daily average water temperature targets described in the Biological Opinion on the Long-Term Central Valley Project Operations Criteria and Plan (NMFS 2004).	1.2: Threats to Water Quality	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Battle Creek, Sacramento River, Clear Creek, Beegum Creek.		2.6.18.2 Identify and implement meadow and/or riparian habitat restoration projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Resource Conservation Districts	CDFG, DWR	NGOs	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Upper Sacramento Tributaries, Cow Creek, Sacramento River, Battle Creek, Clear Creek, Beegum Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.6.19 Red Bluff Diversion Dam impeding and/or blocking adults returning to the Sacramento River.	2.6.19.1 Maintain the gates-up position to prevent passage impediments to listed species.	1.1: Threats to Spawning Habitat	Long-term	Reclamation, Corps, NMFS, USFWS	CDFG, DWR	Tehama-Colusa Canal Authority, City of Red Bluff	N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Sacramento River, Battle Creek, Beegum Creek, and Clear Creek.		2.6.19.2 Install a positive barrier fish screen to replace Red Bluff Diversion Dam										
Steelhead	Sacramento River, Battle Creek, Cow Creek, Upper Sacramento Tributaries, Clear Creek, and Beegum Creek.	2.6.19 Red Bluff Diversion Dam impeding and/or blocking adults returning to the Sacramento River.											
Winter-run Chinook Salmon	Sacramento River.	2.6.20 Hatchery effects related to competition and predation in the upper Sacramento River affecting juveniles.	2.6.20.1 Develop HGMPs and control hatchery release timing, numbers and locations to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.
Spring-run Chinook Salmon	Sacramento River, Battle Creek, Beegum Creek, Clear Creek.		2.6.20.2 Develop a hatchery management plan for the Coleman National Fish Hatchery for each species (NMFS 2007a).		Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	150,000	TBD	TBD	Cost to develop a hatchery management plan for the Lewis River in Washington was approximately $154,000. The plan included (1) Hatchery review; (2) Ecosystem diagnostics and treatment modeling; and (3) Monitoring and evaluation. Source: WDFW 2002.
Steelhead	Sacramento River, Battle Creek, Cow Creek, Upper Sacramento Tributaries, Clear Creek, Beegum Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Winter-run Chinook Salmon	Sacramento River.	2.6.21 Low flows in the upper Sacramento River resulting in reduced attraction and migratory cues for adults.	2.6.21.1 Evaluate pulse flow benefits for Chinook salmon and steelhead attraction and passage; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
Spring-run Chinook Salmon	Battle Creek, Beegum Creek, Clear Creek, Sacramento River.		2.6.21.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Steelhead	Cow Creek, Battle Creek, Stony Creek, Thomes Creek, Beegum Creek, Clear Creek, Upper Sacramento Tributaries, Sacramento River.												

2.7 Northern Sierra Nevada Diversity Group Recovery Actions

Table 2-7 Northern Sierra Nevada Diversity Group Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.1 Agricultural diversion dams in Deer Creek impeding and/or blocking adult immigration.	2.7.1.1 Permit and construct a state-of-the-art fish ladder that meets NMFS' adult fish passage criteria and install a new apron at the Cone-Kimball Diversion (AFRP Website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS	CDFG	Deer Creek Watershed Conservancy, Deer Creek Irrigation District	N/A	2-3 million	TBD	TBD	One fish ladder project on the Sacramento River cost $2.28 million (1999 $). Source: Thomson and Pinkerton 2008.
Steelhead	Deer Creek.		2.7.1.2 Install state-of-the-art fish ladder and jump pool enhancement at Stanford-Vina Dam (AFRP Website 2005, NMFS 2007b).		5 Years	NMFS	CDFG	Deer Creek Watershed Conservancy, Deer Creek Irrigation District	N/A	2-3 million	TBD	TBD	One fish ladder project on the Sacramento River cost $2.28 million (1999 $). Source: Thomson and Pinkerton 2008.
			2.7.1.3 Conduct fish passage evaluation at all agricultural diversions in Deer Creek to determine if they meet NMFS' fish passage criteria (AFRP Website 2005). Design install, and maintain state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.		5 Years	NMFS	CDFG	Deer Creek Watershed Conservancy, Deer Creek Irrigation District	N/A	TBD	TBD	TBD	Cost would be project-specific (e.g., the engineering investigation of anadromous fish passage (for adults and juveniles) in upper battle creek was estimated to cost $790,000). Source: DWR 1997a.
			2.7.1.4 Study feasibility of consolidating diversion points to minimize the number of diversions on Deer Creek. Based on this study, consolidate diversions where feasible.		5 Years	NMFS	CDFG	Deer Creek Watershed Conservancy, Deer Creek Irrigation District	N/A	TBD	TBD	TBD	
			2.7.1.5 Assess the feasibility and need for modifying the lower Deer Creek falls fish ladder, to improve its function for allowing upstream passage to the upper six miles of anadromous habitat. Implement modifications as needed.		5 Years	NMFS	CDFG	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.2 Deer Creek water temperatures affecting the adult spring-run Chinook salmon immigration and holding and spawning life stages, and the steelhead adult immigration and holding life stage.	2.7.2.1 Enhance watershed resiliency in Deer Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows (Deer Creek meadows, Childs meadows, Gurnsey Creek, and North Fork Deer Creek) to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (Deer Creek Conservancy Watershed Report, U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Deer Creek.		2.7.3.2 develop climate change action – emissions	1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Mill Creek.	2.7.3 Mill Creek water temperatures affecting the adult spring-run Chinook salmon immigration and holding and spawning life stages, and the steelhead adult immigration and holding life stage.	2.7.3.1 Enhance watershed resiliency in Mill Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (Mill Creek Conservancy Watershed Report, U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Mill Creek.			1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Yuba River.	2.7.4 Englebright Dam blocking upstream migration of adults returning to the Yuba River, and affecting spawning by increasing the potential for redd superimposition, increasing competition for habitat, and reducing genetic integrity of spring-run Chinook salmon due to hybridization with hatchery-produced Chinook salmon and fall-run Chinook salmon.	2.7.4.1 Examine the feasibility of utilizing a temporary weir, or other techniques to spatially segregate spring-run Chinook salmon and fall-run Chinook salmon during spawning in the Yuba River.	1.1: Threats to Spawning Habitat	Long-term	NMFS	CDFG	Yuba County Water Agency, Yuba Watershed Council	N/A	TBD	TBD	TBD	
		2.7.4 Englebright Dam blocking upstream migration of adults returning to the Yuba River, and affecting spawning by increasing the potential for redd superimposition, increasing competition for habitat, and reducing genetic integrity of spring-run Chinook salmon due to hybridization with hatchery-produced Chinook salmon and fall-run Chinook salmon.	2.7.4.2 Develop hydro-electric license re-opener clauses for FERC projects with triggers based on reintroduction of anadromous fish to project watershed.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Feather River.	2.7.5 The Fish Barrier Dam and Oroville Dam blocking upstream migration of adults returning to the Feather River, and affecting spawners by causing redd superimposition, increasing competition for habitat, and reducing genetic integrity due to hybridization.	2.7.5.1 Determine the feasibility of providing access to habitat above the Fish Barrier Dam and above Oroville Dam.	1.1: Threats to Spawning Habitat	5 Years	NMFS	CDFG		N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
Steelhead	Feather River.		2.7.5.2 Provide access to suitable habitat in the Feather River basin to create new geographically isolated independent populations of Spring-run Chinook salmon and steelhead.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS	CDFG		N/A	TBD	TBD	TBD	
			2.7.5.3 Implement actions to enhance habitat conditions and improve access within the area above Oroville Dam, including increasing minimum flows, providing passage at upstream dams, and assessing feasibility of passage improvement at natural barriers.		Long-term	NMFS	CDFG	Yuba County Water Agency, Yuba Watershed Council	N/A	TBD	TBD	TBD	
		2.7.5 The Fish Barrier Dam and Oroville Dam blocking upstream migration of adults returning to the Feather River, and affecting spawners by causing redd superimposition, increasing competition for habitat, and reducing genetic integrity due to hybridization.	2.7.5.4 Design and conduct a trap-and-haul pilot program to evaluate adult distribution, survival, spawning, and production in habitats above Oroville Dam.		5 Years	NMFS, USFWS	CDFG, DWR		N/A	6 - 10 million	2-5 million	2-5 million	The cost for a trap and haul system at Trail Bridge Dam in Oregon was reported to be $6.7 million for construction and $2.5 to $4.0 million for operation. Source: Foundation for Water and Energy Education Website 2006.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Antelope Creek. Antelope Creek.	2.7.6 Antelope Creek water temperatures affecting the adult immigration and holding, life stage.	2.7.6.1 Enhance watershed resiliency in Antelope Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Antelope Creek	2.7.7 Antelope Creek water temperatures affecting spawning and embryo incubation.	2.7.7.1 Enhance watershed resiliency in Antelope Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon Steelhead	Butte Creek. Butte Creek.	2.7.8 Butte Creek water temperatures affecting the adult immigration and holding life stage.	2.7.8.1 Enhance watershed resiliency in Butte Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Butte Creek Watershed Conservancy, PG&E	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Antelope Creek.	2.7.9 Agricultural diversion dams in Antelope Creek impeding and/or blocking adult immigration.	2.7.9.1 Maintain and operate the Edwards Dam Ladder to allow fish passage at all project design flows.	1.1: Threats to Spawning Habitat	Complete	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Antelope Creek.		2.7.9.2 Implement an Antelope Creek Anadromous Fish Passage Study to evaluate fish passage at all agricultural diversions to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.		5 Years	NMFS, USFWS	CDFG, DWR	Irrigation districts	N/A	200,000	200,000	200,000	Cost would be project-specific (e.g., the engineering investigation of anadromous fish passage (for adults and juveniles) in upper battle creek was estimated to cost $790,000). Source: DWR 1997a.
Spring-run Chinook Salmon	Antelope Creek.	2.7.10 Terminal diversions and loss of channel connectivity in Antelope Creek affecting juvenile rearing and outmigration.	2.7.10.1 Develop an Antelope Creek fish passage assessment, including recommendations for improving channel connectivity, flow consolidation, and minimizing entrainment through installation of state-of-the-art fish passage facilities at diversions (AFRP Website 2005). The passage assessment should determine which migratory route between Edwards Diversion Dam and the Sacramento River is most effective at passing adult and juvenile salmonids and optimizing their survival	5.2: Threats from Water Diversions	5 Years	USFWS, NMFS	CDFG	Edwards Ranch, Los Molinos Mutual Water Company	N/A	60,000	TBD	TBD	USFWS is funding the implementation of a solution to minimize juvenile salmonid entrainment into the Edwards diversion ditch at Edwards dam. Up to $60,000 is available for FY 2008. Source: USFWS 2008
Steelhead	Antelope Creek.	2.7.10 Terminal diversions and loss of channel connectivity in Antelope Creek affecting juvenile rearing and outmigration.	2.7.10.2 Conduct fish passage evaluation at all agricultural diversions in Antelope Creek to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions that currently do not meet the passage criteria.	5.4: Threats from Migration Obstructions and Impediments	5 Years	NMFS, USFWS	CDFG, DWR	Irrigation districts	N/A	200,000	200,000	200,000	Cost would be project-specific (e.g., the engineering investigation of anadromous fish passage (for adults and juveniles) in upper battle creek was estimated to cost $790,000). Source: DWR 1997a.
Spring-run Chinook Salmon	Big Chico Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Big Chico Creek.	2.7.11 Passage impediment/barrier at Iron Canyon, City of Chico swimming holes, and associated dams affecting the adult immigration and holding life stage.	2.7.11.1 Implement the Iron Canyon Fish Passage Project (AFRP Website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS	CDFG, DWR, CSU Chico	City of Chico, Big Chico Creek Watershed Alliance	N/A	1.8 million	TBD	TBD	Estimated cost for construction of Iron Canyon fish ladder rehabilitation project is $1.8 million. Source: Big Chico Creek Watershed Alliance 2008.
			2.7.11.2 Conduct fish passage evaluation at all dams and diversions in Big Chico Creek to determine if they meet NMFS' fish passage criteria. Design and install state-of-the-art fish passage facilities at diversions (1-mile dam, 5-mile dam) that currently do not meet the passage criteria.	5.4: Threats from Migration Obstructions and Impediments	5 Years	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	N/A	TBD	TBD	TBD	Estimated cost for construction of Iron Canyon fish ladder rehabilitation project is $1.8 million. Source: Big Chico Creek Watershed Alliance 2008.
Spring-run Chinook Salmon	Big Chico Creek.	2.7.12 Water temperatures in Big Chico Creek affecting the adult immigration and holding, spawning, and embryo incubation life stages.	2.7.12.1 Enhance watershed resiliency in Big Chico Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment. (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Big Chico Creek.			1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Mill Creek.	2.7.13 Water quality, including turbidity and sedimentation affecting spawning and embryo incubation.	2.7.13.1 Restore meadows and reduce stream channel incisement and bank erosion by modifying grazing practices and excluding cattle from nearshore zones, and reduce the potential for, and magnitude of a catastrophic wildfire, and reduce sources of chronic road-related erosion in Mill Creek (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	CDFG	Mill Creek Conservancy	N/A	200,000	200,000	200,000	Cost would be project-specific (e.g., the engineering investigation of anadromous fish passage (for adults and juveniles) in upper battle creek was estimated to cost $790,000). Source: DWR 1997a.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Mill Creek.		2.7.13.2 Enhance watershed resiliency in Mill Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas. (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy)	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.7.13 Water quality, including turbidity and sedimentation affecting spawning and embryo incubation.	2.7.13.3 Develop a baseline monitoring program to evaluate water quality throughout the Mill Creek watershed to identify areas of concern.		2 Years	USFS	DWR, CDFG	Mill Creek Conservancy	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.7.13.4 Encourage voluntary landowner participation in Mill Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners, Mill Creek Conservancy	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
		2.7.13 Water quality, including turbidity and sedimentation affecting spawning and embryo incubation.	2.7.13.5 Fortify streambanks with native vegetation in Mill Creek.		Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	500 - 1000 per structure	TBD	TBD	TBD	In the Six Rivers National Forest each log and straw bale sediment retention structure cost approximately $300 (1987 $). Source: Smith and Wright 1987.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.14 Water quality, including turbidity, sedimentation and hazardous spills (e.g., HWY 32) affecting spawning, embryo incubation and juvenile emigration.	2.7.14.1 Carry out a Deer Creek (upper) erosion reduction project (AFRP Website 2005).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy, CSU Chico	N/A	1 million	1 million	1 million	Estimated total cost for construction of various projects in Deer Creek, including revegetating stream banks, repairing / modifying roads to reduce sediment input, bridge removal, and replacement of culverts was approximately $3.1 million. Source: CSU Chico Research Foundation 2001.
Steelhead	Deer Creek.		2.7.14.2 Restore meadows and reduce stream channel incisement and bank erosion by modifying grazing practices and excluding cattle from nearshore zones, and reduce the potential for, and magnitude of a catastrophic wildfire, and reduce sources of chronic road-related erosion in Deer Creek (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Resource Conservation Districts	CDFG	Deer Creek Watershed Conservancy	1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
			2.7.14.3 Ban fuel tanker truck traffic on Highway 32.		3 Years		Caltrans		N/A	N/A	N/A	N/A	
		2.7.14 Water quality, including turbidity, sedimentation and hazardous spills (e.g., HWY 32) affecting spawning, embryo incubation and juvenile emigration.	2.7.14.4 Maintain current size and configuration of Highway 32 within the Deer Creek watershed.		Long-term		Caltrans		N/A	N/A	N/A	N/A	
			2.7.14.5 Decommission Fire Mountain Lodge Hydro-electric project, and remove the earthen dam, restore the stream channel, and obliterate project roads.		Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.14.6 Continue educational outreach and support and assist DCWC in watershed management activities (AFRP Website 2005).		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented and available grant funding.
			2.7.14.7 Enhance watershed resiliency in Deer Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas. (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy)		Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.7.14 Water quality, including turbidity, sedimentation and hazardous spills (e.g., HWY 32) affecting spawning, embryo incubation and juvenile emigration.	2.7.14.8 Eliminate sources of chronic sediment delivered to Deer Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.		Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	N/A	1 million	1 million	1 million	Estimated total cost for construction of various projects in Deer Creek, including revegetating stream banks, repairing / modifying roads to reduce sediment input, bridge removal, and replacement of culverts was approximately $3.1 million. Source: CSU Chico Research Foundation 2001.
			2.7.14.9 Develop a baseline monitoring program to evaluate water quality throughout the Deer Creek watershed to identify areas of concern.		2 Years	USFS	DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.14 Water quality, including turbidity, sedimentation and hazardous spills (e.g., HWY 32) affecting spawning, embryo incubation and juvenile emigration.	2.7.14.10 Encourage voluntary landowner participation in Deer Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA	CDFG, DWR	Deer Creek Watershed Conservancy	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
Spring-run Chinook Salmon	Yuba River.	2.7.15 Loss of natural river morphology and function in the Yuba River affecting juvenile rearing and outmigration.	2.7.15.1 Set back training walls and restore floodplain function in gold fields and other appropriate floodplain zones.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Yuba Watershed Council	N/A	TBD	TBD	TBD	
Steelhead	Yuba River.	2.7.15 Loss of natural river morphology and function in the Yuba River affecting juvenile rearing and outmigration.	2.7.15.2 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
			2.7.15.3 Implement gravel injection program below Englebright Dam to restore geofluvial processes.		Long-term	NMFS, USFWS,	CDFG		11 - 36 per cubic yard of gravel	TBD	TBD	TBD	In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.15.4 Curtail further development in active Yuba River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments, Yuba Watershed Council	N/A	N/A	N/A	N/A	
			2.7.15.5 Increase monitoring and enforcement of illegal rip rap applications.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
		2.7.15 Loss of natural river morphology and function in the Yuba River affecting juvenile rearing and outmigration.	2.7.15.6 Develop education and outreach programs to encourage river stewardship.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	SRYCL, Yuba Watershed Council	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.15.7 Create and restore side-channel habitats to increase the quantity and quality of off-channel rearing (and spawning) areas in the Yuba River.		Long-term	NMFS, USFWS	CDFG	Yuba Watershed Council	20,000 - 300,000 per acre	TBD	TBD	TBD	Cost estimate depends on the extent of earthmoving required and the energy of the waterway. Source: Evergreen 2003.
Spring-run Chinook Salmon	Yuba River.	2.7.16 Loss of riparian habitat and instream cover in the Yuba River affecting juvenile rearing and outmigration.	2.7.16.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in the Yuba River (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council	1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
Steelhead	Yuba River.		2.7.16.2 Relocate the riverside motocross recreation area (i.e., shad pad) outside of the Yuba River's active floodplain.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	5 Years		CDFG	Yuba County, Yuba Watershed Council	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.16 Loss of riparian habitat and instream cover in the Yuba River affecting juvenile rearing and outmigration.	2.7.16.3 Develop vegetation maintenance inspection protocols and practices within the State flood control project to encourage riparian growth and establish a native vegetated corridor on the Yuba River.		Long-term	NMFS, USFWS, USFS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council	N/A	600,000	600,000	600,000	Cost would be project-specific (e.g., on Cache Creek in Yolo County, a non-native invasive species removal program with flood channel maintenance activities was proposed, consisting of replanting native plant species while still allowing for levee inspection and flood fighting; proposed cost over a 3 year period was approximately $1,800,000). Source: DWR 2006a
			2.7.16.4 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Yuba River watershed.		Long-term	NMFS, USFWS, Corps, Reclamation, USFS	DWR, CDFG, CDPR	Local agencies, Yuba Watershed Council	N/A	TBD	TBD	TBD	
		2.7.16 Loss of riparian habitat and instream cover in the Yuba River affecting juvenile rearing and outmigration.	2.7.16.5 Develop and implement a large woody material restoration program along the lower Yuba River utilizing sources of wood that enter upstream reservoirs.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Yuba Watershed Council	12.90 - 164.50 per meter of channel	TBD	TBD	TBD	The cost of LWD projects varies with the complexity of the design, site accessibility, flow conditions, and cost of LWD materials, cables, anchors, etc. Cost could vary by an order of magnitude due to differences in design complexity alone. Source: Cederholm et al. 1997.
			2.7.16.6 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in the Yuba River.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.16.7 Increase monitoring and enforcement of illegal rip rap applications in the Yuba River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.16.8 Curtail further development in active Yuba River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments, Yuba Watershed Council	N/A	N/A	N/A	N/A	
		2.7.16 Loss of riparian habitat and instream cover in the Yuba River affecting juvenile rearing and outmigration.	2.7.16.9 Develop education and outreach programs to encourage river stewardship in the Yuba River watershed.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	SRYCL, Yuba Watershed Council	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.16.10 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon	Antelope Creek.	2.7.17 Low flows in Antelope Creek affecting the adult immigration and holding life stage by reducing attraction and migratory cues.	2.7.17.1 Evaluate and dedicate instream flows in Antelope Creek to facilitate upstream attraction and passage (NMFS 2007b).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS	CDFG, DWR		43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Steelhead	Antelope Creek.		2.7.17.2 Dedicate instream flows through water exchange agreements with all water users in Antelope Creek.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Water users	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
		2.7.17 Low flows in Antelope Creek affecting the adult immigration and holding life stage by reducing attraction and migratory cues.	2.7.17.3 Improve passage conditions at Paynes crossing to allow upstream passage during low flows.		Long-term	NMFS, USFWS, USFS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek.	2.7.18 Low flows in Mill Creek affecting the adult immigration and holding life stage by decreasing the magnitude of attraction and migratory cues.	2.7.18.1 Work with State and Federal water acquisition programs to develop dedicated instream water; participate in the lower Mill Creek Watershed Restoration Project (AFRP Website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Mill Creek Conservancy	TBD	TBD	TBD	TBD	
Steelhead	Mill Creek.			1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Yuba River.	2.7.19 Flow fluctuations and flood events in the Yuba River affecting the embryo incubation life stage.	2.7.19.1 Complete the fry stranding and redd dewatering study being conducted by YCWA to determine the effectiveness of the flow fluctuation requirements specified in the Narrows II FERC license. Implement flow fluctuation and ramping rates found to be protective of embryos and juveniles by the fry stranding and redd dewatering study.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, FERC	CDFG, DWR	Yuba County Water Agency	N/A	TBD	TBD	TBD	
Steelhead	Yuba River.												
Spring-run Chinook Salmon	Deer Creek.	2.7.20 Limited spawning habitat availability in Deer Creek.	2.7.20.1 Re-design Highway 32 culvert crossing at Calf Creek to allow for unimpeded bedload transport.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USGS, USFS	CDFG, DWR, Caltrans	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	
Steelhead	Deer Creek.			1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.21 Gravel embeddedness and fines affecting spawning in Deer Creek.	2.7.21.1 Enhance watershed resiliency by identifying and implementing projects that would reduce the potentia for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy). Fortify streambanks with native vegetation.	1.2: Threats to Water Quality	Long-term	USFWS, USFS	CDFG, RWQCB	Deer Creek Watershed Conservancy, CSU Chico, Collins Pine Company	N/A	1 million	1 million	1 million	Estimated total cost for construction of various projects in Deer Creek, including revegetating stream banks, repairing / modifying roads to reduce sediment input, bridge removal, and replacement of culverts was approximately $3.1 million. Source: CSU Chico Research Foundation 2001.
Steelhead	Deer Creek.	2.7.21 Gravel embeddedness and fines affecting spawning in Deer Creek.	2.7.21.2 Forest Practice actions from Santa Rosa list										
Spring-run Chinook Salmon	Mill Creek.	2.7.22 Gravel embeddedness and fines affecting spawning in Mill Creek.	2.7.22.1 Enhance watershed resiliency by identifying and implementing projects that would reduce the potentia for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade and reduce sources of chronic road-related erosion of sediment (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy). Fortify streambanks with native vegetation.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	N/A	TBD	TBD	TBD	
Steelhead	Mill Creek.		2.7.22.2 Forest Practice actions from Santa Rosa list	1.2: Threats to Water Quality									
Spring-run Chinook Salmon	Butte Creek.	2.7.23 Limited spawning habitat availability/suitability in Butte Creek.	2.7.23.1 Conduct an instream flow study in Butte Creek to identify a spawning habitat-flow relationship and to identify factors (e.g., substrate size and quality, velocity, water depth) limiting spawning habitat availability.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS	CDFG	Butte Creek Watershed Conservancy	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Butte Creek.												
Spring-run Chinook Salmon	Yuba River.	2.7.24 Predation in the Yuba River affecting the juvenile rearing and outmigration life stages.	2.7.24.1 Identify and implement projects designed to minimize predation on juvenile salmonids at Daguerre Point Dam and associated structures.	3.2: Threats from Predation	Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Yuba River.		2.7.24.2 Implement programs and measures designed to control non-native predatory fish in the Yuba River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Yuba Watershed Council	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Steelhead	Feather River.	2.7.25 Hatchery effects in the Feather River affecting spawning by increasing competition for spawning habitat, potentially reducing genetic integrity, and potentially contributing to redd superimposition.	2.7.25.1 Develop a spring-run Chinook salmon conservation hatchery program at the Feather River Fish Hatchery (NMFS 2007b).		5 Years	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Deer Creek.	2.7.26 Water quality affecting juveniles in Deer Creek.	2.7.26.1 Continue educational outreach and support and assist DCWC in watershed management activities in Deer Creek (AFRP Website 2005).	1.2: Threats to Water Quality	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented and available grant funding.
Steelhead	Deer Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Antelope Creek.	2.7.27 Loss of natural river morphology and function in Antelope Creek affecting juvenile rearing and outmigration.	2.7.27.1 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan for flood control (FloodSAFE) authorized bank protection projects efforts (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
Steelhead	Antelope Creek.		2.7.27.2 Curtail further development in the active Antelope Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.27.3 Increase monitoring and enforcement of illegal rip rap applications in Antelope Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
		2.7.27 Loss of natural river morphology and function in Antelope Creek affecting juvenile rearing and outmigration.	2.7.27.4 Develop education and outreach programs to encourage river stewardship in Antelope Creek.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Spring-run Chinook Salmon	Yuba River.	2.7.28 Daguerre Point Dam affecting adults returning to the Yuba River.	2.7.28.1 Examine the feasibility of improving fish passage at Daguerre Point Dam.	1.1: Threats to Spawning Habitat	Complete	NMFS, USFWS, Corps	CDFG, DWR	Yuba County Water Agency, SYRCL, Yuba Watershed Council	N/A	N/A	N/A	NA	Fish passage alternatives at Daguerre Point Dam were evaluated by USACE and DWR (2003).

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Yuba River.		2.7.28.2 If deemed feasible, collaboratively design the Daguerre Point Dam fish ladder passage engineering and design of the preferred alternative described in DWR and Corps (2003) (AFRP Website 2005).		Long-term	NMFS, USFWS, Corps	CDFG, DWR	Yuba County Water Agency, SYRCL, Yuba Watershed Council	N/A	TBD	TBD	TBD	Cost estimates for fish passage alternatives range from $2.5 million to construct an engineered channel to $97 million to remove the dam (USACE and DWR 2003).
Spring-run Chinook Salmon	Antelope Creek.	2.7.29 Limited spawning habitat availability in Antelope Creek.	2.7.29.1 Identify gravel starved areas in Antelope Creek and implement gravel additions.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS	CDFG, DWR		11 - 36 per cubic yard of gravel	TBD	TBD	TBD	Proposed cost to prepare for and conduct surveys to identify spawning riffles, evaluate spawning gravel quality, and develop a rehabilitation plan in lower Battle Creek was approximately $150,000. Source:. In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.
Steelhead	Antelope Creek.												
Spring-run Chinook Salmon	Antelope Creek.	2.7.29 Agricultural and urban runoff into Antelope Creek affecting juvenile rearing and outmigration.	2.7.29.2 Build sediment retention structures and fortify stream banks with native vegetation in Antelope Creek.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG		500 - 1000 per structure	TBD	TBD	TBD	In the Six Rivers National Forest each log and straw bale sediment retention structure cost approximately $300 (1987 $). Source: Smith and Wright 1987.
Steelhead	Antelope Creek.												
Spring-run Chinook Salmon	Antelope Creek.	2.7.30 Physical habitat alteration in Antelope Creek affecting steelhead spawning.	2.7.30.1 Build sediment retention structures and fortify stream banks with native vegetation in Antelope Creek.	1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Antelope Creek.	2.7.30 Physical habitat alteration in Antelope Creek affecting steelhead spawning.											
Spring-run Chinook Salmon	Butte Creek.	2.7.31 Predation in Butte Creek affecting the juvenile rearing and outmigration life stages.	2.7.31.1 Implement a study designed to develop quantitative estimates of predation on spring-run Chinook salmon by non-native species in Butte Creek.	3.1: Threats from Predation	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Steelhead	Butte Creek.		2.7.31.2 Implement programs and measures designed to control non-native predatory fish in Butte Creek (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.7.31.3 Implement projects to minimize predation at weirs, diversion dams, and related structures in Butte Creek.		Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	Improve passage at diversion structures to reduce predation (See 2.7.14.1 and 2.7.14.2).

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.31 Predation in Butte Creek affecting the juvenile rearing and outmigration life stages.	2.7.31.4 Improve nearshore refuge cover for salmonids in Butte Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Spring-run Chinook Salmon Steelhead	Yuba River. Yuba River.	2.7.32 Entrainment of juveniles at individual diversions in the Yuba River and at Daguerre Point Dam.	2.7.32.1 Improve efficiency of screening devices at Hallwood-Cordua and Brophy-South Yuba water diversions, and construct screens at unscreened diversions (USFWS 2001).	5.3: Threats from Water Diversions	Long-term	NMFS, USFWS	CDFG, DWR	Yuba County Water Agency, South Yuba and Brophy Water Districts, BVID, SYRCL, Yuba Watershed Council	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Yuba River. Yuba River.	2.7.33 Hatchery effects in the Yuba River affecting: (1) steelhead spawning; and (2) hatchery-produced Chinook salmon (primarily FRFH) and naturally-produced fall-run Chinook salmon affecting naturally-produced spring-run Chinook salmon in the Yuba River by increasing competition for spawning habitat, potentially reducing genetic integrity, and potentially contributing to redd superimposition.	2.7.33.1 Develop a hatchery management plan for the Feather River Fish Hatchery, including specific criteria for operating as either an integrated or segregated hatchery (See Action 2.7.30.1).	5.1: Threats from Artificial Propagation	5 Years	NMFS, USFWS	CDFG, DWR		N/A	150,000	TBD	TBD	Cost to develop a hatchery management plan for the Lewis River in Washington was approximately $154,000. The plan included (1) Hatchery review; (2) Ecosystem diagnostics and treatment modeling; and (3) Monitoring and evaluation. Source: WDFW 2002.
Spring-run Chinook Salmon	Yuba River.	2.7.34 Physical habitat alteration in the Yuba River affecting spawning.	2.7.34.1 Conduct gravel additions above and below Narrows Pool (Corps mitigation) (AFRP Website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Corps	CDFG, DWR	Yuba Watershed Council	11 - 36 per cubic yard of gravel	TBD	TBD	TBD	In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.
			2.7.34.2 If the experimental fish passage program demonstrates that passage above Englebright Dam can substantively contribute to the long-term viability of the ESU, then develop and implement long-term fish passage programs.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Butte Creek.	2.7.35 Flow fluctuations affecting Butte Creek spawning and embryo incubation.	2.7.35.1 Install and maintain real-time flow monitoring gages in Butte Creek.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USGS	CDFG, DWR		8,500 per gage station	TBD	TBD	TBD	$8,500 was reported to be a typical cost of a gauging station in the region. Source: AFRP 2006.
Steelhead	Butte Creek.	2.7.35 Flow fluctuations affecting Butte Creek spawning and embrvo	2.7.35.2 Develop sustainable instream flow criteria for Butte Creek during spawning and incubation periods.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.7.35.3 Develop and implement flow ramping protocols in Butte Creek to protect all life stages of spring-run Chinook salmon.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.7.35.4 Enhance watershed resiliency in Butte Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.		Long-term	NMFS, USFWS, USFS	CDFG	Butte Creek Watershed Conservancy, PG&E	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook	Butte Creek.	2.7.36 Summer inner tubing and swimming affecting adults returning and holding in Butte Creek.	2.7.36.1 Reduce the number of temporary passage impediments installed to create swimming holes in Butte Creek near Chico; conduct associated public outreach projects.	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost would depend on the number and complexity of impediments and the types of educational and outreach programs developed and implemented.
Steelhead	Butte Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Feather River and Yuba River.	2.7.37 Predation in the Feather River affecting juveniles.	2.7.37.1 Implement a study designed to develop quantitative estimates of predation on spring-run Chinook salmon by non-native species in the Feather River.	3.2: Threats from Predation	5 Years	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Steelhead	Feather River and Yuba River.	2.7.37 Predation in the Feather River affecting juveniles.	2.7.37.2 Implement programs and measures designed to control non-native predatory fish in the Feather River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.7.37.3 Implement projects to minimize predation at weirs, diversion dams, and related structures in the Feather River.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.7.37.4 Improve nearshore refuge cover for salmonids in the Feather River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Butte Creek.	2.7.38 Loss of riparian habitat and instream cover affecting juveniles in Butte Creek.	2.7.38.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in Butte Creek (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
			2.7.38.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Butte Creek watershed.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Local governments	N/A	N/A	TBD	TBD	
			2.7.38.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Butte Creek.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.38.4 Curtail further development in active Butte Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
		2.7.38 Loss of riparian habitat and instream cover affecting juveniles in Butte Creek.	2.7.38.5 Develop education and outreach programs to encourage river stewardship in the Butte Creek watershed.		Long-term	NMFS, USFWS	CDFG, DWR, CSU Chico	Landowners, schools	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.38.6 Permanently protect riparian habitat through easements and/or land acquisition										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Antelope Creek.	2.7.39 Water quality in Antelope Creek affecting embryo incubation, juvenile rearing and outmigration and spawning.	2.7.39.1 Increase monitoring and enforcement in the Antelope Creek watershed to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
Steelhead	Antelope Creek.	2.7.39 Water quality in Antelope Creek affecting embryo incubation, juvenile rearing and outmigration and spawning.	2.7.39.2 Develop a baseline monitoring program in Antelope Creek to evaluate water quality throughout the watershed to identify areas of concern.	1.3: Threats to Habitat Quality and Complexity	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.7.39.3 Encourage voluntary landowner participation in Antelope Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.7.39 Water quality in Antelope Creek affecting embryo incubation, juvenile rearing and outmigration and spawning.	2.7.39.4 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Antelope Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.39.5 Enhance watershed resiliency in Antelope Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.		Long-term	NMFS, USFWS, USFS	CDFG		500 - 1000 per structure	TBD	TBD	TBD	In the Six Rivers National Forest each log and straw bale sediment retention structure cost approximately $300 (1987 $). Source: Smith and Wright 1987.
			2.7.39.6 Eliminate sources of chronic sediment delivered to Antelope Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.		Long-term	NMFS, USFWS, USFS	CDFG		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.39.7 Develop a baseline monitoring program in Antelope Creek to evaluate water quality throughout the watershed to identify areas of concern.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.7.39 Water quality in Antelope Creek affecting embryo incubation, juvenile rearing and outmigration and spawning.	2.7.39.8 Encourage voluntary landowner participation in Antelope Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.39.9 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Antelope Creek.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
Spring-run Chinook Salmon	Butte Creek.	2.7.40 Loss of natural river morphology and function in Butte Creek affecting juveniles.	2.7.40.1 Identify stream reaches that have been most altered by anthropogenic factors and reconstruct natural channel geometry scaled to current channel forming flows in Butte Creek.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
			2.7.40.2 Curtail further development in the active Butte Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	CDFG, DWR	Local governments	N/A	N/A	N/A	N/A	
			2.7.40.3 Increase monitoring and enforcement of illegal rip rap applications in Butte Creek.		Long-term	Corps, DWR	SWRCB		N/A	N/A	N/A	N/A	
			2.7.40.4 Develop education and outreach programs to encourage river stewardship in Butte Creek.		Long-term	NMFS, USFWS	CDFG, DWR, CSU Chico	Landowners, schools	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Butte Creek.	2.7.41 Water quality in Butte Creek affecting the adult immigration and holding, spawning, and embryo incubation life stages.	2.7.41.1 Increase monitoring and enforcement in Butte Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.7.41.2 Develop a baseline monitoring program in Butte Creek to evaluate water quality throughout the watershed to identify areas of concern.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	USFS	DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.7.41 Water quality in Butte Creek affecting the adult immigration and holding, spawning, and embryo incubation life stages.	2.7.41.3 Encourage voluntary landowner participation in Butte Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy 2008a.
			2.7.41.4 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Butte Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Feather River and Yuba River.	2.7.42 Loss of natural river morphology and function in the Feather River affecting juvenile rearing and outmigration.	2.7.42.1 Identify stream reaches that have been most altered by anthropogenic factors and reconstruct natural channel geometry scaled to current channel forming flows in the Feather River.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Steelhead	Feather River, Yuba River, and Bear River.	2.7.42 Loss of natural river morphology and function in the Feather River affecting juvenile rearing and outmigration.	2.7.42.2 Curtail further development in the active Feather River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.7.42.3 Increase monitoring and enforcement of illegal rip rap applications in the Feather River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.7.42.4 Develop education and outreach programs to encourage river stewardship in the Feather River.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG, CSU Chico	Landowners, schools, Feather River Nature Center	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Spring-run Chinook Salmon	Yuba River.	2.7.43 Loss of floodplain habitat in the Yuba River affecting juvenile rearing and outmigration.	2.7.43.1 Purchase conservation easements (AFRP 2006b) adjacent to the Yuba River and manage those easements as seasonal floodplain habitats.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Yuba Watershed Council, SYRCL, Western Aggregates	1800 - 4800 per acre	TBD	TBD	TBD	Cost would depend on the land's zoning, its proximity to an urban area, and its development potential. Source: Thomson and Pinkerton 2008.
Steelhead	Yuba River.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Butte Creek.	2.7.43 Loss of floodplain habitat in the Yuba River affecting juvenile rearing and outmigration.	2.7.43.2 Implement projects to increase Yuba River floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).		Long-term	NMFS, USFWS	CDFG, DWR	Yuba County Water Agency, Yuba Watershed Council, SYRCL	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Butte Creek.	2.7.44 Loss of floodplain habitat in Butte Creek affecting juvenile rearing and outmigration.	2.7.44.1 Implement projects to increase Butte Creek floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Spring-run Chinook Salmon	Antelope Creek.	2.7.45 Loss of riparian habitat and instream cover in Antelope Creek affecting juvenile rearing and outmigration.	2.7.45.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Corps, Reclamation	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
Steelhead	Antelope Creek.	2.7.45 Loss of riparian habitat and instream cover in Antelope Creek affecting juvenile rearing and outmigration.	2.7.45.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in Antelope Creek.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, Corps, Reclamation, USFS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.45.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Antelope Creek.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.45.4 Curtail further development in active Antelope Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.45.5 Develop education and outreach programs to encourage river stewardship in Antelope Creek.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
		2.7.45 Loss of riparian habitat and instream cover in Antelope Creek affecting juvenile rearing and outmigration.	2.7.45.6 Permanently protect riparian habitat through easements and/or land acquisition										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.46 Loss of floodplain habitat in Deer Creek affecting juvenile rearing and outmigration.	2.7.46.1 Implement projects to increase Deer Creek floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Deer Creek.												
Spring-run Chinook Salmon	Mill Creek.	2.7.47 Loss of floodplain habitat in Mill Creek affecting juvenile rearing and outmigration.	2.7.47.1 Implement projects to increase Deer Creek floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Mill Creek.												
Spring-run Chinook Salmon	Feather River and Yuba River.	2.7.48 Loss of riparian habitat and instream cover in the Feather River affecting juveniles.	2.7.48.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in the Feather River (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Feather River, Yuba River, and Bear River.	2.7.48 Loss of riparian habitat and instream cover in the Feather River affecting juveniles.	2.7.48.2 Develop vegetation maintenance inspection protocols and practices within the State flood control project to encourage riparian growth and establish a native vegetated corridor on the Feather River.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	600,000	600,000	600,000	Cost would be project-specific (e.g., on Cache Creek in Yolo County, a non-native invasive species removal program with flood channel maintenance activities was proposed, consisting of replanting native plant species while still allowing for levee inspection and flood fighting; proposed cost over a 3 year period was approximately $1,800,000). Source: DWR 2006a
			2.7.48.3 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Feather River watershed.		Long-term	NMFS, USFWS, Corps, Reclamation, USFS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
			2.7.48.4 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in the Feather River.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.7.48 Loss of riparian habitat and instream cover in the Feather River affecting juveniles.	2.7.48.5 Increase monitoring and enforcement of illegal rip rap applications in the Feather River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.48.6 Curtail further development in active Feather River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.7.48.7 Develop education and outreach programs to encourage river stewardship in the Feather River.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG, CSU Chico	Landowners, schools, Feather River Nature Center	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.48.8 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon	Butte Creek.	2.7.49 Recreational harvest/angling affecting the adult immigration and holding and spawning life stages.	2.7.49.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon in Butte Creek and steelhead in Butte Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Butte Creek.	2.7.50 Water temperature in Butte Creek affecting spawning.	2.7.50.1 Enhance watershed resiliency in Butte Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG	Butte Creek Watershed Conservancy, PG&E	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Butte Creek.			1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.50 Water temperature in the Feather River affecting the Feather River adult immigration and holding and embryo incubation life stages, and the Yuba River adult immigration and holding life stage.	2.7.50.2 Increase Feather River stream flows as needed to reduce water temperatures for steelhead juvenile rearing (NMFS 2007b).		Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Yuba River.		2.7.50.3 Increase Feather River stream flows as needed to reduce water temperatures for steelhead juvenile rearing (NMFS 2007b).		Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Mill Creek, Deer Creek, and Antelope Creek.	2.7.51 Passage impediments/barriers at the Sutter Bypass (Tisdale Weir) impeding and/or delaying adult immigration.	2.7.51.1 Install effective adult fish passage facilities at Sutter Bypass weirs that currently impede adult passage (e.g., Tisdale Weir).	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	2,177,000	TBD	TBD	Preliminary cost estimate for the design and construction of the Willow Slough Fish Passage Project. Source: DWR 2005.
Steelhead	Mill Creek, Deer Creek, and Antelope Creek.												
Spring-run Chinook Salmon	Yuba River and Feather River.	2.7.52 Loss of floodplain habitat in the Feather River affecting juveniles.	2.7.52.1 Develop feasibility plan through the Oroville Dam FERC negotiated relicensing study plan; and implement riparian and floodplain habitat modeling and restoration projects in the Feather River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation, FERC	CDFG, DWR	City of Oroville	N/A	TBD	TBD	TBD	
Steelhead	Yuba River.												
Spring-run Chinook Salmon	Deer Creek.	2.7.53 Harvest/ angling impacts in Deer Creek affecting the adult immigration and holding and spawning life stages.	2.7.53.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon and steelhead in Deer Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Deer Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Mill Creek. Mill Creek.	2.7.54 Harvest/ angling impacts in Mill Creek affecting the adult immigration and holding and spawning life stages.	2.7.54.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon in Mill Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon Steelhead	Big Chico Creek. Big Chico Creek.	2.7.55 Water temperature in Big Chico Creek affecting spawning.	2.7.55.1 Enhance watershed resiliency in Big Chico Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Mill Creek.	2.7.56 Passage impediments/barriers in Mill Creek affecting juvenile rearing and outmigration.	2.7.56.1 Identify and implement projects designed to improve downstream passage conditions for juveniles in Mill Creek.	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Mill Creek Conservancy	N/A	TBD	TBD	TBD	
Steelhead	Mill Creek.		2.7.56.2 Work with State and Federal water acquisition programs to develop dedicated instream water; participate in the Lower Mill Creek Watershed Restoration Project; implement the Mill Creek Fish Passage Improvement Project (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Mill Creek Conservancy	TBD	TBD	TBD	TBD	
Spring-run Chinook Salmon	Deer Creek.	2.7.57 Passage impediments in Deer Creek affecting juvenile rearing and outmigration.	2.7.57.1 Identify and implement projects designed to improve downstream passage conditions for juveniles in Deer Creek.	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Feather River.	2.7.58 Physical habitat alternation and limited spawning habitat availability in the Feather River.	2.7.58.1 Identify stream reaches that have been most altered by anthropogenic factors and reconstruct natural channel geometry scaled to current channel forming flows in the Feather River.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS	CDFG, DWR		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Steelhead	Feather River.		2.7.58.2 Conduct a spawning gravel augmentation feasibility study to increase available spawning habitat in the Feather River.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR		N/A	150,000	TBD	TBD	Proposed cost to prepare for and conduct surveys to identify spawning riffles, evaluate spawning gravel quality, and develop a rehabilitation plan in lower Battle Creek was approximately $150,000. Source: DWR 1997b.
		2.7.58 Physical habitat alternation and limited spawning habitat availability in the Feather River.	2.7.58.3 Implement spawning gravel augmentation projects in the Feather River if the feasibility study determines that such projects will not cause adverse ecological impacts.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
			2.7.58.4 Provide access to suitable habitat in the Feather River to create a new geographically isolated independent population of a minimum of spring-run Chinook salmon.		Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.58.5 Implement actions to enhance habitat conditions and improve access within the area above Oroville Dam, including increasing minimum flows, providing passage at upstream dams, and assessing feasibility of passage improvement at natural barriers.		Long-term	NMFS, USFWS, Corps, Reclamation, FERC	CDFG, DWR	City of Oroville	N/A	TBD	TBD	TBD	
		2.7.58 Physical habitat alternation and limited spawning habitat availability in the Feather River.	2.7.58.6 Design and conduct a trap-and-haul pilot program to evaluate adult distribution, survival, spawning, and production in habitats above Oroville Dam.		5 Years	NMFS, USFWS	CDFG, DWR		N/A	6 - 10 million	2-5 million	2-5 million	The cost for a trap and haul system at Trail Bridge Dam in Oregon was reported to be $6.7 million for construction and $2.5 to $4.0 million for operation. Source: Foundation for Water and Energy Education Website 2006.
Spring-run Chinook Salmon	Feather River.	2.7.59 Water temperature in the Feather River affecting spawning.	2.7.59.1 Implement Facilities Modifications(s) to achieve Feather River water temperatures at least as protective as those specified in Table 2 of the Settlement Agreement For Licensing of the Oroville Facilities (March 2006) (http://orovillerelicensing.water.ca.gov/settlement%20agreement.html).	1.2: Threats to Water Quality									
Steelhead	Feather River.												
Spring-run Chinook Salmon	Butte Creek.	2.7.60 Entrainment at individual diversions in Butte Creek affecting juvenile rearing and outmigration.	2.7.60.1 Develop an entrainment monitoring program in Butte Creek to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS	CDFG, DWR		2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
Steelhead	Butte Creek.		2.7.60.2 One identified priority: Five Points Diversion										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.60 Entrainment at individual diversions in Butte Creek affecting juvenile rearing and outmigration.	2.7.60.3 Develop and increase application of alternative diversion technologies that eliminate entrainment in Butte Creek.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
			2.7.60.4 Implement projects that consolidate and screen existing diversions in Butte Creek where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Costs would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)
Spring-run Chinook Salmon	Antelope Creek.	2.7.61 Loss of floodplain habitat in Antelope Creek affecting juvenile rearing and outmigration.	2.7.61.1 Develop an Antelope Creek Watershed Assessment, which includes recommendations for restoring riparian habitat (AFRP Website 2005).	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
Steelhead	Antelope Creek.	2.7.61 Loss of floodplain habitat in Antelope Creek affecting juvenile rearing and outmigration.	2.7.61.2 Implement projects to increase Antelope Creek floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).		Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Spring-run Chinook Salmon	Feather River.	2.7.62 Harvest/ angling impacts in the Feather River affecting the embryo incubation life stage.	2.7.62.1 Modify sport fishing regulations to minimize the impact of anglers wading in the Feather River during spring-run Chinook salmon and steelhead embryo incubation.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.62 Harvest/ angling impacts in the Feather River affecting the embryo incubation life stage.	2.7.62.2 Implement outreach projects in the Feather River watershed to educate the public regarding the salmon and steelhead life cycles including how to identify salmon and steelhead redds.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Spring-run Chinook Salmon	Antelope Creek.	2.7.63 Harvest/ angling impacts in Antelope Creek affecting adult and spawning spring-run Chinook salmon and adult steelhead.	2.7.63.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon and steelhead in Antelope Creek.	2.1: Threats from Overutilization	Long-term	Reclamation, NMFS, USFWS	CDFG, DWR		N/A	N/A	N/A	N/A	
Steelhead	Antelope Creek.												
Spring-run Chinook Salmon	Deer Creek.	2.7.64 Loss of natural river morphology and function in Deer Creek affecting the juvenile rearing and outmigration life stage.	2.7.64.1 Identify stream reaches in Deer Creek that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS	CDFG		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Steelhead	Deer Creek.		2.7.64.2 Curtail further development in the active Deer Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.64.3 Increase monitoring and enforcement of illegal rip rap applications in Deer Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.64.4 Develop education and outreach programs to encourage river stewardship in Deer Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Spring-run Chinook Salmon	Mill Creek.	2.7.65 Loss of natural river morphology and function in Mill Creek affecting juvenile rearing and outmigration.	2.7.65.1 Identify stream reaches in Mill Creek that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Steelhead	Mill Creek.		2.7.65.2 Curtail further development in the active Mill Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	CDFG, DWR		N/A	N/A	TBD	TBD	
			2.7.65.3 Increase monitoring and enforcement of illegal rip rap applications in Mill Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.7.65.4 Develop education and outreach programs to encourage river stewardship in Mill Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Deer Creek.	2.7.66 Loss of riparian habitat and instream cover in Deer Creek affecting the juvenile rearing and outmigration life stage.	2.7.66.1 Enhance watershed resiliency in Deer Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Deer Creek.		2.7.66.2 Curtail further development in active Deer Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.66.3 Develop education and outreach programs to encourage river stewardship in Deer Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.66.4 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon	Mill Creek.	2.7.67 Loss of riparian habitat and instream cover in Mill Creek affecting juvenile rearing and outmigration.	2.7.67.1 Enhance watershed resiliency in Mill Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Mill Creek.		2.7.67.2 Curtail further development in active Mill Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	CDFG, DWR		N/A	N/A	TBD	TBD	
			2.7.67.3 Develop education and outreach programs to encourage river stewardship in Mill Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.67.4 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon Steelhead	Yuba River. Yuba River.	2.7.68 Harvest/ angling impacts in the Yuba River affecting adult immigration and holding.	2.7.68.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon in Mill Creek.	2.1: Threats to Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Big Chico Creek.	2.7.69 Physical habitat alteration (i.e., watershed disturbance) in the Big Chico Creek watershed affecting the embryo incubation life stage through increased sedimentation.	2.7.69.1 Eliminate sources of chronic sediment delivered to Big Chico Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Big Chico Creek.		2.7.69.2 Enhance watershed resiliency in Big Chico Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Antelope Creek.	2.7.70 Passage impediments (e.g., agricultural diversions) in Antelope Creek affecting juvenile rearing and outmigration.	2.7.70.1 Implement an Antelope Creek Anadromous Fish Passage Study.	5.3: Threats Resulting from Water Diversions	5 Years	NMFS, USFWS	CDFG, DWR	Irrigation districts	N/A	200,000	200,000	200,000	Cost would be project-specific (e.g., the engineering investigation of anadromous fish passage (for adults and juveniles) in upper battle creek was estimated to cost $790,000). Source: DWR 1997a.
Steelhead	Antelope Creek.		2.7.70.2 Implement the Edwards Dam Ladder construction project (AFRP Website 2005).	5.4: Threats from Migration Obstructions and Impediments	Complete	NMFS	CDFG		N/A	N/A	N/A	N/A	
		2.7.70 Passage impediments (e.g., agricultural diversions) in Antelope Creek affecting juvenile rearing and outmigration.	2.7.79.3 Implement projects that cooperatively work with landowners to modify existing diversions in Antelope Creek so that fish do not become entrained in agricultural fields.		Long-term	NMFS, USFWS	CDFG, DWR	Landowners, Irrigation districts	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Feather River.	2.7.71 Low flows in the Feather River resulting in reduced attraction and migratory cues for the adult immigration life stage.	2.7.71.1 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights in the Feather River(AFRP website 2005).	1.1: Threats to Spawning Habitat	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Feather River.		2.7.71.2 Evaluate pulse flow benefits in the Feather River for attraction and passage during peak migration periods for years with low water availability; if pulse flows are determined to be effective for attracting spring-run Chinook salmon and steelhead, implement the most beneficial pulse flow regime.		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
			2.7.71.3 Provide for flows that are protective of all steelhead life stages in the Feather River through FERC processes and Section 7 implementation.		Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Feather River.	2.7.72 Feather River flow conditions (i.e., flow fluctuations and flood flows) affecting embryo incubation.	2.7.72.1 Adaptively manage releases in the Feather River in consideration of the spatial and temporal distribution of spring-run Chinook salmon and steelhead life stages in the Feather River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	
Steelhead	Feather River.	2.7.72 Feather River flow conditions (i.e., flow fluctuations and flood flows) affecting embryo incubation.	2.7.72.2 Develop and implement instream flow schedules, flow ramping protocols and flow fluctuation criteria for the Feather River designed to minimize spring-run Chinook salmon redd dewatering and to be protective of all steelhead life stages.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Feather River.	2.7.73 Water quality in the Feather River affecting the embryo incubation life stage.	2.7.73.1 Increase monitoring and enforcement in the Feather River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Feather River.		2.7.73.2 Develop a baseline monitoring program in the Feather River to evaluate water quality throughout the watershed to identify areas of concern.		3 Years		DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.7.73 Water quality in the Feather River affecting the embryo incubation life stage.	2.7.73.3 Encourage voluntary landowner participation in the Feather River watershed in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
			2.7.73.4 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Feather River watershed.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Big Chico Creek.	2.7.74 Loss of floodplain habitat in Big Chico Creek affecting the juvenile rearing life stage.	2.7.74.1 Implement projects to increase Big Chico Creek floodplain habitat availability to improve habitat conditions for juvenile rearing (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Big Chico Creek.												
Spring-run Chinook Salmon	Big Chico Creek.	2.7.75 Loss of natural river morphology and function in Big Chico Creek.	2.7.75.1 Identify stream reaches in Big Chico Creek that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	1.9 - 2.3 million per mile	TBD			Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
Steelhead	Big Chico Creek.		2.7.75.2 Curtail further development in the active Big Chico Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
		2.7.75 Loss of natural river morphology and function in Big Chico Creek.	2.7.75.3 Increase monitoring and enforcement of illegal rip rap applications in Big Chico Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.7.75.4 Develop education and outreach programs to encourage river stewardship in Big Chico Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG, CSU Chico	Landowners, Local schools	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Mill Creek.	2.7.76 Flow fluctuations in Mill Creek affecting the embryo incubation life stage.	2.7.76.1 Enhance watershed resiliency in Mill Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Mill Creek Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Deer Creek.	2.7.76 Flow fluctuations in Deer Creek affecting the embryo incubation life stage.	2.7.76.2 Enhance watershed resiliency in Deer Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Deer Creek Watershed Conservancy	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Yuba River.	2.7.77 Feather River diversions affecting juveniles produced in the Yuba River.	2.7.77.1 Ensure that all Feather River diversions have fish screens that meet NMFS' fish screen criteria.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS	CDFG, DWR	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
Steelhead	Auburn Ravine and Coon Creek.	2.7.78 Passage impediments in the Auburn Ravine and Coon Creek drainage affecting the adult immigration and holding and juvenile rearing and outmigration life stages.	2.7.78.1 Conduct an anadromous fish passage assessment in Auburn Ravine and Coon Creek including recommendations for improving passage conditions.	1.1: Threats to Spawning Habitat 5.4: Threats from Migration Obstructions and Impediments	5 Years	NMFS	CDFG, DWR			200,000	200,000	200,000	Cost to conduct a fish ladder and natural barrier assessment using radiotelemetry on Battle Creek was estimated at approximately $211,000 annually.
Steelhead	Bear River.	2.7.79 Water temperature in the Bear River affecting the adult immigration and holding, embryo incubation, and juvenile rearing life stages.	2.7.79.1 Enhance watershed resiliency in the Bear River by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Yuba Watershed Council, Bear River Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Bear River.	2.7.80 Flow conditions in the Bear River affecting the juvenile rearing and outmigration life stage.	2.7.80.1 Develop a Bear River Watershed Plan (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS, USFS	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	N/A	TBD	TBD	TBD	
Steelhead	Dry Creek.	2.7.81 Passage impediments/barriers in the Dry Creek drainage (Sacramento Region) affecting the adult immigration life stage.	2.7.81.1 Conduct an anadromous fish passage assessment in Dry Creek including recommendations for improving passage conditions.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin		200,000	200,000	200,000	Cost to conduct a fish ladder and natural barrier assessment using radiotelemetry on Battle Creek was estimated at approximately $211,000 annually.
Steelhead	Bear River.	2.7.82 Low flows in the Bear River limiting attraction of immigrating adults.	2.7.82.1 Evaluate pulse flow benefits for steelhead attraction and passage in the Bear River; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.
Steelhead	Dry Creek.	2.7.83 Water quality in Dry Creek drainage (Sacramento Region) affecting adult immigration and holding, spawning, and the juvenile rearing and outmigration life stages.	2.7.83.1 Enhance watershed resiliency in Dry Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.7.83 Water quality in Dry Creek drainage (Sacramento Region) affecting adult immigration and holding, spawning, and the juvenile rearing and outmigration life stages.	2.7.83.2 Eliminate sources of chronic sediment delivered to Dry Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.83.3 Develop a baseline monitoring program for Dry Creek to evaluate water quality throughout the watershed to identify areas of concern.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	3 Years	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.7.83 Water quality in Dry Creek drainage (Sacramento Region) affecting adult immigration and holding, spawning, and the juvenile rearing and outmigration life stages.	2.7.83.4 Encourage voluntary landowner participation in Dry Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
			2.7.83.5 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Dry Creek watershed.		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.83.6 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects in the Dry Creek watershed to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in Dry Creek.
			2.7.83.7 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands in the Dry Creek watershed to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	
			2.7.83.8 Increase monitoring and enforcement in Dry Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
Steelhead	Deer Creek.	2.7.84 Put-and-take rainbow trout fishery in the upper Deer Creek affecting spawning.	2.7.84.1 Eliminate the put-and-take rainbow trout fishery program in upper Deer Creek.	5.1: Threats Resulting from Artificial Propagation	5 Years	NMFS, USFWS	CDFG, DWR		N/A	N/A	N/A	N/A	
Steelhead	American River.	2.7.85 Water temperature in the American River affecting the juvenile rearing and outmigration, spawning and embryo incubation life stages.	2.7.85.1 Develop and implement an ecologically based flow management plan for the lower American River, including water temperature considerations (Water Forum 2001).	1.1: Threats to Spawning Habitat 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Water Forum	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Dry Creek.	2.7.86 Water temperature in the Dry Creek drainage (Sacramento Region) affecting the juvenile rearing and outmigration and adult immigration and holding life stages.	2.7.86.1 Enhance watershed resiliency in Dry Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Auburn Ravine and Coon Creek.	2.7.87 Passage impediments/barriers at the Auburn Ravine and Coon Creek drainage affecting spawning.	2.7.87.1 Assess feasibility of providing enhanced steelhead habitat in Auburn Ravine and Coon Creek (Water Forum 2001).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR	Water Forum	N/A	TBD	TBD	TBD	
Steelhead	American River.	2.7.88 Loss of riparian habitat and instream cover in the American River affecting the juvenile rearing and outmigration life stage.	2.7.88.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in the American River (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
			2.7.88.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the American River watershed.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, Corps, Reclamation, USFS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
			2.7.88.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in the American River.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.88.4 Curtail further development in active American River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
		2.7.88 Loss of riparian habitat and instream cover in the American River affecting the juvenile rearing and outmigration life stage.	2.7.88.5 Develop education and outreach programs to encourage river stewardship in the American River watershed.		Long-term	Corps, NMFS, USFWS	DWR, CDFG	American River Conservancy, Local governments	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999
			2.7.88.6 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	Auburn Ravine and Coon Creek.	2.7.89 Entrainment in Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.89.1 Develop an entrainment monitoring program in Auburn Ravine and Coon Creek to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS	CDFG, DWR	Placer County, Irrigation districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
			2.7.89.2 Develop and increase application of alternative diversion technologies that eliminate entrainment in Auburn Ravine and Coon Creek.		Long-term	NMFS, USFWS	CDFG, DWR	Placer County, Irrigation districts	N/A	TBD	TBD	TBD	
		2.7.89 Entrainment in Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.89.3 Implement projects that consolidate and screen existing diversions in Auburn Ravine and Coon Creek where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Cost would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Dry Creek.	2.7.90 Flow conditions in the Dry Creek Drainage (Sacramento Region) affecting the juvenile rearing and outmigration and embryo incubation life stages.	2.7.90.1 Conduct a hydrologic analysis of the Dry Creek watershed that explores conjunctive use opportunities to reduce water allocations that are dependent on surface water.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	
Steelhead	Bear River.	2.7.91 Flow conditions in the Bear River affecting spawning.	2.7.91.1 Develop a Bear River Watershed Plan (AFRP website 2005).	1.1: Threats to Habitat Quality and Complexity									
Steelhead	Bear River.	2.7.92 Entrainment in the Bear River affecting the juvenile rearing and outmigration life stage.	2.7.92.1 Conduct a SHIRA Analysis of the Lower Bear River; conduct feasibility analyses for screening and laddering five agricultural diversions in Dry Creek (tributary to Bear River) (AFRP website 2005).	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group, Irrigation districts	N/A	TBD	TBD	TBD	
				5.4: Threats from Migration Obstructions and Impediments									
Steelhead	Dry Creek.	2.7.93 Barrier at Dry Creek drainage (Sacramento Region) affecting spawning.	2.7.93.1 Evaluate gravel resources on Dry Creek and identify locations for gravel restoration (AFRP website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	150,000	TBD	TBD	Proposed cost to prepare for and conduct surveys to identify spawning riffles, evaluate spawning gravel quality, and develop a rehabilitation plan in lower Battle Creek was approximately $150,000. Source: DWR 1997b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Dry Creek.	2.7.94 Spawning habitat availability in Dry Creek drainage (Sacramento Region) affecting spawning.	2.7.94.1 Conduct stream habitat restoration on the Sierra College campus and conduct Secret Ravine Channel Habitat Restoration (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	35,000	TBD	TBD	Restoration of one site on Secret Ravine, including overexcavation of the toe of the failing bank, willow planting, and installation of root wads was estimated at $35,000. Source: Dry Creek Conservancy 2001.
Steelhead	American River.	2.7.95 Loss of floodplain habitat in the American River affecting the juvenile rearing and outmigration life stage.	2.7.95.1 Inventory locations for creating shallow inundated floodplain habitat in the American River for multi-species benefits and implement where suitable opportunities are available (Water Forum 2001).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.7.95 Loss of floodplain habitat in the American River affecting the juvenile rearing and outmigration life stage.	2.7.95.2 Implement projects on the American River to increase floodplain habitat availability to improve juvenile rearing habitat (NMFS 2007b).		Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Deer Creek.	2.7.96 Hatchery effects in Deer Creek affecting the juvenile rearing and outmigration life stage.	2.7.96.1 Discontinue out of basin hatchery stocking (NMFS 2007a).	5.1: Threats Resulting from Artificial Propagation	Long-term	NMFS, USFWS	CDFG, DWR	Deer Creek Watershed Conservancy	N/A	TBD	TBD	TBD	
Steelhead	Auburn Ravine and Coon Creek.	2.7.97 Low flows in the Auburn Ravine and Coon Creek drainage limiting attraction of immigrating adults.	2.7.97.1 Conduct a hydrologic analysis of the Auburn/Coon Creek watershed that explores conjunctive use opportunities to reduce water allocations that are dependent on surface water.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Bear River.	2.7.98 Loss of floodplain habitat in the Bear River affecting the juvenile rearing and outmigration life stage.	2.7.98.1 Restore and improve opportunities for the Bear River to inundate its floodplain on a seasonal basis (CALFED 2000).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead		2.7.98 Loss of floodplain habitat in the Bear River affecting the juvenile rearing and outmigration life stage.	2.7.98.2 Implement projects to increase floodplain habitat availability in the Bear River to improve juvenile rearing habitat (NMFS 2007b).		Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Bear River.	2.7.99 Flow conditions in the Bear River affecting embryo incubation.	2.7.99.1 Develop a Bear River Watershed Plan (AFRP website 2005).	1.1: Threats to Spawning Habitat									
	Yuba River.	2.7.100 Spawning habitat availability in the Yuba River affecting spawning.	2.7.100.1 Conduct gravel additions above and below Narrows Pool (Corps mitigation) (AFRP Website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council, Yuba County Water Agency	11 - 36 per cubic yard of gravel	TBD	TBD	TBD	In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead Steelhead	Dry Creek.	2.7.101 Low flows at the Dry Creek drainage (Sacramento Region) limiting attraction of immigrating adults.	2.7.101.1 Conduct a hydrologic analysis of the Dry Creek watershed that explores conjunctive use opportunities to reduce water allocations that are dependent on surface water.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	
Steelhead	Auburn Ravine and Coon Creek.	2.7.102 Water quality at the Auburn Ravine and Coon Creek drainage affecting the adult immigration and holding, spawning, and juvenile rearing and outmigration life stages.	2.7.102.1 Enhance watershed resiliency in Auburn Ravine and Coon Creek by identifying and implementing projects that would reduce the potentia for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Placer County	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.102.2 Eliminate sources of chronic sediment delivered to Auburn Ravine and Coon Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Placer County	N/A	TBD	TBD	TBD	
		2.7.102 Water quality at the Auburn Ravine and Coon Creek drainage affecting the adult immigration and holding, spawning, and juvenile rearing and outmigration life stages.	2.7.102.3 Develop a baseline monitoring program in Auburn Ravine and Coon Creek to evaluate water quality throughout the watershed to identify areas of concern.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	3 Years	NMFS, USFWS, EPA	SWRCB, DHS, DWR, CDFG	Placer County	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.102.4 Encourage voluntary landowner participation in the Auburn Ravine/Coon Creek watershed in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners, Placer County	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.7.102 Water quality at the Auburn Ravine and Coon Creek drainage affecting the adult immigration and holding, spawning, and juvenile rearing and outmigration life stages.	2.7.102.5 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Auburn Ravine/Coon Creek watershed.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Placer County	N/A	TBD	TBD	TBD	
			2.7.102.6 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects in Auburn Ravine and Coon Creek to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Placer County	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in Auburn Ravine and Coon Creek.
			2.7.102.7 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands in the Auburn Ravine/Coon Creek watershed to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.102.8 Increase monitoring and enforcement in Auburn Ravine and Coon Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
Steelhead	Dry Creek.	2.7.103 Loss of natural river morphology and function in the Dry Creek drainage (Sacramento Region) affecting the juvenile rearing and outmigration life stage.	2.7.103.1 Conduct stream habitat restoration on the Sierra College campus and conduct Secret Ravine Channel Habitat Restoration (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	35,000	TBD	TBD	Restoration of one site on Secret Ravine, including overexcavation of the toe of the failing bank, willow planting, and installation of root wads was estimated at $35,000. Source: Dry Creek Conservancy 2001.
			2.7.103.2 Identify stream reaches that have been most altered by anthropogenic factors and reconstruct natural channel geometry scaled to current channel forming flows in Dry Creek.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	5 Years	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
			2.7.103.3 Curtail further development in the active Dry Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.103 Loss of natura river morphology and function in the Dry Creek drainage (Sacramento Region) affecting the juvenile rearing and outmigration life stage.	2.7.103.4 Develop education and outreach programs to encourage river stewardship in Dry Creek.		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Steelhead	Dry Creek.	2.7.104 Loss of riparian habitat and instream cover in the Dry Creek drainage (Sacramento Region) affecting the juvenile rearing and outmigration life stage.	2.7.104.1 Conduct stream habitat restoration on the Sierra College campus and conduct Secret Ravine Channel Habitat Restoration (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity									
			2.7.104.2 Develop State and national levee vegetation policies to maintain and restore riparian corridors in Dry Creek (Corps vegetation management policy and FloodSAFE).	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS, Corps, Reclamation	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
			2.7.104.3 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Dry Creek watershed.		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	N/A	N/A	N/A	
		2.7.104 Loss of riparian habitat and instream cover in the Dry Creek drainage (Sacramento Region) affecting the juvenile rearing and outmigration life stage.	2.7.104.4 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Dry Creek.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.104.5 Curtail further development in active Dry Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.104.6 Develop education and outreach programs to encourage river stewardship in the Dry Creek watershed.		Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.7.104.7 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	American River.	2.7.105 Loss of natural river morphology and function in the American River affecting the juvenile rearing and outmigration life stage.	2.7.105.1 Develop a riparian corridor management plan and improve and protect riparian habitat and instream cover in the American River (USFWS 2001).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Local governments	N/A	TBD	TBD	TBD	
			2.7.105.2 Inventory locations on the American River for creating shallow inundated floodplain habitat for multi-species benefits and implement where suitable opportunities are available (Water Forum 2001).		Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.105.3 Develop education and outreach programs to encourage river stewardship in the American River watershed.		Long-term	Corps, NMFS, USFWS	DWR, CDFG	American River Conservancy, Local governments	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Steelhead	Auburn Ravine and Coon Creek.	2.7.106 Flow conditions in the Auburn Ravine and Coon Creek drainage affecting spawning and juvenile rearing.	2.7.106.1 Conduct a hydrologic analysis of the Auburn/Coon Creek watershed that explores conjunctive use opportunities to reduce water allocations that are dependent on surface water.	1.1: Threats to Spawning Habitat 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Auburn Ravine and Coon Creek.	2.7.107 Loss of natural river morphology and function in the Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.107.1 Identify stream reaches in Auburn Ravine and Coon Creek that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG, DWR		1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
			2.7.107.2 Curtail further development in the active Auburn Ravine and Coon Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
			2.7.107.3 Develop education and outreach programs to encourage river stewardship in the Auburn Ravine/Coon Creek watershed.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Auburn Ravine and Coon Creek.	2.7.108 Loss of riparian habitat and instream cover in the Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.108.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in Auburn Ravine and Coon Creek (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		1-1.5 million per mile of levee	TBD	TBD	TBD	Cost estimate for levee planting on Twitchell Island. Source: Nuedeck 2000.
			2.7.108.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Auburn Ravine/Coon Creek watershed.		Long-term	NMFS, USFWS, Corps, Reclamation, USFS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
			2.7.108.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Auburn Ravine and Coon Creek.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.7.108.4 Curtail further development in active Auburn Ravine and Coon Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
		2.7.108 Loss of riparian habitat and instream cover in the Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.108.5 Develop education and outreach programs to encourage river stewardship in the Auburn Ravine/Coon Creek watershed.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.108.6 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	Dry Creek.	2.7.109 Physical habitat alteration in the Dry Creek drainage (Sacramento Region) affecting spawning.	2.7.109.1 Conduct stream habitat restoration on the Sierra College campus and conduct Secret Ravine Channel Habitat Restoration (AFRP website 2005).	1.1: Threats to Spawning Habitat 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, National Park Service	SWRCB, DWR, CDFG	Dry Creek Conservancy, Placer County, Sierra College, City of Roseville, City of Rocklin	N/A	35,000	TBD	TBD	Restoration of one site on Secret Ravine, including overexcavation of the toe of the failing bank, willow planting, and installation of root wads was estimated at $35,000. Source: Dry Creek Conservancy 2001.
Steelhead	Mill Creek.	2.7.110 Flow conditions in Mill Creek affecting the juvenile rearing and outmigration life stage.	2.7.110.1 Work with State and Federal water acquisition programs to develop dedicated instream water; participate in the Lower Mill Creek Watershed Restoration Project (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Mill Creek Conservancy	TBD	TBD	TBD	TBD	
Steelhead	Deer Creek.	2.7.111 Flow conditions in Deer Creek affecting the juvenile rearing and outmigration life stage.	2.7.111.1 Conduct real time flow and water temperature monitoring in Deer Creek (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USGS	CDFG, DWR		8,500 per flow gage station	TBD	TBD	TBD	$8,500 was reported to be a typical cost of a gauging station in the region. Source: AFRP 2006.
Steelhead	Auburn Ravine and Coon Creek.	2.7.112 Water temperature in Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration and spawning life stages.	2.7.112.1 Enhance watershed resiliency in Auburn Ravine and Coon Creek by identifying and implementing projects that would reduce the potentia for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Placer County	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Antelope Creek.	2.7.113 Flow conditions in Antelope Creek affecting the juvenile rearing and outmigration life stage.	2.7.113.1 Develop an Antelope Creek Watershed Assessment (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Auburn Ravine and Coon Creek.	2.7.114 Predation in the Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.114.1 Implement programs and measures in Auburn Ravine and Coon Creek designed to control non-native predatory fish (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
		2.7.114 Predation in the Auburn Ravine and Coon Creek drainage affecting the juvenile rearing and outmigration life stage.	2.7.114.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in Auburn Ravine and Coon Creek.	3.2: Threats from Predation	Long-term	NMFS, USFWS, Corps, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.7.114.3 Improve nearshore refuge cover for salmonids in Auburn Ravine and Coon Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	American River.	2.7.115 Hatchery effects in the American River affecting the spawning and juvenile rearing and outmigration life stages.	2.7.115.1 Evaluate Nimbus Steelhead Hatchery production and stocking practices to identify measures that would promote restoration of steelhead in the lower American River (Water Forum 2001).	5.1: Threats from Artificial Propagation	5 Years	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Water Forum	N/A	150,000	TBD	TBD	Cost to develop a hatchery management plan for the Lewis River in Washington was approximately $154,000. The plan included (1) Hatchery review; (2) Ecosystem diagnostics and treatment modeling; and (3) Monitoring and evaluation. Source: WDFW 2002.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.115.2 Develop Nimbus Hatchery Genetic Management Plan.		Long-term	NMFS, USFWS	CDFG		N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.
Steelhead	Bear River.	2.7.116 Physical habitat alteration in the Bear River affecting spawning.	2.7.116.1 Evaluate gravel resources on Dry Creek (tributary to Bear River) and identify locations for gravel restoration (AFRP website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	N/A	150,000	TBD	TBD	Proposed cost to prepare for and conduct surveys to identify spawning riffles, evaluate spawning gravel quality, and develop a rehabilitation plan in lower Battle Creek was approximately $150,000. Source: DWR 1997b.
Steelhead	Bear River.	2.7.117 Spawning habitat availability in the Bear River affecting spawning.	2.7.117.1 Conduct an instream flow study in the Bear River to identify a spawning habitat-flow relationship and to identify factors (e.g., substrate size and quality, velocity, water depth) limiting spawning habitat availability.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	N/A	TBD	TBD	TBD	
Steelhead	American River.	2.7.118 Flow conditions in the American River affecting the adult immigration and holding, spawning, and juvenile rearing and outmigration life stages.	2.7.118.1 Develop and implement an ecologically based flow management plan for the lower American River, including water temperature considerations (Water Forum 2001).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Water Forum	N/A	TBD	TBD	TBD	
				1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	American River.	2.7.119 Harvest/ angling impacts in the American River affecting the adult immigration and holding and embryo incubation life stages.	2.7.119.1 Modify sport-fishing regulations to further minimize harvest of steelhead in the lower American River.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	American River.	2.7.120 Water quality in the American River affecting the embryo incubation life stage.	2.7.120.1 Implement projects that improve wastewater and stormwater treatment in residential, commercial, and industrial areas throughout the American River watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS	CDFG		N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
		2.7.120 Water quality in the American River affecting the embryo incubation life stage.	2.7.120.2 Increase monitoring and enforcement in the American River watershed to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term		SWRCB, RWQCBs		N/A	N/A	N/A	N/A	
			2.7.120.3 Develop a baseline monitoring program in the American River watershed to evaluate water quality throughout the watershed to identify areas of concern.		3 Years	NMFS, USFWS, EPA	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.120 Water quality in the American River affecting the embryo incubation life stage.	2.7.120.4 Encourage voluntary landowner participation in the American River watershed in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners, American River Conservancy	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
Steelhead	Dry Creek (Sacramento Region).	2.7.121 Harvest/ angling impacts in Dry Creek affecting the adult immigration and holding and spawning life stages.	2.7.121.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Dry Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Dry Creek (Sacramento Region).	2.7.122 Hatchery effects in Dry Creek affecting the spawning life stage.	2.7.122.1 Control hatchery release timing, numbers and locations in Dry Creek to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats Resulting from Artificial Propagation	Long-term	NMFS	CDFG		N/A	TBD	TBD	TBD	
Steelhead	Dry Creek (Sacramento Region).	2.7.123 Predation in Dry Creek affecting the juvenile rearing and outmigration life stage.	2.7.123.1 Implement programs and measures designed to control non-native predatory fish in Dry Creek (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.7.123.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in Dry Creek.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.123.3 Improve nearshore refuge cover for salmonids in Dry Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD			Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	Auburn Ravine and Coon Creek.	2.7.124 Harvest/ angling impacts in Auburn Ravine/Coon Creek affecting the spawning and adult immigration and holding life stages.	2.7.124.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Auburn Ravine/Coon Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Bear River.	2.7.125 Water quality in Bear River affecting the adult immigration and holding and embryo incubation life stages.	2.7.125.1 Increase monitoring and enforcement in the Bear River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.7.125.2 Develop a baseline monitoring program in the Bear River to evaluate water quality throughout the watershed to identify areas of concern.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Yuba Watershed Council, Bear River Watershed Group	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.125 Water quality in Bear River affecting the adult immigration and holding and embryo incubation life stages.	2.7.125.3 Encourage voluntary landowner participation in the Bear River in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Yuba Watershed Council, Bear River Watershed Group, Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
Steelhead	Bear River.	2.7.126 Passage impediments/barriers in the Bear River affecting the adult immigration and holding life stage.	2.7.126.1 Conduct an anadromous fish passage assessment in the Bear River including recommendations for improving passage conditions.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Corps, Reclamation	CDFG, DWR	Yuba Watershed Council, Bear River Watershed Group	N/A	200,000	200,000	200,000	Cost to conduct a fish ladder and natural barrier assessment using radiotelemetry on Battle Creek was estimated at approximately $211,000 annually.
Steelhead	Bear River.	2.7.127 Harvest/ angling impacts in the Bear River affecting the embryo incubation life stage.	2.7.127.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Bear River	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Yuba River and Feather River.	2.7.128 Entrainment at individual diversions in the Feather River affecting juveniles produced in the Yuba and Feather Rivers.	2.7.128.1 Develop an entrainment monitoring program in the Feather Rier to determine the level of take at individual diversions. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS	CDFG	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
			2.7.128.2 Develop and increase application of alternative diversion technologies that eliminate entrainment in the Feather River.		Long-term	NMFS	CDFG	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.7.128.3 Implement projects that consolidate and screen existing diversions in the Feather River where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Cost would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)
Steelhead	Big Chico Creek.	2.7.129 Flow fluctuations in Big Chico Creek affecting the embryo incubation and spawning life stages.	2.7.129.1 Enhance watershed resiliency in Big Chico Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Big Chico Creek Watershed Alliance	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Big Chico Creek.	2.7.130 Water quality in Big Chico Creek affecting the embryo incubation life stage.	2.7.130.1 Increase monitoring and enforcement in Big Chico Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.7.130.2 Develop a baseline monitoring program to evaluate water quality throughout the watershed to identify areas of concern.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.7.130 Water quality in Big Chico Creek affecting the embryo incubation life stage.	2.7.130.3 Encourage voluntary landowner participation in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
			2.7.130.4 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	

2.8 Basalt and Porous Lava Diversity Group Threats and Associated Recovery Actions

Table 2-8. Basalt and Poruous Lava Diversity Group Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Battle Creek.	2.8.1 North Fork Dams impeding and/or blocking adults attempting to return to Battle Creek.	2.8.1.1 Install state-of-the-art fish ladders at, or remove small dams on the North Fork of Battle Creek to provide fish passage (NMFS 2007b).	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	50 million for Phase 1A	TBD	TBD	Cost for implementation of Phase 1A of the Battle Creek Salmon and Steelhead Restoration Plan. Source: Battle Creek Watershed Conservancy Website 2008.
Steelhead	Battle Creek.												
Spring-run Chinook Salmon	Battle Creek.	2.8.2 South Fork Dams impeding and/or blocking adults attempting to return to Battle Creek.	2.8.2.1 Install state-of-the-art ladders at, or remove small dams on the South Fork of Battle Creek to provide fish passage (NMFS 2007b).	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	50 million for Phase 1A	TBD	TBD	Cost for implementation of Phase 1A of the Battle Creek Salmon and Steelhead Restoration Plan. Source: Battle Creek Watershed Conservancy Website 2008.
Steelhead	Battle Creek.												
Spring-run Chinook Salmon	Battle Creek.	2.8.3 Water temperature in Battle Creek affecting the adult immigration and holding, the embryo incubation, and the juvenile rearing and outmigration life stage.	2.8.3.1 Increase streamflows as specified in the Battle Creek Salmon And Steelhead Restoration Plan (NMFS 2007b).	1.1: Threats to Spawning Habitat	Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	See 2.8.9.1	TBD	TBD	
Steelhead	Battle Creek.	2.8.3 Water temperature in Battle Creek affecting the adult immigration and holding, the embryo incubation, and the juvenile rearing and outmigration life stage	2.8.3.2 Enhance watershed resiliency in Battle Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas (U.S. Forest Service Long-term Anadromous Fish Conservation Strategy).	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Battle Creek.	2.8.4 Hatchery effects (competition/predation) in Battle Creek on the juvenile rearing and spawning life stages.	2.8.4.1 Develop HGMPs and control hatchery release timing, numbers and locations in Battle Creek to minimize adverse effects to wild stock.	5.1: Threats from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.
			2.8.4.2 Conduct feasibility study of moving and/or modifying Coleman Hatchery operations to prevent adverse impacts to listed species in Battle Creek.		Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Battle Creek.	2.8.5 Low flows in Battle Creek affecting the adult immigration and holding life stage by reducing the magnitude of attraction and migratory cues.	2.8.5.1 Increase flow releases from remaining diversion dams affecting anadromous fish on Battle Creek as per the Battle Creek Restoration Plan (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	See 2.8.9.1	TBD	TBD	
Steelhead	Battle Creek.	2.8.5 Low flows in Battle Creek affecting the adult immigration and holding life stage by reducing the magnitude of attraction and migratory cues.	2.8.5.2 Avoid implementation of additional water projects (i.e., FERC permits) that are detrimental to the goals and objectives of the Battle Creek Salmon and Steelhead Restoration Plan.		Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	N/A	N/A	N/A	
Spring-run Chinook Salmon	Battle Creek.	2.8.6 Low instream flows per FERC license affecting Battle Creek spawning.	2.8.6.1 Increase flow releases from remaining diversion dams affecting anadromous fish on Battle Creek as per the Battle Creek Salmon and Steelhead Restoration Plan (CALFED 2007).	1.1: Threats to Spawning Habitat	Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	See 2.8.9.1	TBD	TBD	
Steelhead	Battle Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Battle Creek.	2.8.7 Entrainment at individual diversions in Battle Creek affecting juveniles.	2.8.7.1 Screen PG&E diversions to prevent entrainment of juvenile salmonids as per the Battle Creek Restoration Project (AFRP Website 2006).	5.3: Threats Resulting from Water Diversions	3 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	See 2.8.9.1	TBD	TBD	
Steelhead	Battle Creek.		2.8.7.2 Develop and increase application of alternative diversion technologies that eliminate entrainment in Battle Creek.		Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Battle Creek.	2.8.8 Redd superimposition, increased competition for habitat, and hybridization, (from barriers) affecting Battle Creek spawning.	2.8.8.1 Provide anadromous fish passage as specified in the Battle Creek Salmon And Steelhead Restoration Plan (CALFED 2007).	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	See 2.8.9.1	TBD	TBD	
Steelhead	Battle Creek.												
Spring-run Chinook Salmon	Battle Creek.	2.8.9 Flow dependent habitat availability affecting juveniles produced in Battle Creek.	2.8.9.1 Implement the Battle Creek Salmon And Steelhead Restoration Plan (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy, The Nature Conservancy	N/A	50 million for Phase 1A	TBD	TBD	Costs for Phase 1B and Phase 2 TBD. Source: Battle Creek Watershed Conservancy Website 2008.
Steelhead	Battle Creek.												
Spring-run Chinook Salmon	Battle Creek.	2.8.10 Flow fluctuations in Battle Creek affecting the embryo incubation life stage.	2.8.10.1 Implement the Battle Creek Salmon And Steelhead Restoration Plan.	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy, The Nature Conservancy	N/A	50 million for Phase 1A	TBD	TBD	Costs for Phase 1B and Phase 2 TBD. Source: Battle Creek Watershed Conservancy Website 2008.
Steelhead	Battle Creek.		2.8.10.2 Modernize/upgrade PG&E facilities to reduce the potential for flow fluctuations in Battle Creek and outages.	1.3: Threats to Habitat Quality and Complexity	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Battle Creek. Battle Creek.	2.8.11 Limited spawning habitat availability/ suitability in Battle Creek.	2.8.11.1 Implement the Battle Creek Salmon And Steelhead Restoration Plan.	1.1 Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E, Battle Creek Watershed Conservancy, The Nature Conservancy	N/A	50 million for Phase 1A	TBD	TBD	Costs for Phase 1B and Phase 2 TBD. Source: Battle Creek Watershed Conservancy Website 2008.
Spring-run Chinook Salmon	Battle Creek.	2.8.12 Predation in Battle Creek affecting juvenile rearing and outmigration.	2.8.12.1 Implement a study designed to develop quantitative estimates of predation on spring-run Chinook salmon by non-native species in Battle Creek.	1.3 Threats to Habitat Quality and Complexity	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Steelhead	Battle Creek.		2.8.12.2 Implement programs and measures designed to control non-native predatory fish in Battle Creek (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	3.2: Threats from Predation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.8.12.3 Implement projects to minimize predation at weirs, diversion dams, and related structures in Battle Creek.	5.1: Threats from Artificial Propagation	Long-term	Reclamation, NMFS, USFWS, FERC	CDFG, DWR, SWRCB	PG&E	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.8.12 Predation in Battle Creek affecting juvenile rearing and outmigration.	2.8.12.4 Improve nearshore refuge cover for salmonids in Battle Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG, CDPR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
			2.8.12.5 Modify hatchery operations in Battle Creek (e.g., release strategies) to prevent hatchery salmonid predation on naturally-produced juvenile salmonids.		Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.
Steelhead	Cow Creek.	2.8.13 Passage impediments/barriers in Cow Creek affecting the adult immigration life stage.	2.8.13.1 Conduct feasibility analyses for screening and laddering five agricultural diversions in Cow Creek (AFRP website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
				5.3: Threats from Water Diversions									
				5.4: Threats from Migration Obstructions and Impediments									

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Cow Creek.	2.8.14 Cow Creek water temperatures affecting adult immigration and holding, spawning, juvenile rearing and outmigration, and embryo incubation.	2.8.14.1 Install water temperature recorders at select locations in Cow Creek; develop recommendations for minimum instream flow based on temperature needs (AFRP website 2005).	1.2: Threats to Water Quality	5 Years	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group		TBD	TBD	TBD	
Steelhead	Upper Sacramento Tributaries.	2.8.15 Passage impediments/barriers in Upper Sacramento River Tributaries (i.e., Stillwater, Churn, Sulphur, Salt, Olney, Paynes etc.) affecting the adult immigration life stage.	2.8.15.1 Prepare a Paynes/Antelope watershed assessment (AFRP website 2006b).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, USFWS, USFS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Cow Creek.	2.8.16 Entrainment of juveniles at Cow Creek diversions.	2.8.16.1 Conduct feasibility analyses for screening and laddering five agricultural diversions; conduct Cow Creek Diversion Mapping (AFRP website 2005).	5.3: Threats Resulting from Water Diversions	5 Years	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
		2.8.16 Entrainment of juveniles at Cow Creek diversions.	2.8.16.2 Develop and increase application of alternative diversion technologies that eliminate entrainment in Cow Creek.		Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
Steelhead	Cow Creek.	2.8.17 Flow fluctuations in Cow Creek affecting embryo incubation.	2.8.17.1 Enhance watershed resiliency in Cow Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
				1.3: Threats to Habitat Quality and Complexity									
Steelhead	Cow Creek.	2.8.18 Loss of natural river morphology and function in Cow Creek affecting juvenile rearing and outmigration.	2.8.18.1 Implement actions specified in the Cow Creek Watershed Management Plan directed at restoring instream and riparian habitat (AFRP Website 2003).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.8.18.2 Identify stream reaches in Cow Creek that have been most altered by anthropogenic factors and reconstruct a natural channel geometry scaled to current channel forming flows.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	5 Years	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	1.9 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel processes and habitats in the Tuolumne and Merced Rivers ranged from $1.9 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.
		2.8.18 Loss of natural river morphology and function in Cow Creek affecting juvenile rearing and outmigration.	2.8.18.3 Curtail further development in the active Cow Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	TBD	TBD	
			2.8.18.4 Increase monitoring and enforcement of illegal rip rap applications in Cow Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.8.18.5 Develop education and outreach programs to encourage river stewardship in Cow Creek.		Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Cow Creek.	2.8.19 Loss of riparian habitat and instream cover affecting juvenile rearing and outmigration in Cow Creek.	2.8.19.1 Cooperatively negotiate long-term agreements with local landowners to maintain and restore riparian communities along lower reaches of Cow Creek (CALFED 2000).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.8.19 Loss of riparian habitat and instream cover affecting juvenile rearing and outmigration in Cow Creek.	2.8.19.2 Enhance watershed resiliency in Cow Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.8.19.3 Curtail further development in active Cow Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	TBD	TBD	
			2.8.19.4 Develop education and outreach programs to encourage river stewardship in Cow Creek.		Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.8.19.5 Permanently protect riparian habitat through easements and/or land acquisition										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Cow Creek.	2.8.20 Passage impediments in Cow Creek limiting spawning habitat availability and affecting juvenile outmigration.	2.8.20.1 Implement actions (e.g., spawning gravel augmentation) designed to increase spawning habitat availability and complement flows in Cow Creek.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
			2.8.20.2 Develop and implement actions to reduce or eliminate passage impediments in Cow Creek.	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
Steelhead	Upper Sacramento Tributaries.	2.8.21 Low flows in the upper Sacramento Tributaries limiting attraction of immigrating adults and affecting juvenile rearing and outmigration.	2.8.21.1 Conduct a hydrologic analysis for the upper Sacramento River tributaries and identify opportunities for conjunctive use to reduce surface water diversions.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Cow Creek.	2.8.22 Stocked trout in Upper Cow Creek potentially spawning with wild steelhead in Cow Creek.	2.8.22.1 Eliminate the put-and-take rainbow trout fishery program in upper Cow Creek.	5.1: Threats Resulting from Artificial Propagation	3 Years	NMFS, USFWS, USFS	CDFG, DWR	Cow Creek Watershed Management Group	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento Tributaries.	2.8.23 Entrainment affecting juvenile rearing and outmigration in the upper Sacramento Tributaries.	2.8.23.1 Develop an entrainment monitoring program to determine the level of take at individual diversions in the upper Sacramento River tributaries. Prioritize diversions based on this monitoring and screen those that are determined to have substantial impacts at the population level.	5.3: Threats Resulting from Water Diversions	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
			2.8.23.2 Develop and increase application of alternative diversion technologies that eliminate entrainment in the upper Sacramento River tributaries.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
			2.8.23.3 Implement projects that consolidate and screen existing diversions in the upper Sacramento River tributaries where feasible.		Long-term	NMFS, Reclamation	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	Costs would be project-specific (e.g., proposed cost for the Anderson-Cottonwood Irrigation District Fish Screen Improvement and Diversion Consolidation Project was $14 million (1997 $)
Steelhead	Battle Creek and Stony Creek.	2.8.24 Steelhead produced at Coleman Hatchery competing with adults and juveniles produced in Battle Creek and in Stony Creek.	2.8.24.1 Control hatchery release timing, numbers and locations in Battle Creek to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats Resulting from Artificial Propagation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Battle Creek Watershed Conservancy	N/A	TBD	TBD	TBD	Biennial total cost estimate to develop and complete the HGMP for Puget Sound Chinook and Columbia River Steelhead was $450,000. Source: Washington State GSRO 2000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento Tributaries.	2.8.25 Passage impediments limiting spawning habitat availability in the upper Sacramento Tributaries.	2.8.25.1 Implement actions (e.g., spawning gravel augmentation) in the upper Sacramento River tributaries designed to increase spawning habitat availability.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
			2.8.25.2 Develop and implement actions to reduce or eliminate passage impediments in the upper Sacramento River tributaries.	5.4: Threats from Migration Obstructions and Impediments	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Cow Creek.	2.8.26 Loss of floodplain habitat affecting juveniles produced in Cow Creek.	2.8.26.1 Implement projects to increase floodplain habitat availability in Cow Creek to improve juvenile rearing habitat (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento Tributaries.	2.8.27 Predation on juvenile steelhead in the upper Sacramento Tributaries.	2.8.27.1 Implement programs and measures designed to control non-native predatory fish in the upper Sacramento River tributaries (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.8.27.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in the upper Sacramento River tributaries.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR	Irrigation districts, Water districts	N/A	TBD	TBD	TBD	
			2.8.27.3 Improve nearshore refuge cover for salmonids in the upper Sacramento River tributaries to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	Cow Creek.	2.8.28 Low flow conditions limiting attraction of adults and affecting juveniles produced in Cow Creek.	2.8.28.1 Investigate measures to increase flows in Cow Creek and tributaries, such as: (1) investigating opportunities to increase irrigation efficiency; (2) managing vegetation to improve water supply and timing of supply; (3) purchasing water or water rights from willing sellers; (4) removing or laddering diversions; (5) providing alternate water sources during important periods; and (6) implementing a conjunctive use program (AFRP Website 2003).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR, SWRCB	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento Tributaries.	2.8.29 Water quality affecting adults attempting to return to the upper Sacramento River Tributaries and embryo incubation.	2.8.29.1 Implement projects that improve wastewater and stormwater treatment in Redding and in surrounding residential and commercial areas (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments	N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
			2.8.29.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects in the upper Sacramento River watershed to treat, store, convey, and/or dispose of agricultural drainage (SWRCB website).	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the upper Sacramento River and its tributaries.
			2.8.29.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands in the upper Sacramento River tributaries to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		Long-term		SWRCB		N/A	N/A	N/A	N/A	
			2.8.29.4 Increase monitoring and enforcement in the upper Sacramento River tributaries to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.8.29 Water quality affecting adults attempting to return to the upper Sacramento River Tributaries and embryo incubation.	2.8.29.5 Develop a baseline monitoring program for the upper Sacramento River tributaries to evaluate water quality throughout the watershed to identify areas of concern.		3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.8.29.6 Encourage voluntary landowner participation in the upper Sacramento River tributaries in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.8.29 Water quality affecting adults attempting to return to the upper Sacramento River Tributaries and embryo incubation.	2.8.29.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the upper Sacramento River tributaries.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.8.29.8 Improve and maintain containment of contaminants from Iron Mountain Mine.		Long-term	EPA	DWR		N/A	TBD	TBD	TBD	Continue EPA's cleanup of Iron Mountain Mine. In 2000, a settlement was proposed which included $862 million in funding to clean up Iron Mountain Mine. Source: EPA Website 2008.
Steelhead	Upper Sacramento Tributaries.	2.8.30 Passage impediments/barriers in the upper Sacramento Tributaries affecting adult immigration.	2.8.30.1 Conduct an anadromous fish passage assessment for Stillwater, Churn, Sulphur, Salt, Olney, and Paynes creeks.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost to conduct a fish ladder and natural barrier assessment using radiotelemetry on Battle Creek was estimated at approximately $211,000 annually.
Steelhead	Upper Sacramento Tributaries.	2.8.31 Limited instream gravel supply affecting spawning habitat availability in the upper Sacramento Tributaries.	2.8.31.1 Identify gravel starved areas in the upper Sacramento River tributaries and implement gravel additions (AFRP Website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG, DWR		11 - 36 per cubic yard of gravel	TBD	TBD	TBD	Proposed cost to prepare for and conduct surveys to identify spawning riffles, evaluate spawning gravel quality, and develop a rehabilitation plan in lower Battle Creek was approximately $150,000. Source: DWR 1997b. In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.
Steelhead	Cow Creek.	2.8.32 Water quality affecting adult immigration and embryo incubation in Cow Creek.	2.8.32.1 Implement the water quality action options described in the Cow Creek Watershed Management Plan (AFRP Website 2003).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.8.32.2 Enhance watershed resiliency in Cow Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.		Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.8.32 Water quality affecting adult immigration and embryo incubation in Cow Creek.	2.8.32.3 Eliminate sources of chronic sediment delivered to Cow Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
			2.8.32.4 Develop a baseline monitoring program for Cow Creek to evaluate water quality throughout the watershed to identify areas of concern.		2 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Cow Creek Watershed Management Group	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.8.32 Water quality affecting adult immigration and embryo incubation in Cow Creek.	2.8.32.5 Encourage voluntary landowner participation in Cow Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners, Cow Creek Watershed Management Group	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
			2.8.32.6 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Cow Creek.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners, Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	
Steelhead	Cow Creek.	2.8.33 Limited instream gravel reducing potential spawning habitat.	2.8.33.1 Develop and implement a Cow Creek spawning gravel augmentation plan.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Western Shasta Resource Conservation District	CDFG, DWR	Cow Creek Watershed Management Group	N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Upper Sacramento River Tributaries.	2.8.34 Spawning habitat availability in the upper Sacramento River tributaries affecting spawning.	2.8.34.1 Conduct an instream flow studies in the upper Sacramento River tributaries to identify spawning habitat-flow relationships and to identify factors (e.g., substrate size and quality, velocity, water depth) limiting spawning habitat availability.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.8.34 Spawning habitat availability in the upper Sacramento River tributaries affecting spawning.	2.8.34.2 Conduct periodic (e.g., every 5 years) spawning gravel assessments in the upper Sacramento River (i.e., above RBDD) and implement gravel augmentation projects, as necessary.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Upper Sacramento River Tributaries.	2.8.35 Harvest/angling impacts in the upper Sacramento River tributaries adults attempting to return to the upper Sacramento Tributaries.	2.8.35.1 Modify sport-fishing regulations to further minimize harvest of steelhead in the upper Sacramento River tributaries.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Cow Creek.	2.8.36 Harvest/angling impacts Cow Creek affecting adult immigration and holding.	2.8.36.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Cow Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Battle Creek.	2.8.37 Loss of riparian habitat and instream cover in Battle Creek affecting juvenile rearing.	2.8.37.1 The Corps, DWR, CDFG, BLM, USFWS, NMFS, private land owners, and Resource Conservation Districts should continue to focus on retaining, restoring and creating continuous riparian corridors within their jurisdictions in Battle Creek.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS, NMFS, BLM, Resource Conservation Service	DWR, CDFG, CDPR	Local agencies, NGOs, landowners	N/A	N/A	N/A	N/A	
Steelhead	Battle Creek.		2.8.37.2 Utilize bio-technical techniques for river bank stabilization instead of conventional rip rap in Battle Creek.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5-135 per acre	TBD	TBD	TBD	Cost would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.8.37.3 Increase monitoring and enforcement of illegal rip rap applications in Battle Creek.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.8.37.4 Permanently protect riparian habitat through easements and/or land acquisition										

2.9 Northwestern California Diversity Group Recovery Actions

Table 2-9 Northwestern California Diversity Group Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Beegum Creek. Beegum Creek.	2.9.1 Water temperature in Cottonwood/Beegum Creek affecting adult immigration and holding, and spawning.	2.9.1.1 Enhance watershed resiliency in Beegum Creek and the greater Cottonwood watershed by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Thomes Creek.	2.9.2 Agricultural diversion dams, braiding, and low natural channel gradient affecting adults attempting to return to Thomes Creek.	2.9.2.1 Conduct a feasibility study on potential channel modifications that would improve upstream migration conditions in Thomes Creek.	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS	CDFG		N/A	TBD	TBD	TBD	
Steelhead	Thomes Creek.		2.9.2.2 Design and implement a Thomes Creek anadromous fish passage study (AFRP Website 2005).	1.3: Threats to Habitat Quality and Complexity	5 Years	NMFS, USFWS	CDFG		N/A	200,000	200,000	200,000	Cost to conduct a fish ladder and natural barrier assessment using radiotelemetry on Battle Creek was estimated at approximately $211,000 annually.
			2.9.2.3 Evaluate and improve passage at the Corning Canal siphon and small diversion dams near Paskenta and Henlyville.		Long-term	NMFS, USFWS	CDFG, DWR	Irrigation districts	N/A	TBD	TBD	TBD	
		2.9.2 Agricultural diversion dams, braiding, and low natural channel gradient affecting adults attempting to return to Thomes Creek.	2.9.2.4 Flow consolidation through reduction of braided channels in Thomes Creek.		Long-term	NMFS, USFWS	CDFG		1.7 - 2.3 million per mile	TBD	TBD	TBD	Cost to restore natural channel morphology and processes on the Tuolumne and Merced Rivers ranged from $1.7 to 2.3 million per mile. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Thomes Creek.	2.9.3 Water temperature in Thomes Creek affecting adult immigration and holding, spawning, and embryo incubation.	2.9.3.1 Enhance watershed resiliency in Thomes Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	CDFG		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Thomes Creek.			1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Beegum Creek, Clear Creek.	2.9.4 Passage impediments associated with the RBDD affecting adults attempting to return to Beegum Creek and Clear Creek.	2.9.4.1 Maintain the gates-up position to prevent passage impediments to listed species at RBDD .	1.1: Threats to Spawning Habitat	Long-term	Reclamation, Corps, NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Beegum Creek, Clear Creek.												
Spring-run Chinook Salmon	Clear Creek.	2.9.5 Water temperature in Clear Creek affecting adult immigration and holding, spawning and embryo incubation.	2.9.5.1 Increase stream flows in Clear Creek as needed to reduce water temperatures (NMFS 2007b)	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.9.5 Water temperature in Clear Creek affecting adult immigration and holding, spawning and embryo incubation.	2.9.5.2 Enhance watershed resiliency in Clear Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.		Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Beegum Creek.	2.9.6 Limited spawning habitat availability in Beegum Creek.	2.9.6.1 Develop and implement a spawning gravel augmentation plan in Beegum Creek.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Beegum Creek.	2.9.6 Limited spawning habitat availability in Beegum Creek.	2.9.6.2 Enhance watershed resiliency in Beegum Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially reduce local water temperatures.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Thomes Creek.	2.9.7 Limited spawning habitat availability in Thomes Creek.	2.9.7.1 Develop and implement a spawning gravel augmentation plan in Thomes Creek.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Thomes Creek.		2.9.7.2 Enhance watershed resiliency in Thomes Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially reduce local water temperatures.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Beegum Creek.	2.9.8 Loss of riparian habitat and instream cover in the Cottonwood/Beegum Creek watershed affecting juveniles.	2.9.8.1 Protect/enhance existing riparian habitat and corridors in Beegum Creek and the greater Cottonwood watershed (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Beegum Creek.		2.9.8.2 Modify gravel mining operations to allow riparian regeneration in Beegum Creek and the greater Cottonwood watershed.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	N/A	TBD	TBD	TBD	
			2.9.8.3 Apply NMFS gravel mining criteria to all gravel mining projects in Beegum Creek and the greater Cottonwood watershed.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	N/A	N/A	N/A	N/A	
			2.9.8.4 Integrate riparian habitat restoration into bank protection and other stream side development projects in Beegum Creek and the greater Cottonwood watershed.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.9.8.5 Implement a non-native plant (e.g. Arundo) eradication plan in Beegum Creek and the greater Cottonwood watershed .		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	12,000 per acre	TBD	TBD	TBD	Cost estimate from Napa River. Source: CDFG-072, as cited in Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.9.8 Loss of riparian habitat and instream cover in the Cottonwood/Beegum Creek watershed affecting juveniles.	2.9.8.6 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Beegum Creek and the greater Cottonwood watershed.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.9.8.7 Curtail further development in active Beegum and the greater Cottonwood watershed floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	NMFS, USFWS, USFS	CDFG, DWR	Local governments, Cottonwood Creek Watershed Group	N/A	N/A	N/A	N/A	
			2.9.8.8 Develop education and outreach programs to encourage river stewardship in the Beegum and the greater Cottonwood Creek watershed.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners, Cottonwood Creek Watershed Group	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.9.8.9 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon	Clear Creek.	2.9.9 Flow fluctuations affecting Clear Creek spawning and embryo incubation.	2.9.9.1 Enhance watershed resiliency in Clear Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Clear Creek.		2.9.9.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights in Clear Creek (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Beegum Creek.	2.9.10 Loss of natural river morphology and function in the Cottonwood Creek watershed affecting juveniles.	2.9.10.1 Re-establish natural channel morphology in Cottonwood Creek by: (1) applying NMFS gravel mining criteria to all gravel mining projects; (2) integrating natural morphological features and functions into bank protection and other stream side development projects; and (3) implementing non-native plant (e.g. Arundo) eradication plan.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Resource Conservation Districts	CDFG, DWR	Cottonwood Creek Watershed Group		N/A	TBD	TBD	TBD
Steelhead	Beegum Creek.			4.1: Threats from Inadequacy of Existing Regulatory Mechanisms									
Spring-run Chinook Salmon	Clear Creek.	2.9.11 Sedimentation in Clear Creek affecting the embryo incubation life stage.	2.9.11.1 Eliminate sources of chronic sediment delivered to Clear Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG			N/A	TBD	TBD	TBD
Steelhead	Clear Creek.		2.9.11.2 Enhance watershed resiliency in Clear Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Beegum Creek.	2.9.12 Sedimentation in Beegum Creek affecting the embryo incubation life stage.	2.9.12.1 Eliminate sources of chronic sediment delivered to Beegum Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG	Cottonwood Creek Watershed Group	N/A		TBD	TBD	TBD

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Beegum Creek.		2.9.12.2 Enhance watershed resiliency in Beegum Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3 Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Clear Creek.	2.9.13 Low flow conditions and flow dependent habitat availability in Clear Creek affecting juveniles.	2.9.13.1 Develop a cooperative program to improve flow on Clear Creek by increasing releases from Whiskeytown Dams (USFWS 1997).	1.3 Threats to Habitat Quality and Complexity	Long-term				N/A	TBD	TBD	TBD	
Steelhead	Clear Creek.		2.9.13.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights in Clear Creek (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Spring-run Chinook Salmon	Beegum Creek.	2.9.14 Low flows (attraction and migratory cues) in lower Cottonwood Creek affecting the immigration life stage.	2.9.14.1 Develop cooperative water use agreements (e.g., groundwater exchange agreements) with local water users to provide flows in Cottonwood Creek during the immigration life stage.	1.3 Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	N/A	TBD	TBD	TBD	
Steelhead	Beegum Creek.		2.9.14.2 Negotiate agreements with landowners and Federal and State agencies to provide additional instream flows or purchase water rights in Cottonwood Creek (AFRP website 2005).		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon	Clear Creek.	2.9.15 Redd superimposition, competition for habitat and hybridization (from barriers) affecting Clear Creek spawning.	2.9.15.1 Develop long-term operation and maintenance plan for the segregation weir in Clear Creek.	1.1 Threats to Spawning Habitat									
Steelhead	Clear Creek.		2.9.15.2 Conduct a passage feasibility study in Clear Creek, including an assessment of potential habitat above Whiskeytown Dam.		5 Years	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
Spring-run Chinook Salmon	Clear Creek.	2.9.16 Loss of floodplain habitat in Clear Creek affecting juveniles.	2.9.16.1 Evaluate Lower Clear Creek Floodway Rehabilitation Project (Phase 3B) and implement other projects designed to increase floodplain habitat availability to juvenile rearing habitat (CALFED 2007; NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Complete	Western Shasta Resource Conservation District, BLM		Lower Clear Creek Watershed Group, City of Redding	N/A	N/A	N/A	N/A	
Steelhead	Clear Creek.												
Spring-run Chinook Salmon	Clear Creek.	2.9.17 Loss of natural river morphology and function affecting juveniles in Clear Creek.	2.9.17.1 Implement Lower Clear Creek Floodway Rehabilitation Project (Phase 3B) (CALFED 2007).	1.3: Threats to Habitat Quality and Complexity	Complete	Western Shasta Resource Conservation District, BLM		Lower Clear Creek Watershed Group, City of Redding	N/A	N/A	N/A	N/A	
Steelhead	Clear Creek.												
Spring-run Chinook Salmon	Clear Creek.	2.9.18 Water quality in Clear Creek affecting the immigration and holding life stage.	2.9.18.1 Increase monitoring and enforcement in Clear Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants (SWRCB 2007).	1.2: Threats to Water Quality	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Clear Creek.		2.9.18.2 Encourage voluntary landowner participation in Clear Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.9.18 Water quality in Clear Creek affecting the immigration and holding life stage.	2.9.18.3 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Clear Creek.		Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Landowners, Local governments, NGOs	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Beegum Creek.	2.9.19 Flow fluctuations affecting adults spawning and embryo incubation in Beegum Creek.	2.9.19.1 Enhance watershed resiliency in Beegum Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.1: Threats to Spawning Habitat									
Steelhead	Beegum Creek.			1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Beegum Creek.	2.9.20 Water quality in Beegum Creek affecting the embryo incubation life stage.	2.9.20.1 Enhance watershed resiliency in Beegum Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR	Cottonwood Creek Watershed Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Beegum Creek.		2.9.20.2 Eliminate sources of chronic sediment delivered to Beegum Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.3 Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS	CDFG	Cottonwood Creek Watershed Group	N/A	TBD	TBD	TBD	
		2.9.20 Water quality in Beegum Creek affecting the embryo incubation life stage.	2.9.20.3 Develop a baseline monitoring program for Beegum Creek to evaluate water quality throughout the watershed to identify areas of concern.		3 Years	NMFS, USFWS	SWRCB, DHS, DWR, CDFG, Local governments		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.9.20.4 Encourage voluntary landowner participation in Beegum Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality “Fact Sheets”.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.9.20 Water quality in Beegum Creek affecting the embryo incubation life stage.	2.9.20.5 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Beegum Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Spring-run Chinook Salmon	Clear Creek.	2.9.21 Loss of riparian habitat and instream cover in Clear Creek affecting juveniles.	2.9.21.1 Develop State and national levee vegetation policies to maintain and restore riparian corridors in Clear Creek (Corps vegetation management policy and FloodSAFE).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, USFS, Corps, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Clear Creek.		2.9.21.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Clear Creek watershed.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, USFWS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
			2.9.21.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Clear Creek.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.9.21.4 Curtail further development in active Clear Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS, USFS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.9.21 Loss of riparian habitat and instream cover in Clear Creek affecting juveniles.	2.9.21.5 Develop education and outreach programs to encourage river stewardship in Clear Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.9.21.6 Permanently protect riparian habitat through easements and/or land acquisition										
Spring-run Chinook Salmon	Thomes Creek.	2.9.22 Loss of floodplain habitat affecting juveniles in Thomes Creek.	2.9.22.1 Conduct West Tehama riparian and floodplain conditions inventory (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Complete	NMFS, USFWS, Tehama County Resource Conservation District	CDFG		N/A	N/A	N/A	N/A	Tehama West Watershed Assessment was completed in 2006. Source: Tehama County Resource Conservation District 2006.
Steelhead	Thomes Creek.	2.9.22 Loss of floodplain habitat affecting juveniles in Thomes Creek.	2.9.22.2 Implement projects to increase floodplain habitat availability in Thomes Creek to improve juvenile rearing habitat (NMFS 2007b).		Long-term	NMFS, USFWS	CDFG		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Spring-run Chinook Salmon	Thomes Creek.	2.9.23 Loss of natural river morphology and function affecting juveniles in Thomes Creek.	2.9.23.1 Re-establish natural channel morphology in Thomes Creek by: (1) applying NMFS gravel mining criteria to all gravel mining projects; (2) integrating natural morphological features and functions into bank protection and other stream side	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Resource Conservation Districts	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Thomes Creek.		protection and other stream side development projects; and (3) implementing non-native plant (e.g. Arundo) eradication plan.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms									
Spring-run Chinook Salmon	Thomes Creek.	2.9.24 Watershed disturbance affecting embryo incubation in Thomes Creek.	2.9.24.1 Eliminate sources of chronic sediment delivered to Thomes Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Thomes Creek.		2.9.24.2 Enhance watershed resiliency in Thomes Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.3 Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Spring-run Chinook Salmon	Cottonwood/Beegum watershed.	2.9.25 Predation in the Cottonwood/Beegum watershed.	2.9.25.1 Implement programs and measures designed to control non-native predatory fish in Cottonwood/Beegum Creek (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
Steelhead	Cottonwood/Beegum watershed.		2.9.25.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in Cottonwood/Beegum Creek.	3.2: Threats from Predation	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.9.26 Predation in the Cottonwood/Beegum watershed.	2.9.25.3 Improve nearshore refuge cover for salmonids in Cottonwood/Beegum Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Spring-run Chinook Salmon	Thomes Creek.	2.9.26 Flow fluctuations affecting spawning and embryo incubation in Thomes Creek.	2.9.26.1 Enhance watershed resiliency in Thomes Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.1: Threats to Spawning Habitat									
Steelhead	Thomes Creek.			1.3: Threats to Habitat Quality and Complexity									
Spring-run Chinook Salmon	Beegum Creek.	2.9.27 Loss of floodplain habitat affecting juvenile rearing in Cottonwood/Beegum Creek.	2.9.27.1 Implement projects to increase floodplain habitat availability in Beegum Creek and the greater Cottonwood watershed to improve juvenile rearing habitat (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Beegum Creek.												

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run Chinook Salmon Steelhead	Clear Creek. Clear Creek.	2.9.28 Harvest/angling impacts in Clear Creek affecting adults attempting to return to natal tributaries.	2.9.28.1 Modify sport-fishing regulations to further minimize harvest of spring-run Chinook salmon and steelhead in Clear Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Stony Creek.	2.9.29 Black Butte Dam affecting adults returning to Stony Creek.	2.9.29.1 Provide anadromous fish passage above Black Butte Dam.	1.1 Threats to Spawning Habitat	Long-term	Reclamation, Corps, NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Stony Creek.	2.9.30 Water temperature in Stony Creek affecting adult immigration and holding and juvenile rearing.	2.9.30.1 Enhance watershed resiliency in Stony Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Putah Creek.	2.9.31 Solano and Montecello dams affecting adults returning to Putah Creek.	2.9.31.1 Conduct an anadromous fish passage feasibility study in Putah Creek that assesses upstream habitat conditions and operational alternatives.	1.1 Threats to Spawning Habitat	5 Years	NMFS, USFWS, USFS	CDFG, DWR	Yolo Basin Working Group	N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
Steelhead	Stony Creek.	2.9.32 Limited spawning habitat availability in Stony Creek.	2.9.32.1 Provide anadromous fish passage above Black Butte Dam.	1.1: Threats to Spawning Habitat	Long-term	Reclamation, Corps, NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.9.32 Limited spawning habitat availability in Stony Creek.	2.9.32.2 Develop and implement a spawning gravel augmentation plan in Stony Creek, which includes habitats above Black Butte Dam after passage is provided.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Stony Creek.	2.9.33 Low flow conditions reducing adult attraction into Stony Creek and limiting juvenile rearing habitat availability.	2.9.33.1 Evaluate water releases from Black Butte Dam, water exchanges with the Tehama-Colusa Canal and interim and long term water diversion solutions at RBDD (USFWS 2001).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Tehama-Colusa Canal Authority, City of Red Bluff	N/A	TBD	TBD	TBD	
Steelhead	Putah Creek.	2.9.34 Low flow conditions limiting juvenile rearing habitat availability and limiting adult attraction into Putah Creek.	2.9.34.1 Develop a cooperative program to provide water for target flows in Putah Creek from additional Lake Berryessa releases or reductions in water diversions at Solano Diversion Dam and in the creek downstream of the dam (CALFED 2000).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Putah Creek.	2.9.35 Water temperature affecting juveniles in Putah Creek.	2.9.35.1 Enhance watershed resiliency in Putah Creek by identifying and implementing projects that would reduce the potential for, and magnitude of a catastrophic wildfire, restore meadows to potentially increase summer flows and reduce local water temperatures, or increase riparian shade.	1.2 Threats to Water Quality	Long-term			Yolo Basin Working Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
				1.3: Threats to Habitat Quality and Complexity									
Steelhead	Putah Creek.	2.9.36 Harvesting and angling impacts affecting adults returning to Putah Creek.	2.9.36.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Putah Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
Steelhead	Putah Creek.	2.9.37 Loss of floodplain habitat affecting juveniles in Putah Creek.	2.9.37.1 Implement projects to increase floodplain habitat availability in Putah Creek to improve juvenile rearing habitat (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Yolo Basin Working Group	5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Putah Creek.	2.9.38 Flow conditions affecting embryo incubation and juveniles in Putah Creek.	2.9.38.1 Develop a cooperative program to provide water for target flows in Putah Creek from additional Lake Berryessa releases or reductions in water diversions at Solano Diversion Dam and in the creek downstream of the dam (CALFED 2000).	1.1: Threats to Spawning Habitat 1.3: Threats to Habitat Quality and Complexity									
Steelhead	Stony Creek.	2.9.39 Flow fluctuations affecting spawning and embryo incubation in Stony Creek.	2.9.39.1 Enhance watershed resiliency in Stony Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
				1.3: Threats to Habitat Quality and Complexity									
Steelhead	Putah Creek.	2.9.40 Predation on juvenile steelhead in Putah Creek.	2.9.40.1 Implement programs and measures designed to control non-native predatory fish in Putah Creek (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.9.40.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in Putah Creek.	3.2: Threats from Predation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.9.40 Predation on juvenile steelhead in Putah Creek.	2.9.40.3 Improve nearshore refuge cover for salmonids in Putah Creek to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	USFWS, NMFS, Reclamation	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Stony Creek.	2.9.41 Flow conditions affecting juveniles in Stony Creek.	2.9.41.1 Evaluate water releases from Black Butte Dam, water exchanges with the Tehama-Colusa Canal and interim and long term water diversion solutions at RBDD (USFWS 2001).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Tehama-Colusa Canal Authority, City of Red Bluff	N/A	TBD	TBD	TBD	
Steelhead	Stony Creek.	2.9.42 Water quality in Stony Creek affecting spawning and embryo incubation.	2.9.42.1 Enhance watershed resiliency in Stony Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
		2.9.42 Water quality in Stony Creek affecting spawning and embryo incubation.	2.9.42.2 Eliminate sources of chronic sediment delivered to Stony Creek from roads and other near stream development by out-sloping roads, constructing diversion prevention dips, replacing under-sized culverts and applying other storm proofing guidelines.		Long-term	NMFS, USFWS, USFS	CDFG		N/A	TBD	TBD	TBD	
			2.9.42.3 Develop a baseline monitoring program for Stony Creek to evaluate water quality throughout the watershed to identify areas of concern.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.9.42.4 Encourage voluntary landowner participation in Stony Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.9.42.5 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Stony Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Steelhead	Stony Creek.	2.9.43 Water temperature affecting embryo incubation in Stony Creek.	2.9.43.1 Improve water temperature conditions in Stony Creek by identifying and implementing projects that would increase stream flows and increase shaded riverine habitat	1.2 Threats to Water Quality 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Stony Creek.	2.9.44 Loss of floodplain habitat affecting juveniles in Stony Creek.	2.9.44.1 Implement projects to increase floodplain habitat availability in Stony Creek to improve juvenile rearing habitat (NMFS 2007b).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 80,000 per acre	TBD	TBD	TBD	Cost estimate for floodplain tributary reconnection, which includes costs for construction, design, permitting, monitoring and maintenance (2 years), re-establishing site to prior conditions, and project management. Cost would vary depending on the extent of earthmoving required (e.g., minimal, moderate or substantial) Source: Evergreen 2003, p. 39
Steelhead	Putah Creek.	2.9.45 Loss of natural river morphology in Putah Creek.	2.9.45.1 Implement actions specified by the Putah Creek Council directed at restoring instream and riparian habitat.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Putah Creek.	2.9.46 Loss of riparian habitat and instream cover.	2.9.46.1 Implement actions specified by the Putah Creek Council directed at restoring instream and riparian habitat.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.9.46.2 Permanently protect riparian habitat through easements and/or land acquisition										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Putah Creek.	2.9.47 Water quality in Putah Creek affecting the juvenile rearing life stage.	2.9.47.1 Implement projects that improve wastewater and stormwater treatment throughout the Putah Creek watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, EPA	SWRCB, DHS, DWR, CDFG	Local governments	N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention/retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
			2.9.47.2 Increase monitoring and enforcement in Putah Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met throughout the Putah Creek watershed for all potential pollutants (SWRCB 2007).	4.1: Threats from Inadequacy of Regulatory Mechanisms	Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
		2.9.47 Water quality in Putah Creek affecting the juvenile rearing life stage.	2.9.47.3 Develop a baseline monitoring program for Putah Creek to evaluate water quality throughout the watershed to identify areas of concern.		3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.9.47.4 Encourage voluntary landowner participation in Putah Creek in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.9.47 Water quality in Putah Creek affecting the juvenile rearing life stage.	2.9.47.5 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in Putah Creek.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
Steelhead	Putah Creek.	2.9.48 Limited instream gravel supply affecting spawning habitat availability in Putah Creek.	2.9.48.1 Develop and implement a spawning gravel augmentation plan in Putah Creek.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Stony Creek	2.9.49 Water temperatures affecting spawning in Stony Creek.	2.9.49.1 Install water temperature recorders at select locations in Stony Creek; develop recommendations for minimum instream flow based on temperature needs (AFRP website 2005).	1.2: Threats to Water Quality	5 Years	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
				1.3: Threats to Habitat Quality and Complexity									
Steelhead	Stony Creek.	2.9.50 Harvest/angling impacts in Stony Creek affecting adult spawning.	2.9.50.1 Modify sport-fishing regulations to further minimize harvest of steelhead in Stony Creek.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	

2.10 Southern Sierra Nevada Diversity Group Recovery Actions

Table 2-10 Southern Sierra Nevada Diversity Group Threats and Associated Recovery Actions

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead Spring Run	San Joaquin River.	2.10.1 Friant Dam blocking access to historic spawning habitat in the San Joaquin River.	2.10.1.1 Conduct feasibility studies for allowing steelhead access to habitat above Friant Dam, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dam and emigrating juveniles below it).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
			2.10.1.2 If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Friant Dam.										
			2.10.1.3 If the experimental fish passage program demonstrates that passage above Friant Dam can substantively contribute to the long-term viability of the DPS, then develop and implement long-term fish passage programs.										
Steelhead	Calaveras River.	2.10.2 Bellota Weir affecting adults and juveniles in the Calaveras River.	2.10.2.1 Implement monitoring of passage through the existing Bellota weir fish ladder and monitor upstream and downstream passage and stranding, as recommended in the Habitat Conservation Plan.	5.3: Threats from Water Diversions	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Fishery Foundation of California, Stockton East Water District	N/A	6,000+	6,000+	6,000+	Cost to monitor adult passage at the Bellota Weir Fish Ladder from October through February is approximately $6,000. Source: AFRP Website 2001.
		2.10.2 Bellota Weir affecting adults and juveniles in the Calaveras River.	2.10.2.2 Replace Bellota weir incorporating a permanent fish ladder and screened diversion as recommended in the Calaveras River Fish Screen Facilities Feasibility Study.	5.4: Threats from Migration Obstructions and Impediments	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR	Fishery Foundation of California, Stockton East Water District	N/A	TBD	TBD	TBD	Preliminary designs for improvement of fish passage at eight instream structures in the Calaveras River are under development. Source: DWR Website 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.2.3 Implement recommendations for permanent upstream and downstream passage of salmonids between the Delta and Bellota weir from the Calaveras Habitat Conservation Plan and DWR Calaveras River Fish Passage Improvement Plan.		Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Fishery Foundation of California, Stockton East Water District	N/A	TBD	TBD	TBD	Migration barriers have been assessed; preliminary designs are under development. Source: DWR Website 2008.
			2.10.2.4 Implement the Calaveras River fish passage improvement project (AFRP website 2005).		5 Years	NMFS, USFWS, Reclamation	CDFG, DWR	Fishery Foundation of California, Stockton East Water District	2,000 - 10,000 per CFS	TBD	TBD	TBD	Typical fish screens cost approximately $2,000 to $10,000 per CFS (the design approach velocity of the screen). Source: Thomson and Pinkerton 2008.
			2.10.2.5 Screen unscreened diversions in the Calaveras River beginning with Bellota weir (AFRP website 2005).										
			2.10.2.6 Implement conservation measures from the Habitat Conservation Plan.										
Steelhead	Calaveras River.	2.10.3 Multiple Flash Board Dams affecting adults returning to the Calaveras River.	2.10.3.1 Implement Calaveras River fish passage improvement project (AFRP website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Fishery Foundation of California, Stockton East Water District	N/A	TBD	TBD	TBD	Migration barriers have been assessed; preliminary designs are under development. Source: DWR Website 2008.
		2.10.3 Multiple Flash Board Dams affecting adults returning to the Calaveras River.	2.10.3.2 Implement recommendations for permanent upstream and downstream passage of salmonids between the Delta and Bellota weir from the Calaveras Habitat Conservation Plan and DWR Calaveras River Fish Passage Improvement Plan.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	San Joaquin River, Merced River, Tuolumne River, Stanislaus River.	2.10.4 Flow conditions limiting juvenile rearing habitat availability in the San Joaquin River Basin.	2.10.4.1 Develop the San Joaquin Basin water supply plan (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	5 Years	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	CSU Chico, Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	
Spring-Run			2.10.4.2 Improve flow conditions from Friant Dam to the confluence of the Merced River, for juvenile steelhead through implementation of the San Joaquin River Restoration Program.		Long-term	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	
			2.10.4.3 Develop and implement steelhead protection and maintenance flow standards specific to the Tuolumne, Merced, Stanislaus, and San Joaquin rivers respectively.										
Steelhead	Tuolumne River.	2.10.5 Limited spawning habitat availability in the Tuolumne River.	2.10.5.1 Develop and implement a spawning gravel augmentation plan for the Tuolumne River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	The placement of 8,000 tons of gravel in the Tuolumne River cost approximately $162,000 in 2003. Source: DWR 2004.
Steelhead	Calaveras River.	2.10.6. Flow conditions limiting juvenile rearing habitat availability in the Calaveras River.	2.10.6.1 Negotiate agreements with landowners, Stockton East Water District (SEWD), Calaveras County Water District (CCWD) and Federal and stage agencies to provide additional instream flows or purchase water rights (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.6.2 Implement flow-related measures from the Habitat Conservation Plan.										
Steelhead	Tuolumne River.	2.10.7 La Grange and New Don Pedro dams affecting adults returning to the Tuolumne River.	2.10.7.1 Implement experimental flow design to evaluate fish spawning response relating to varying flow levels.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
			2.10.7.2 Conduct a new instream flow evaluation										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Stanislaus River.	2.10.8 Limited spawning habitat availability in the Stanislaus River.	2.10.8.1 Manage releases from New Melones Reservoir in consideration of all steelhead life stages.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	In 1994 Reclamation purchased 50,000 acre-feet of water from the Tri-Dam Project at a cost of $50.00 per acre-foot to meet the release requirements for the fall salmon run. Source: Bureau of Reclamation Website 2008.
			2.10.8.2 Implement the Spawning Gravel Augmentation Program (Reclamation); augment spawning gravel in suitable locations upstream of Oakdale (AFRP website 2005).		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
			2.10.8.3 Conduct a new instream flow evaluation										
Steelhead	Merced River.	2.10.9 Limited spawning habitat availability in the Merced River.	2.10.9.1 Collaborate with Santa Fe Aggregates, CDFG and other landowners to restore the Dredger Tailings Reach; continue to supply spawning-sized gravel to landowners for construction of wing dam diversion structures; implement the Gravel Mining reach Phase II projects; Complete the Merced River Salmon Habitat Enhancement Project (AFRP website 2005).	1.1: Threats to Spawning Habitat	5 Years	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	2.2 million for Dredger Tailings Reach restoration			The Merced River Corridor Restoration Plan Phase IV: Dredger Tailings Reach proposal was estimated to cost approximately $2.2 million over 4 years. Source: Stillwater Sciences 2002.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.9 Limited spawning habitat availability in the Merced River.	2.10.9.2 Conduct feasibility studies for allowing steelhead access to habitat above Crocker-Huffman Dam (including removal of dam) and New Exchequer dams, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dams and emigrating juveniles below them) (assessment of habitat suitability above Crocker-Huffman has been completed).		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Merced Irrigation District	N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
			2.10.9.3 If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Crocker-Huffman and New Exchequer dams.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Merced Irrigation District	N/A	TBD	TBD	TBD	
			2.10.9.4 If the experimental fish passage program demonstrates that passage above Crocker-Huffman and/or New Exchequer dams can substantively contribute to the long-term viability of the DPS, then develop and implement long-term fish passage programs, where appropriate.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Merced Irrigation District	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.9 Limited spawning habitat availability in the Merced River.	2.10.9.5 Provide suitable spawning habitat through FERC processes and Section 7 implementation such as providing spawning gravel to compensate for habitat inundated/blocked by dams and habitat degraded through gravel mining practices.		Long-term	NMFS, USFWS, Reclamation, FERC	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Stanislaus River.	2.10.10 New Melones, Tulloch, and Goodwin dams affecting adults returning to the Stanislaus River.	2.10.10.1 Implement experimental flow design to evaluate fish migration response relating to varying flow levels.										
			2.10.10.2 Conduct a new instream flow evaluation										
Steelhead	Calaveras River.	2.10.11 Flow fluctuations affecting embryo incubation and spawning in the Calaveras River.	2.10.11.1 Continue implementing the lower Calaveras River Salmonid Life History Limiting Factor Analysis (AFRP) to assess flow requirements for anadromous salmonids; and Phase 1 restoration plan for anadromous fish in the Calaveras River (AFRP website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stockton East Water District	N/A	TBD	TBD	TBD	
Steelhead	Calaveras River.	2.10.12 Low flows reducing adult attraction into the Calaveras River.	2.10.12.1 Negotiate agreements with landowners, SEWD, CCWD and Federal and state agencies to provide additional instream flows or purchase water rights in the Calaveras River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.12.2 Evaluate pulse flow benefits for steelhead attraction and passage in the Calaveras River; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.		Long-term	NMFS, USFWS, Reclamation, Corps	DWR, CDFG		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River was $49,954. Source: Bureau of Reclamation Website 2004.
		2.10.12 Low flows reducing adult attraction into the Calaveras River.	2.10.12.3 Provide for flows that are protective of all steelhead life stages through Section 7 implementation.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.12.4 Work with State and Federal water acquisition programs to dedicate instream water.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.12.5 Implement flow measures from Habitat Conservation Plan.										
Steelhead	Merced River.	2.10.13 Flow conditions limiting juvenile rearing habitat availability and affecting adult immigration in the Merced River.	2.10.13.1 Provide for flows in the Merced River that are protective of all steelhead life stages through FERC processes and Section 7 implementation.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.13.2 Work with State and Federal water acquisition programs to dedicate instream water in the Merced River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.13.3 Work with Natural Resources Conservation Services (NRCS), Family Water Alliance, Merced Irrigation District (MID), riparian water rights holders, and other stakeholders to coordinate releases and diversions in the Merced River.		Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	NRCS, Family Water Alliance, Merced Irrigation District	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Calaveras River.	2.10.14 Flow conditions affecting juveniles in the Calaveras River.	2.10.14.1 Continue implementing the lower Calaveras River Salmonid Life History Limiting Factor Analysis (AFRP) to assess flow requirements for anadromous salmonids; and Phase 1 restoration plan for anadromous fish in the Calaveras River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stockton East Water District	N/A	TBD	TBD	TBD	
			2.10.14.2 Implement flow conservation measure from the Habitat Conservation Plan.										
Steelhead	San Joaquin River, Stanislaus River, Tuolumne River, Merced River.	2.10.15 Water quality in the San Joaquin River Basin affecting juveniles and adults.	2.10.15.1 Implement projects that improve wastewater and stormwater treatment in residential, commercial, and industrial areas throughout the San Joaquin River watershed (NMFS 2007b).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS	SWRCB, DHS, DWR, CDFG	Local governments	N/A	TBD	TBD	TBD	The average cost for constructing and maintaining a typical stormwater detention / retention basin in California was approximately $121,439 per acre. Source: Center for Urban Forest Research 2002.
Spring Run			2.10.15.2 Cities, counties, districts, joint powers authority or other political subdivisions of the State involved with water management should implement agricultural drainage management projects to treat, store, convey, and/or dispose of agricultural drainage in the San Joaquin River (SWRCB website)	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Local governments, local agriculture groups	N/A	TBD	TBD	TBD	Continue to fund projects through programs such as the SWRCB's Agricultural Water Quality Grants Program to address agricultural drainage issues in the San Joaquin River.
			2.10.15.3 Develop a long-term strategy for monitoring and regulating discharges from agricultural lands in the San Joaquin River basin to protect waters within the Central Valley, including enforcing the regulations (SWRCB website).		5 Years		SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.15 Water quality in the San Joaquin River Basin affecting juveniles and adults.	2.10.15.4 Increase monitoring and enforcement in the San Joaquin River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
			2.10.15.5 Develop a baseline monitoring program for the San Joaquin River to evaluate water quality throughout the watershed to identify areas of concern.		3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.10.15 Water quality in the San Joaquin River Basin affecting juveniles and adults.	2.10.15.6 Encourage voluntary landowner participation in the San Joaquin River basin in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.15.7 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the San Joaquin River.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.10.15.8 Pursue 303(d) listing for temperature; establish TMDL's.										
Steelhead	Stanislaus River.	2.10.16 Low flows reducing adult attraction into the Stanislaus River and limiting juvenile habitat availability.	2.10.16.1 Evaluate pulse flow benefits for steelhead attraction and passage in the Stanislaus River; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River was $49,954. Source: Bureau of Reclamation Website 2004.
			2.10.16.2 Provide for flows that are protective of all steelhead life stages in the Stanislaus River through FERC processes and Section 7 implementation.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	
			2.10.16.3 Work with State and Federal water acquisition programs to dedicate instream water in the Stanislaus River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	
			2.10.16.4 Conduct Instream Flow Evaluation										
Steelhead Spring Run	San Joaquin River.	2.10.17 Mendota Dam affecting adults returning to the San Joaquin River.	2.10.17.1 Implement actions identified in the San Joaquin River Restoration Program (e.g. Mendota Pool bypass)	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	Modification of Sack Dam to allow fish passage is expected to occur by 2013, as part of the San Joaquin River Restoration Settlement. Source: Friant Water Users Authority 2006.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead Spring Run	San Joaquin River.	2.10.18 Sack Dam affecting adults returning to the San Joaquin River.	2.10.18.1 Implement actions identified in the San Joaquin River Restoration Program (e.g. retrofit Sack Dam)	1.1: Threats to Spawning Habitat	5 Years	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	Modification of Sack Dam to allow fish passage is expected to occur by 2013, as part of the San Joaquin River Restoration Settlement. Source: Friant Water Users Authority 2006.
Steelhead	Stanislaus River.	2.10.19 Flow fluctuations affecting embryo incubation and spawning in the Stanislaus River.	2.10.19.1 Adaptively manage releases in the Stanislaus River in consideration of the spatial and temporal distribution of steelhead life stages in the Stanislaus River through the re-operation plan for New Melones Reservoir.	1.1: Threats to Spawning Habitat 1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	
Steelhead	Mokelumne River.	2.10.20 Hatchery effects (e.g., competition and predation) affecting juveniles produced in the Mokelumne River.	2.10.20.1 Control hatchery release timing, numbers and locations in the Mokelumne River to minimize adverse effects to wild stock (NMFS 2007b).	5.1: Threats Resulting from Artificial Propagation	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.20.2 Develop a HGMP										
			2.10.20.3 Use Mokelumne River Hatchery as a conservation hatchery during passage program development; if passage program is successful, phase out hatchery.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	San Joaquin River, Stanislaus River, Calaveras River, Tuolumne River, and Merced River.	2.10.21 Water temperature in the San Joaquin River affecting juveniles produced in the San Joaquin, Stanislaus, Tuolumne and Merced Rivers, and affecting adults attempting to return to the San Joaquin, Tuolumne, Stanislaus, and Merced Rivers.	2.10.21.1 Provide continued support for and application of San Joaquin Basin integrated water temperature model and flow study (AFRP website 2005).	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Spring Run		2.10.21 Water temperature in the San Joaquin River affecting juveniles produced in the San Joaquin, Stanislaus, Tuolumne and Merced Rivers, and affecting adults attempting to return to the San Joaquin, Tuolumne, Stanislaus, and Merced Rivers.	2.10.21.2 Use the information from the model to develop specified water temperature criteria for the San Joaquin Basin and identify specific reaches in each system that do not meet the criteria.										
			2.10.21.3 Implement agricultural practices in the San Joaquin River basin that would eliminate or minimize thermal loading associated with agricultural runoff.	1.3: Threats to Habitat Quality and Complexity	Long-term	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	
			2.10.21.4 Implement actions designed to decrease water temperatures in San Joaquin River tributaries during late-spring through early fall, thereby decreasing thermal loading to the mainstem San Joaquin River.		Long-term	NMFS, USFWS, Reclamation, Resource Conservation Districts	CDFG, DWR, SWRCB		N/A	TBD	TBD	TBD	Cost would depend on various factors, including costs to manage coldwater releases from upstream reservoirs, manage agricultural runoff and restore riparian areas.
			2.10.21.5 Pursue 303(d) listing for temperature; establish TMDL's										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Mokelumne River.	2.10.22 Limited spawning habitat availability in the Mokelumne River.	2.10.22.1 Develop and implement a spawning gravel augmentation plan for the Mokelumne River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	84,000	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
			2.10.22.2 Conduct feasibility studies for allowing steelhead access to habitat above Camanche and Pardee dams, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dam and emigrating juveniles below it).		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a
			2.10.22.3 If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Camanche and Pardee dams.										
		2.10.22 Limited spawning habitat availability in the Mokelumne River.	2.10.22.4 If the experimental fish passage program demonstrates that passage above Camanche and Pardee dams can substantively contribute to the long-term viability of the DPS, then develop and implement long-term fish passage programs.										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Calaveras River.	2.10.23 Water quality in the Calaveras River affecting the adult immigration and juvenile rearing life stages.	2.10.23.1 Develop a baseline monitoring program for the Calaveras River to evaluate water quality throughout the watershed to identify areas of concern.	1.2: Threats to Water Quality	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.10.23.2 Encourage voluntary landowner participation in the Calaveras River basin in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.10.23 Water quality in the Calaveras River affecting the adult immigration and juvenile rearing life stages.	2.10.23.3 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Calaveras River.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	
			2.10.23.4 Increase monitoring and enforcement in the Calaveras River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.23.5 Establish TMDL's										
			2.10.23.6 Establish water quality criteria for storm water outfall certification and enforcement process										
Steelhead	Tuolumne River.	2.10.24 Flow fluctuations affecting embryo incubation in the Tuolumne River.	2.10.24.1 Adaptively manage releases in the Tuolumne River in consideration of the spatial and temporal distribution of steelhead life stages in the Tuolumne River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	
			2.10.24.2 Develop and implement flow fluctuation criteria for the Tuolumne River that is protective of anadromous fishes.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	
Steelhead	Calaveras River.	2.10.25 Water temperature affecting juveniles, embryo incubation and adults in the Calaveras River.	2.10.25.1 Implement Phase 1 restoration plan for anadromous fish in the Calaveras River (AFRP website 2005).	1.2 Threats to Water Quality	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stockton East Water District	N/A	TBD	TBD	TBD	
			2.10.25.2 Implement conservation measures from the Habitat Conservation Plan										
		2.10.25 Water temperature affecting juveniles, embryo incubation and adults in the Calaveras River.	2.10.25.3 Monitor water temperatures and assess the affect to juveniles and adults										
Steelhead	Mokelumne River.	2.10.26 Flow fluctuations affecting embryo incubation and spawning in the Mokelumne River.	2.10.26.1 Adaptively manage releases in the Mokelumne River in consideration of the spatial and temporal distribution of steelhead life stages in the Mokelumne River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
				1.3: Threats to Habitat Quality and Complexity									
Steelhead	Merced River.	2.10.27 Flow fluctuations affecting embryo incubation and spawning in the Merced River.	2.10.27.1 Adaptively manage releases in the Merced River in consideration of the spatial and temporal distribution of steelhead life stages in the Merced River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.27.2 Develop and implement flow fluctuation criteria for the Merced River that is protective of anadromous fishes.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.27.3 Manage flows through FERC processes and Section 7 implementation		Long-term	NMFS, USFWS, USFS	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
Steelhead	Merced River.	2.10.28 Limited instream gravel supply affecting spawning habitat availability in the Merced River.	2.10.28.1 Continue to supply spawning sized gravel to landowners for construction of wing dam diversion structures in the Merced River; implement the Gravel Mining Reach Phase II projects (AFRP website 2005).	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		11 - 36 per cubic yard of gravel	TBD	TBD	TBD	In the Sacramento and Tuolumne Rivers, gravel supplementation cost between $11 and $36 per cubic yard. Source: Thomson and Pinkerton 2008.
Steelhead	Merced River.	2.10.29 New Exchequer Dam, McSwain, Crocker-Huffman, and other dams affecting adults returning to the Merced River.	2.10.29.1 Conduct feasibility studies for allowing steelhead access to habitat above Crocker-Huffman and New Exchequer dams, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dams and emigrating juveniles below them) (assessment of habitat suitability above Crocker-Huffman has been completed)	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Merced Irrigation District	N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.29.2 If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above Crocker-Huffman and New Exchequer dams.										
			2.10.29.3 If the experimental fish passage program demonstrates that passage above Crocker-Huffman and/or New Exchequer dams can substantively contribute to the long-term viability of the DPS, then develop and implement long-term fish passage programs.										
		2.10.29 New Exchequer Dam, McSwain, Crocker-Huffman, and other dams affecting adults returning to the Merced River.	2.10.29.4 Study water treatment systems for the Merced River Hatchery (e.g., ultraviolet); if fish passage is determined to be feasible, install Merced River Hatchery water treatment system.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Mokelumne River.	2.10.30 Flow conditions limiting juvenile rearing habitat availability in the Mokelumne River.	2.10.30.1 Assess salmonid need by life history stage and identify deficits in optimal flow; negotiate water right purchases and/or increase flow releases from Camanche Dam (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.30.2 Dedicate instream flow through the EBMUD Camanche water right extension process										
Steelhead	San Joaquin River.	2.10.31 Low flow conditions reducing adult attraction into the San Joaquin River.	2.10.31.1 Modify releases from Friant Dam to improve adult migration into the San Joaquin River.	1.3: Threats to Habitat Quality and Complexity	Long-term	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring Run			2.10.31.2 Maintain export to pumping ratio of 4:1 to allow for attraction.										
Steelhead	Tuolumne River.	2.10.32 Flow conditions limiting juvenile habitat availability and limiting adult attraction into the Tuolumne River.	2.10.32.1 Provide for flows that are protective of all steelhead life stages through FERC processes and Section 7 implementation.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, FERC	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.10.32 Flow conditions limiting juvenile habitat availability and limiting adult attraction into the Tuolumne River.	2.10.32.2 Work with State and Federal water acquisition programs to dedicate instream water in the Tuolumne River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.32.3 Dedicate instream flow below Don Pedro Dam from upstream water rights holders										
Steelhead	Calaveras River.	2.10.33 Limited spawning habitat availability in the Calaveras River.	2.10.33.1 Develop and implement a spawning gravel augmentation plan in the Calaveras River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
		2.10.33 Limited spawning habitat availability in the Calaveras River.	2.10.33.2 Conduct feasibility studies for allowing steelhead access to habitat above New Hogan Dam, including assessing habitat suitability and passage logistics (i.e., getting immigrating adults above the dam and emigrating juveniles below it).		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Assessing the feasibility of establishing migratory passage and fish protection at Crocker-Huffman Dam cost $160,758. Source: AFRP 2003a

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			· If the feasibility studies suggest that fish passage can be successful, then design and conduct an experimental fish passage program evaluating adult distribution, survival, spawning, and production in habitats above New Hogan Dam.										
			· If the experimental fish passage program demonstrates that passage above New Hogan Dam can substantively contribute to the long-term viability of the DPS, then develop and implement long-term fish passage programs.										
			2.10.33.3 Conduct instream flow evaluation to determine improved use of existing spawning gravel										
Steelhead	Stanislaus River.	2.10.34 Flow conditions affecting juveniles in the Stanislaus River.	2.10.34.1 Negotiate agreements with landowners, water districts, and Federal and stage agencies to provide additional instream flows or purchase water rights in the Stanislaus River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs, Stanislaus River Fish Group	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.34.2 Establish adequate flow regime through OCAP consultations										
Steelhead	San Joaquin River, Stanislaus River, and Merced River.	2.10.35 Loss of riparian habitat and instream cover in the San Joaquin River Basin affecting juveniles.	2.10.35.1 Permanently protect riparian habitat through easements and/or land acquisition.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		1800 - 4800 per acre	TBD	TBD	TBD	Cost would depend on the land's zoning, its proximity to an urban area, and its development potential. Source: Thomson and Pinkerton 2008.
Spring Run			2.10.35.2 Implement the San Joaquin River National Refuge Riparian Habitat Protection and Floodplain Restoration Project (AFRP website 2005).										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.35.3 Compile and/or conduct habitat analysis to determine instream cover needs throughout the basin.										
Steelhead	Tuolumne River.	2.10.36 Water temperature in the Tuolumne River affecting the adult immigration and holding and juvenile rearing life stage.	2.10.36.1 Provide water temperatures in the Tuolumne River that meet steelhead thermal requirements based on the spatial and temporal distribution of these fish through FERC processes and ESA consultations.	1.2: Threats to Water Quality	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	
			2.10.36.2 Develop agreements with landowners, water districts, and Federal and State agencies to provide additional instream flows or purchase water rights, and/or restore riparian habitat to promote shading in the Tuolumne River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	
Steelhead	Mokelumne River.	2.10.37 Water temperature affecting embryo incubation and spawning in the Mokelumne River.	2.10.37.1 Negotiate agreements with landowners, water districts, and Federal and State agencies to provide additional instream flows or purchase water rights, and/or restore riparian habitat to promote shading in the Mokelumne River (AFRP website 2005).	1.2: Threats to Water Quality	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.37.2 Manage cold water pools in Camanche and Pardee Reservoirs to provide suitable water temperatures for all steelhead life stages.										
Steelhead	Merced River.	2.10.38 Water temperature affecting adults and spawning in the Merced River.	2.10.38.1 Support the Merced River Water Temperature Modeling Studies (CALFED) (AFRP website 2005).	1.2: Threats to Water Quality	Complete	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	375,000	TBD	TBD	The Merced River Temperature Management Feasibility Study cost $375,000. Source: CALFED 2000b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.38.2 Provide water temperatures in the Merced River that meet steelhead thermal requirements based on the spatial and temporal distribution of these fish through FERC processes and ESA consultations.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, FERC	CDFG, DWR		N/A	N/A	N/A	N/A	
			2.10.38.3 Develop agreements with landowners, water districts, and Federal and State agencies to provide additional instream flows or purchase water rights, and/or restore riparian habitat to promote shading in the Merced River (AFRP website 2005).	5.2: Threats Resulting from Climate Change	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
		2.10.38 Water temperature affecting adults and spawning in the Merced River.	2.10.38.4 Study the potential quantity of coldwater available in New Exchequer Reservoir given a range of climate change scenarios; provide structures to access coldwater pool if needed for the protection of anadromous fishes.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Steelhead	Calaveras River.	2.10.39 Limited instream gravel supply affecting spawning habitat availability in the Calaveras River.	2.10.39.1 Implement Phase 1 restoration plan for anadromous fish in the Calaveras River (AFRP website 2005).	1.1 Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stockton East Water District	N/A	TBD	TBD	TBD	
Steelhead Spring-run	San Joaquin River.	2.10.40 Limited spawning habitat availability in the San Joaquin River.	2.10.40.1 Increase releases from Friant Dam as agreed upon in the San Joaquin River settlement; Conduct an instream flow study to identify a spawning habitat-flow relationship and to identify factors (e.g., substrate size and quality, velocity, water depth) limiting spawning habitat availability.	1.1: Threats to Spawning Habitat	Long-term	Reclamation, NMFS, USFWS, Corps	DWR, CDFG	Friant Water Users Authority, NRDC	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Calaveras River.	2.10.41 Loss of natural river morphology and function affecting juveniles in the Calaveras River.	2.10.41.1 Implement Phase 1 restoration plan for anadromous fish in the Calaveras River (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Stockton East Water District	N/A	TBD	TBD	TBD	
			2.10.41.2 Curtail further development in active Calaveras River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, NMFS, USFWS	DWR, CDFG	Local governments	N/A	N/A	N/A	N/A	
		2.10.41 Loss of natural river morphology and function affecting juveniles in the Calaveras River.	2.10.41.3 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in the Calaveras River.		Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.10.41.4 Increase monitoring and enforcement of illegal rip rap applications in the Calaveras River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.10.41.5 Develop education and outreach programs to encourage river stewardship in the Calaveras River.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
Steelhead	Mokelumne River.	2.10.42 Low flow conditions in the Mokelumne River affecting the adult immigration and holding and juvenile rearing and outmigration life stage.	2.10.42.1 Evaluate pulse flow benefits for steelhead attraction and passage in the Mokelumne River; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River $49,954. Source: Bureau of Reclamation Website 2004.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.42 Low flow conditions in the Mokelumne River affecting the adult immigration and	2.10.42.2 Provide for flows that are protective of all steelhead life stages through FERC processes and Section 7 implementation.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	N/A	N/A	N/A	
			2.10.42.3 Work with State and Federal water acquisition programs to dedicate instream water in the Mokelumne River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
			2.10.42.4 Dedicate instream flow from Camanche Dam water right extension process										
Steelhead	Merced River.	2.10.43 Loss of riparian habitat and instream cover affecting juveniles in the Merced River.	2.10.43.1 Collaborate with Santa Fe Aggregates, CDFG and other landowners to restore the Dredger Tailings Reach.	1.3: Threats to Habitat Quality and Complexity									
			2.10.43.2 Federal, State, and local agencies should use their authorities to develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the Merced River watershed.		Long-term	Corps, USFWS	DWR, CDFG, CDPR	Local agencies, NGOs	N/A	N/A	N/A	N/A	
			2.10.43.3 Increase monitoring and enforcement of illegal rip rap applications in the Merced River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	
			2.10.43.4 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	San Joaquin River, Merced River, Stanislaus River, and Tuolumne River.	2.10.44 Loss of floodplain habitat in the San Joaquin River affecting juveniles produced in the San Joaquin, Merced, Stanislaus, and Tuolumne rivers.	2.10.44.1 Develop floodplain habitat on private properties through easements or land acquisition (AFRP website 2005).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		1800 - 4800 per acre	TBD	TBD	TBD	Cost would depend on the land's zoning, its proximity to an urban area, and its development potential. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Spring-run			2.10.44.2 implement the San Joaquin River National Refuge Riparian Habitat Protection and Floodplain Restoration Project (AFRP website 2005).										
			2.10.44.3 BDCP floodways (erin)										
			2.10.44.4 Curtail further development in active San Joaquin River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.										
Steelhead	Mokelumne River.	2.10.45 Limited instream gravel supply affecting spawning habitat availability in the Mokelumne River.	2.10.45.1 Continue implementing a spawning gravel augmentation plan for the Mokelumne River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	84,000	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Tuolumne River.	2.10.46 Low flows affecting the adult immigration and holding life stage in the Tuolumne River.	2.10.46.1 Evaluate pulse flow benefits for steelhead attraction and passage in the Tuolumne River; if pulse flows are determined to be effective for attracting steelhead, implement the most beneficial pulse flow regime.	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	Cost to assess the relative benefits of fall pulse flow allocations on the Tuolumne River was $49,954. Source: Bureau of Reclamation Website 2004.
			2.10.46.2 Provide for flows that are protective of all steelhead life stages in the Tuolumne River through FERC processes and Section 7 implementation.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.46.3 Work with State and Federal water acquisition programs to dedicate instream water in the Tuolumne River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Modesto and Turlock Irrigation Districts	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.
Steelhead	Calaveras River.	2.10.47 Harvest/Angling impacts affecting adult immigration and embryo incubation (wading on top of redds containing incubating embryos).	2.10.47.1 Modify sport-fishing regulations to further minimize harvest/angling impacts on steelhead in the Calaveras River. Erin thinks this should be removed	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.47.2 Modify sport fishing regulations in the Calaveras River to minimize the impact of anglers wading in the river during steelhead embryo incubation.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.47.3 Implement outreach projects in the Calaveras River watershed to educate the public regarding the steelhead life cycle including how to identify a steelhead redd.		Long-term	Reclamation, NMFS, USFWS	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented.
Steelhead	Stanislaus River.	2.10.48 Loss of riparian habitat and instream cover in the Stanislaus River affecting the juvenile rearing and outmigration.	2.10.48.1 Make set-back levees integral components of the Corp's authorized bank protection or ecosystem restoration efforts (NMFS 2006).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
			2.10.48.2 Work with local land owners to restore riparian habitats in the Stanislaus River.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Stanislaus River Fish Group	5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.48 Loss of riparian habitat and instream cover in the Stanislaus River affecting the juvenile rearing and outmigration.	2.10.48.3 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	San Joaquin River, Tuolumne River, Merced River, Stanislaus River.	2.10.49 Predation on juvenile steelhead occurring in the San Joaquin River Basin.	2.10.49.1 Implement a study designed to develop quantitative estimates of predation on steelhead by non-native species in the San Joaquin River.	1.3: Threats to Habitat Quality and Complexity	5 Years	USFWS, NMFS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	One proposed study to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta cost approximately $800,000. Source: Stillwater Sciences 2001.
Spring-run			2.10.49.2 Implement programs and measures designed to control non-native predatory fish in the San Joaquin River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	3.2: Threats from Predation	Long-term	USFWS, NMFS, Reclamation	CDFG, DWR	Various NGOs	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.10.49.3 Implement projects to minimize predation at weirs, diversion dams, and related structures in the San Joaquin River.		Long-term	USFWS, NMFS, Reclamation, Corps	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.49 Predation on juvenile steelhead occurring in the San Joaquin River Basin.	2.10.49.4 Improve nearshore refuge cover for salmonids in the San Joaquin River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	Corps, USFWS, NMFS	DWR, CDFG		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
			2.10.49.5 BDCP fluctuating salinity (Erin)										
Steelhead Spring-Run	San Joaquin River.	2.10.50 Limited instream gravel supply affecting spawning habitat availability in the San Joaquin River.	2.10.50.1 Develop and implement a spawning gravel augmentation plan in the San Joaquin River.	1.1: Threats to Spawning Habitat	Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	The proposed Mokelumne River Spawning Habitat Improvement Project consisted of the annual placement of 1,200 cubic yards of gravel (600 cubic yards of 2 - 6 inch diameter, 300 cubic yards of ¼ - 2 inch diameter and 300 cubic yards of 6 - 9 inch diameter) in toe bar configurations, perpendicular to the stream flow, for two consecutive years, and was estimated at approximately $84,000.
Steelhead	Mokelumne River.	2.10.51 Harvest/Angling impacts affecting adult immigration and embryo incubation.	2.10.51.1 Modify sport-fishing regulations to further minimize harvest/angling impacts on steelhead in the Mokelumne River.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.51.2 Modify sport fishing regulations to minimize the impact of anglers wading in the Mokelumne River during steelhead embryo incubation.		Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.51.3 Implement outreach projects in the Mokelumne River basin to educate the public regarding the steelhead life cycle including how to identify a steelhead redd.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR		N/A	TBD	TBD	TBD	
Steelhead	Stanislaus River.	2.10.52 Harvest/Angling impacts affecting adult immigration, spawning and embryo incubation.	2.10.52.1 Modify sport-fishing regulations to further minimize harvest/angling impacts on steelhead in the Stanislaus River.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.52.2 Modify sport fishing regulations to minimize the impact of anglers wading in the Stanislaus River during steelhead embryo incubation.		Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.52.3 Implement outreach projects in the Stanislaus River to educate the public regarding the steelhead life cycle including how to identify a steelhead redd.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	
Steelhead	San Joaquin River.	2.10.53 Harvest/Angling impacts affecting adult immigration and embryo incubation.	2.10.53.1 Modify sport-fishing regulations to further minimize harvest/angling impacts on steelhead in the San Joaquin River.	2.1: Threats from Overutilization	Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.53.2 Modify sport fishing regulations to minimize the impact of anglers wading in the San Joaquin River during steelhead embryo incubation.		Long-term	NMFS	CDFG		N/A	N/A	N/A	N/A	
			2.10.53.3 Implement outreach projects in the San Joaquin River watershed to educate the public regarding the steelhead life cycle including how to identify a steelhead redd.		Long-term	NMFS, USFWS, Reclamation	CDFG, DWR	NGOs	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Calaveras River.	2.10.54 Predation in the Calaveras River.	2.10.54.1 Implement programs and measures designed to control non-native predatory fish in the Calaveras River basin (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.10.54.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in the Calaveras River.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	
			2.10.54.3 Improve nearshore refuge cover for salmonids in the Calaveras River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
		2.10.54 Predation in the Calaveras River.	2.10.54.4 Flow manipulation to mimic natural hydrograph to flush out predators and maintain colder water temperatures (put in all predation threat sections)										

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Tuolumne River.	2.10.55 Predation in the Tuolumne River.	2.10.55.1 Implement programs and measures designed to control non-native predatory fish in the Tuolumne River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.10.55.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in the Tuolumne River.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR	Modesto and Turlock Irrigation Districts	N/A	TBD	TBD	TBD	
		2.10.55 Predation in the Tuolumne River.	2.10.55.3 Improve nearshore refuge cover for salmonids in the Tuolumne River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	Mokelumne River, Tuolumne River, Calaveras River, San Joaquin River, Merced River, Stanislaus River.	2.10.56 The Stockton Deep Water Ship Channel presents an impediment to adult steelhead migrating to natal spawning tributaries.	2.10.56.1 Identify and implement projects designed to improve passage and habitat conditions at the Stockton Deep Water Ship Channel.	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, USFWS, NMFS	CDFG		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.56.2 Jeff's B.O. add in	5.4: Threats from Migration Obstructions and Impediments									
Steelhead	Merced River, Tuolumne River, Stanislaus River, and San Joaquin River.	2.10.57 Loss of natural river morphology and function in the San Joaquin River affecting juveniles produced in the Merced River, Tuolumne River, Stanislaus River and San Joaquin River.	2.10.57.1 Make set-back levees and ecosystem restoration integral components of the Corp's and the California State Plan (FloodSAFE) for authorized bank protection projects related to flood control (NMFS 2006). Implement bank revetment removal programs and projects and breach or remove abandoned levees during set-back levee projects.	1.3: Threats to Habitat Quality and Complexity									
			2.10.57.2 Utilize bio-technical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in the San Joaquin River.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG, CBDA		5,000 - 135,000 per acre	TBD	N/A	N/A	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.10.57.3 Curtail further development in active San Joaquin River floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes.		Long-term	Corps, NMFS, USFWS	DWR, CDFG, DPC	Local governments	N/A	N/A	N/A	N/A	
			2.10.57.4 Increase monitoring and enforcement of illegal rip rap applications in the San Joaquin River.		Long-term	Corps	SWRCB		N/A	N/A	N/A	N/A	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.57 Loss of natural river morphology and function in the San Joaquin River affecting juveniles produced in the Merced River, Tuolumne River, Stanislaus River and San Joaquin River.	2.10.57.5 Develop education and outreach programs to encourage river stewardship in the San Joaquin River basin.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	Cost would depend on the types of educational and outreach programs developed and implemented (e.g., the Kids and Creeks: Restoration Ecology in Action program implemented in Butte County schools cost $22,000 annually). Source: AFRP 1999.
			2.10.57.6 Implement flow schedule that mimics the natural hydrograph.										
Steelhead	Tuolumne River.	2.10.58 Water quality affecting adult immigration and holding in the Tuolumne River.	2.10.58.1 Develop a baseline monitoring program for the Tuolumne River to evaluate water quality throughout the watershed to identify areas of concern.	1.2: Threats to Water Quality	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Modesto and Turlock Irrigation Districts	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
		2.10.58 Water quality affecting adult immigration and holding in the Tuolumne River.	2.10.58.2 Encourage voluntary landowner participation in the Tuolumne River watershed in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality “Fact Sheets”.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.58.3 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Tuolumne River.		Long-term	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	TBD	TBD	TBD	
			2.10.58.4 Increase monitoring and enforcement in the Tuolumne River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
Steelhead	Stanislaus River.	2.10.59 Predation in the Stanislaus River.	2.10.59.1 Implement programs and measures designed to control non-native predatory fish in the Stanislaus River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.10.59.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in the Stanislaus River.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR	Stanislaus River Fish Group	N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.59.3 Improve nearshore refuge cover for salmonids in the Stanislaus River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR	Stanislaus River Fish Group	10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	Merced River.	2.10.60 Predation in the Merced River.	2.10.60.1 Implement programs and measures designed to control non-native predatory fish in the Merced River (NMFS 2007b), including harvest management techniques and programs for non-native predators (e.g., striped bass, largemouth bass, and smallmouth bass).	1.3: Threats to Habitat Quality and Complexity	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	Cost estimate for the sampling and removal of smallmouth bass in the upper Colorado River was approximately $73,000. 36 river miles were sampled three times using boat and raft based electrofishing. Source: Colorado River Recovery Program 2004.
			2.10.60.2 Implement projects to minimize predation at weirs, diversion dams, and related structures in the Merced River.	3.2: Threats from Predation	Long-term	NMFS, USFWS	CDFG, DWR		N/A	TBD	TBD	TBD	

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.60.3 Improve nearshore refuge cover for salmonids in the Merced River to minimize predatory opportunities for striped bass and other non-native predators.		Long-term	NMFS, USFWS	CDFG, DWR		10,000 - 50,000 per stream mile or 10,000 - 80,000 per ELJ	TBD	TBD	TBD	Cost of improving refuge cover could range from approximately $10,000 to 50,000 per stream mile for installation of LWD, or $10,000 to $80,000 for each engineered log jam (ELJ) constructed. Cost ranges include construction, design, permitting, basic monitoring (2 years), routine maintenance (2 years), reestablishing the site to prior conditions, and project management costs. Source: Evergreen 2003.
Steelhead	Mokelumne River.	2.10.61 Water quality in the Mokelumne River affecting the embryo incubation life stage.	2.10.61.1 Develop a baseline monitoring program for the Mokelumne River to evaluate water quality throughout the watershed to identify areas of concern.	1.2: Threats to Water Quality	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG		N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.
			2.10.61.2 Encourage voluntary landowner participation in the Mokelumne River watershed in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality “Fact Sheets”.	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
		2.10.61 Water quality in the Mokelumne River affecting the embryo incubation life stage.	2.10.61.3 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Mokelumne River.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.10.61.4 Increase monitoring and enforcement in the Mokelumne River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007).		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	
Steelhead	Calaveras River.	2.10.62 Entrainment at diversions in the Calaveras River affecting the juvenile rearing and outmigration life stages.	2.10.62.1 Implement recommendations from the Calaveras River Fish Screen Facilities Feasibility Study, (SEWD 2003)	5.3: Threats Resulting from Water Diversions	5 Years	NMFS, USFWS, Reclamation, Corps	CDFG, DWR	Water districts, Irrigation districts	N/A	TBD	TBD	TBD	
			2.10.62.2 Implement conservation measures from the Habitat Conservation Plan										
Steelhead	Stanislaus River.	2.10.63 Water temperature in the Stanislaus River affecting the spawning and juvenile rearing life stages.	2.10.63.1 Negotiate agreements with landowners, water districts, and Federal and stage agencies to provide additional instream flows or purchase water rights, and/or restore riparian habitat to promote shading in the Stanislaus River (AFRP website 2005).	1.2 Threats to Water Quality	Long-term	USFWS, NMFS, Corps, Reclamation, Resource Conservation Districts	CDFG, DWR	Water districts, Landowners, Local governments, NGOs	43 - 100 per AF per year	TBD	TBD	TBD	Water transfer costs range from $43 to 100 per acre-foot per year. Source: Thomson and Pinkerton 2008.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
Steelhead	Mokelumne River.	2.10.64 Loss of riparian habitat and instream cover in the Mokelumne River affecting juvenile rearing.	2.10.64.1 Make set-back levees integral components of the Corp's authorized bank protection or ecosystem restoration efforts (NMFS 2006).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
			2.10.64.2 Work with local land owners to restore riparian habitats in the Mokelumne River.		Long-term	NMFS, USFWS, Resource Conservation Districts	CDFG, DWR		5,000 - 135,000 per acre	TBD	TBD	TBD	Cost for riparian restoration would vary depending on the site's slope and accessibility (e.g., flat/light clearing or steep/heavy clearing) Source: Evergreen 2003, p. 16
			2.10.64.3 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	Calaveras River.	2.10.65 Loss of riparian habitat and instream cover in the Calaveras River affecting juvenile rearing.	2.10.65.1 Make set-back levees integral components of the Corp's authorized bank protection or ecosystem restoration efforts (NMFS 2006).	1.3: Threats to Habitat Quality and Complexity	Long-term	Corps, Reclamation, NMFS, USFWS	DWR, CDFG		3.5 - 4 million per mile	TBD	TBD	TBD	Cost estimate for levee setback and planting on Twitchell Island. Source: Nuedeck 2000.
			2.10.65.2 Permanently protect riparian habitat through easements and/or land acquisition										
Steelhead	Stanislaus River.	2.10.66 Water quality in the Stanislaus River affecting the spawning and juvenile rearing life stages.	2.10.66.1 Develop a baseline monitoring program for the Stanislaus River to evaluate water quality throughout the watershed to identify areas of concern.	1.2: Threats to Water Quality	3 Years	NMFS, USFWS, EPA, Resource Conservation Districts	SWRCB, DHS, DWR, CDFG	Stanislaus River Fish Group	N/A	50,000 - 100,000	50,000 - 100,000	50,000 - 100,000	Cost would depend on the types and number of parameters monitored (e.g., cost to develop and implement a water quality program on the American, Carson, Mokelumne, Stanislaus and Truckee Rivers within Alpine County for one year was approximately $60,000). Source: Sierra Nevada Conservancy Website 2008b.

Species	Population(s)	Threat	Recovery Action(s)	Threat Abatement Recovery Criteria Addressed	Duration	Involved Parties			Estimated Cost ($)				Comments
						Federal	State	Other Parties	Cost Per Unit	Year 1	Year 2	Year 3	
			2.10.66.2 Encourage voluntary landowner participation in the Stanislaus River in educational opportunities such as water quality short courses, field demonstrations and distribution of water quality "Fact Sheets".	4.1: Threats from Inadequacy of Existing Regulatory Mechanisms	Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	10,000 per workshop	TBD	TBD	TBD	Cost would depend on the types of outreach projects conducted and available funding (e.g., the Sustainable Agriculture Workshop educated landowners in the Sierra Valley on water management and conservation, water quality monitoring, and water quality improvement, and cost approximately $10,000). Source: Sierra Nevada Conservancy Website 2008a.
		2.10.6 Water quality in the Stanislaus River affecting the spawning and juvenile rearing life stages.	2.10.66.3 Pursue grant funding or cost-share payments for landowners to inventory, prepare plans and implement best-management practices that reduce water quality impacts in the Stanislaus River.		Long-term	NMFS, USFWS, USFS, EPA, Resource Conservation Districts	DWR, CDFG	Landowners	N/A	TBD	TBD	TBD	
			2.10.66.4 Increase monitoring and enforcement in the Stanislaus River to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants excluding water temperature (SWRCB 2007)		Long-term		SWRCB, RWQCBs	Local agriculture groups	N/A	N/A	N/A	N/A	

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