APPENDIX A

A.1. SACRAMENTO - SAN JOAQUIN DELTA ECOLOGICAL MANAGEMENT ZONE

Introduction

The Sacramento – San Joaquin Delta Ecological Management Zone (EMZ) is the tidal confluence of the Sacramento and San Joaquin Rivers. The Delta is the easternmost portion of the estuary, and today is clearly delineated by a legal boundary that includes the historically intertidal areas, along with supratidal portions of the floodplains of the Sacramento and San Joaquin Rivers (Figure 1). Today's legal Delta extends from the lower Sacramento River (near the city of Sacramento) in the north, Chipps Island to the west, and encompasses the lower portions of the Cosumnes/Mokelumne and San Joaquin river-floodplain systems in the east and south respectively.

Once a vast maze of interconnected wetlands, ponds, sloughs, channels, marshes, and extensive riparian strips, the Delta is now islands of reclaimed farmland protected from flooding by hundreds of miles of levees. Remnants of the tule marshes are found on small "channel" islands or the shorelines of remaining sloughs and channels. Important aquatic habitats are severely limited by levees, geomorphic changes to channels, flood control, and water operation systems.

The Delta is home to many species of native and non-native fish, waterfowl, shorebirds, and wildlife. All anadromous fish of the Central Valley either migrate through the Delta, or spawn in, rear in, or are dependent on the Delta, for some critical part of their life cycle. Many of the Pacific Flyway's waterfowl and shorebirds pass through or winter in the Delta. Many migratory song birds and raptors migrate through the Delta or depend on it for nesting or wintering habitat. Natural habitat is limited to thin margins along the channels and sloughs. There is habitat available for waterfowl and wildlife within the leveed agricultural lands, but it depends on the agriculture management practices and shifting commodity prices. Despite many changes, the Delta remains a productive nursery ground and migratory route for many species.

The Sacramento – San Joaquin Delta Ecological Management Zone is defined by the legal boundary of the Sacramento – San Joaquin River Delta. It is divided into four regional Ecological Management Units (EMUs):

- North Delta
- East Delta
- South Delta
- Central and West Delta

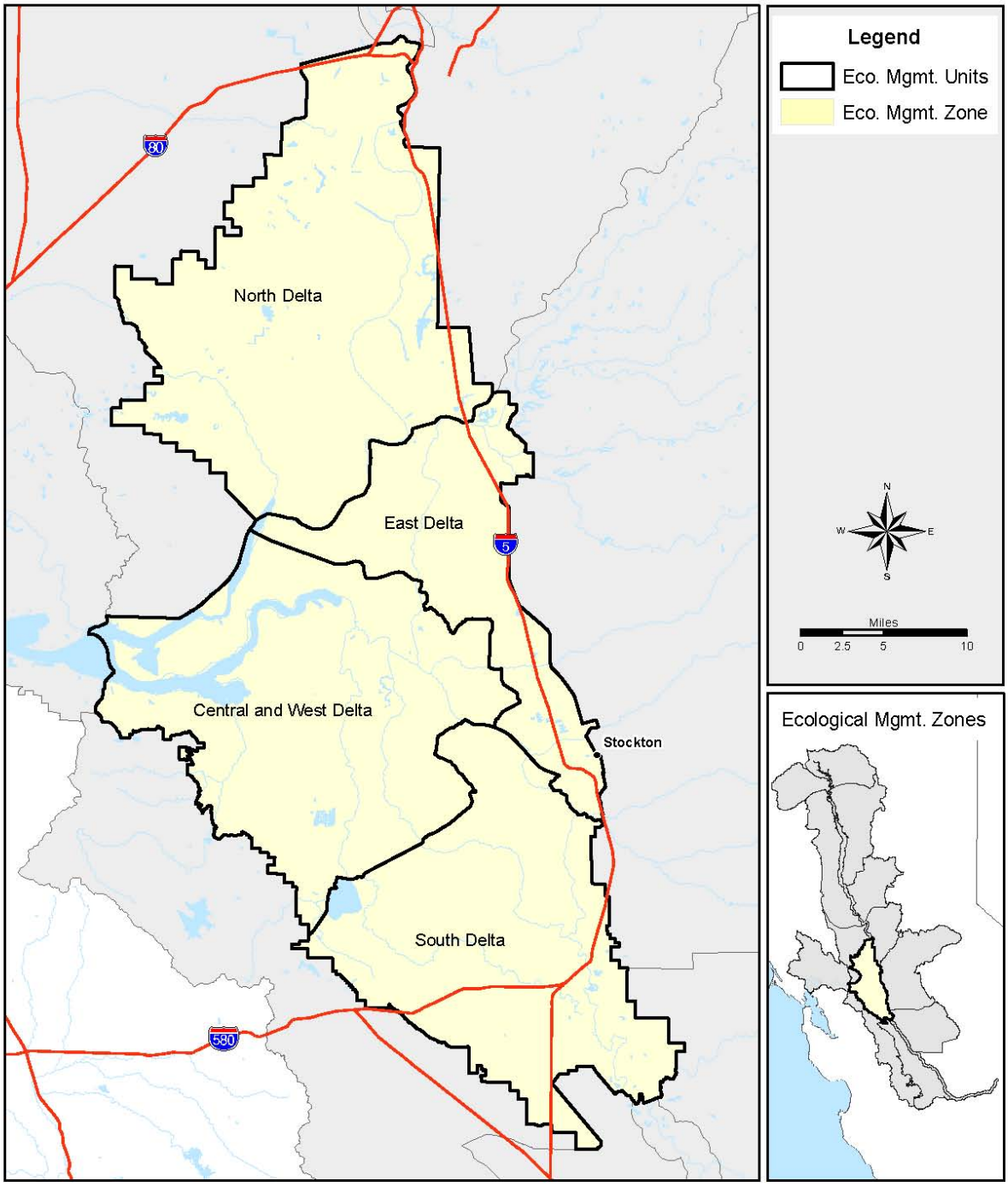

Figure 1. Sacramento-San Joaquin Delta Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Suisun Marsh/North San Francisco Bay EMZ Map

North Delta Ecological Management Unit

The North Delta EMU includes the Lindsay and Cache sloughs, the Yolo Bypass south of Highway 80, the Stone Lakes area, and the confluence of the Cosumnes and Mokelumne Rivers. The southern boundary is the Sacramento River. Notable features are the Yolo Bypass; the Sacramento deep water channel; the Cache Slough complex; the Sacramento River and adjoining sloughs; the Snodgrass Slough and Stone Lakes complex; and the Delta Cross Channel (DCC) gates which, when open, allow Sacramento River water to flow into the east and central Delta to improve drinking water quality at the pumps in the south Delta. Land elevations generally range from 15 feet below to 10 feet above mean sea level.

The primary land use is agriculture, comprised of field crops (i.e. corn, wheat, safflower, rice), orchards and vineyards. Only 5% of this EMU consists of riparian, oak woodland, freshwater marsh, and seasonal wetlands. Much of the permanent and seasonal wetland habitat is found in the Yolo Bypass (the State Wildlife Area and private duck clubs managed under both State and federal easement) and in the Stone Lakes area. Other wetland habitat exists on Liberty Island and Little Holland Tract while riparian habitat is restricted to berm islands, levees, and lower velocity sloughs.

Hydraulic processes in the North Delta EMU are heavily influenced by tides in the western portion due to the size of the Sacramento deep water ship channel. The channel geometry of the Sacramento River changes dramatically just north of Rio Vista, where the mainstem of the river heads east before it heads north towards Sacramento. Both upstream and downstream of that point, the river is tremendously wider which carries the majority of the tidal flow upstream towards the Cache Slough complex. Other hydraulic processes influencing the Unit include upstream water releases, weather, channel diversions, and river inflow. The tidal action has been modified by several water diversions, as well as export pumping, within the Unit. In particular, one diversion is at the end of a terminus slough which has modified tidal circulation and residence time. Current hydraulic conditions in this EMU affect its ability to support channels with suitable residence times and natural net flows; to provide adequate transport flows to the lower estuary; and to support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

The habitat acreage targets for the North Delta EMU are: 1,500 acres of tidal perennial aquatic habitat; 1,000 acres of shallow non-tidal perennial aquatic habitat; 10-30 miles of Delta sloughs; 30-50 miles of Yolo Bypass sloughs; 50-200 acres of mid-channel islands; 2,000 acres of fresh non-tidal emergent wetland; 1,000 acres of restored and 2,000 acres of improved seasonal wetland; 20-35 miles of riparian and riverine aquatic habitat plus 500 acres, and 1,000 acres of perennial grassland (Table 1).

East Delta Ecological Management Unit

The East Delta EMU is bounded on the northwest by the Sacramento River; on the northeast by the Mokelumne and Cosumnes rivers; and on the south by Highway 12, the South Fork of the Mokelumne River, White and Disappointment Sloughs, and the San Joaquin River. Notable features are the Georgianna Slough, the DCC, the Cosumnes River Preserve, and the Woodbridge Ecological Reserve. Land elevations within this unit range from 15 feet below sea level in the west to 10 feet above mean sea level in the east.

The primary land use in the East Delta EMU is agriculture, with 68% in field crops, orchards and vineyards. Less than 5% of the east Delta consists of riparian, oak woodland, fresh emergent wetland, and seasonal wetland habitats. Much of the riparian and permanent and seasonal wetland habitats are found along the Cosumnes and Mokelumne rivers and in the White Slough Wildlife Area.

Hydraulic processes in the east Delta are influenced by tides, river inflow, weather, channel diversions, and upstream water releases. The hydraulic processes have been modified by several water diversions, channel geometry, and export pumping; as well as increased inflow from the Sacramento River into the East Delta EMU through the Delta Cross Channel. Current hydraulic conditions in the east Delta are unhealthy, which reduces the EMU's ability to provide suitable residence times and more natural net flows; provide adequate transport flows to the central and west Delta; and support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

The habitat acreage targets for the East Delta EMU are: 1,000 acres of tidal perennial aquatic habitat; 300 acres of shallow non- tidal perennial aquatic habitat; 200 acres of perennial aquatic habitat; 10-30 miles of Delta sloughs; 50-200 acres of mid channel Islands; 1,000 acres of fresh non-tidal emergent wetland; 1000 acres of restored and 6000 acres of Improved seasonal wetland; 8-15 miles of riparian and riverine aquatic habitat, and 1,000 acres of perennial grassland (Table 1).

South Delta Ecological Management Unit

The South Delta EMU is bounded on the north by the San Joaquin River, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal and Italian Slough. Notable features are the San Joaquin, Old, and Middle rivers; Clifton Court Forebay; and the State and federal fish protection and export facilities. Land elevations range from 10 feet below to 10 feet above mean sea level. Only about half of the unit is at or slightly above sea level.

The primary land use in the South Delta EMU is agriculture with more than 60% in field crops, orchards, and vineyards. Less than 2% of this Ecological Management Unit consists of riparian, oak woodland, fresh emergent wetland, and seasonal wetland

habitats. Much of the riparian and wetland habitat is found in narrow banks along the San Joaquin River and on small channel islands in the Old River.

Hydraulic processes in the south Delta are influenced by tides; river inflow; weather; channel diversion; temporary rock barriers in Middle River, Old River at Tracy, head of Old River, and Grantline Canal; and water releases from upstream reservoirs. Hydraulic processes have been modified by water diversions, as well as export pumping. Current hydraulic conditions in the south Delta are unhealthy and affect the ability of this EMU to support channels with suitable residence times and more natural net flows; provide adequate transport flows to the entrapment zone; and support high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

While the effects of many small unscreened diversions in the South Delta are undocumented; the effects of the two large export facilities on nearly all Delta anadromous and resident fishes have been well described and are very significant.

The habitat acreage targets for the South Delta EMU are: 2,000 acres of tidal perennial aquatic habitat; 300 acres of shallow non-tidal perennial aquatic habitat; 200 acres of perennial aquatic habitat;25-50 miles of Delta sloughs; 50-200 acres of Mid channel Islands; 4000 acres of fresh non-tidal emergent wetland; 500 acres of restored and 12,000 acres of Improved seasonal wetland; 25-45 miles of riparian and riverine aquatic habitat, and 1000 to 2000 acres of perennial grassland (Table 1).

Central and West Delta Ecological Management Unit

The Central and West EMU is bounded on the west and north by Suisun Bay, the Sacramento River, Highway 12, the South Fork of the Mokelumne River, and White and Disappointment Sloughs; and on the south by the San Joaquin River, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal, and Italian Slough. Notable features are the San Joaquin and Sacramento Rivers, Frank's Tract, the channel islands in Middle and Old Rivers, and Potato and Disappointment Sloughs. Land elevations range from 10 feet below to as deep as 21 feet below mean sea level.

The primary land use in the Central and West EMU is agriculture with 48% in field crops, orchards and vineyards. Approximately 3% of the area consists of riparian, oak woodlands, fresh emergent wetland, and seasonal wetland. Much of the riparian and wetland habitat is found on the extensive network of small channel islands in Old and Middle rivers; on White, Potato, and Disappointment Sloughs; along the edges of Big Break and Frank's Tract; on the Lower Sherman Island Wildlife Area; and on adjacent tide lands on both sides of the Sacramento River channel between Collinsville and Rio Vista, including Decker Island and adjacent channels. The central and west Delta contains most of the heavily subsided islands in the Delta. The subsidence has led to potentially serious erosion of the levees around the islands and numerous levee breaks in the last several decades.

Hydraulic processes in the central and west Delta are influenced by tides, river inflow, weather, channel diversions, and river inflow. Hydraulic processes have been modified by water diversions, as well as export pumping. Current hydraulic conditions in the central and west Delta are unhealthy. The ability of this EMU to maintain suitable residence times and provide more natural flows is restricted. These restrictions inhibit adequate transport flows to the entrapment zone and reduce high-quality rearing and spawning habitat, nutrient cycling, and foodweb integrity.

In addition to many, small, unscreened agricultural diversions, electric generating stations divert up to 1,500 cfs of Delta water. The water is diverted at Antioch, along the San Joaquin River channel, for cooling purposes. Some juvenile Delta fish are stressed or killed in the water diverted for plant cooling. Though the amount of heat added to the Delta is small, it is locally measurable. This combined with other heated discharges contributes to significant seasonal warming Delta waters.

The habitat acreage targets for the South Delta EMU are: 2,500 acres of tidal perennial aquatic habitat; 100 acres of shallow non-tidal perennial aquatic habitat; 500 acres of perennial aquatic habitat; 25-50 miles of Delta sloughs; 50-200 acres of mid-channel Islands; 10,000 acres of fresh non-tidal emergent wetland; 1500 acres of restored and 8,000 acres of improved seasonal wetland; 50-100 acres of inland dune habitat, and 1000 to 2000 acres of perennial grassland (Table 1).

Applicable ERP Vision

The vision for the Sacramento-San Joaquin Delta EMZ is to restore processes and functions that meet the ecological needs of plants and animals using the system. A healthy Delta ecosystem will depend on actions taken outside of the Delta as well. For example, to achieve more natural freshwater flow and channel hydraulic patterns, actions must be taken outside of the Delta to contribute to or restore those functions. More natural channel geomorphology and configuration with linkages to floodplains and wetland habitats will provide more habitat for fish, waterfowl, and wildlife; and improve aquatic foodweb production, residence time, and water quality. Restored natural functions and habitats will improve survival of native and anadromous fish that depend on the Delta for a portion of their life cycles, including Chinook salmon and steelhead, splittail, Delta smelt, striped bass, white and green sturgeon, and American shad. It will also help to maintain or recover resident and migratory wildlife such as waterfowl, shorebirds, Neotropical birds, Swainson's hawks, and special-status plants and plant communities.

A restored Delta ecosystem will be directly affected by actions taken upstream. Upstream actions, such as reservoir releases for water delivery, have a direct influence on quality of habitat within the Delta, and will contribute to and, in some cases drive,

recovery of important or critical natural processes in the Delta. The duration, amount, and timing of releases (river flow) affect one of the driving ecological processes that contributes to habitat restoration and quality, potentially reduces stressors, and increase sustainability or viability. Other ecological processes that will be improved include freshwater inflow, outflow, Delta hydraulics, channel configuration, water temperature, floodplain connectivity, and aquatic and terrestrial foodweb productivity. A mosaic of habitats needs to be restored, including increases in the acreages of tidal emergent wetlands, seasonal and permanent nontidal wetlands, shallow water, riparian, and tidal slough habitats. Restoration efforts must also continue to link with other programs to reduce the environmental stressors from land use, urban and industrial development, contaminants, land reclamation, water diversions, flood control (i.e. levees and bank protection), non-native plant and animal species, recreational activity (e.g. boating), water conveyance structures, livestock grazing, and agricultural practices.

Another key component of restoration is to conduct a comprehensive monitoring program that measures performance and can inform the adaptive management process. There are several existing programs that could be expanded or used as models. For example, the Interagency Ecological Program has collected a tremendous amount of information on Delta Fish species over the years. Those data have been used to inform operations of the State and Federal water projects. There should be a similar effort in the future to monitor and evaluate restoration actions to determine how the system, species, and habitats responded to change. While it is relatively easy to determine what types of habitats are absent from the Delta, and focus restoration activities on those habitats, the ecosystem response to such changes is not as apparent.

As restoration and monitoring occur in the Delta, the sustainability of habitats and processes should be apparent over time. A sustainable Delta will result in better, higher quality, and more diverse fish spawning, rearing, and migration habitats and be more effective in nutrient cycling which will increase primary (plant) and secondary (animal) productivity. Productivity will increase through improved freshwater inflow and outflow, longer hydraulic residence time in Delta channels, and an increase in the amount of tidal wetlands. As habitat and processes improve in the Delta, the benefits (particularly from productivity) will transfer downstream and improve conditions in the Suisun and San Pablo bays.

In order to accomplish Delta restoration, however, there are many obstacles to overcome. Habitat restoration will not be straightforward because much land that makes up the Delta is subsided well below sea level. Reclamation of the Delta for agriculture and the continued extensive agricultural practices have produced large areas of land that have interior elevations up to 30 feet below sea level. This significantly complicates the task of restoring and sustaining natural wetland habitats that were once prevalent throughout the Delta. The loss of those habitats; the engineering of the

system; and management for water conveyance have all contributed to serious declines in native species, such as the delta smelt. In order to restore conditions better for native species, innovative solutions will be needed over time and will likely require conversion of agriculture lands. New information suggests that the Delta is at a growing risk of catastrophic levee failures from seismic activity, sea level rise, and climate change. The existing levee configurations and design, as well as the interior land elevations, all contribute to the levels of risk for the Delta. In order to reduce the level of risk of catastrophic levee failure, land elevations need to be restored. This would also help to restore a sustainable Delta.

By managing the Delta's lands and levee systems to reduce the risk of failure, water quality losses (e.g. saltwater intrusion) and the loss of high-value wildlife habitat and agricultural land will also be minimized. Riparian, wetland, and aquatic habitats along the levees will be improved where possible. In those areas where leveed lands can eventually be restored to tidal action, the exterior levees will be maintained until the island interiors are restored to the elevations necessary to support the desired habitats.

A basic restoration strategy is to protect and enlarge areas of remaining native habitats and establish the connectivity of these areas. For example, the Cosumnes River Preserve (Badger Creek Marsh) supports a sizable population of giant garter snakes. There have also been several recent and historical giant garter snake sightings in the area of Caldoni Marsh (White Slough Wildlife Area), west of Lodi. Stone Lakes Refuge, Morrision Creek drainage, and the Yolo Basin also contain suitable giant garter snake habitat, though population sizes are thought to be quite small. Restoring connectivity of these areas would benefit giant garter snakes and contribute to their recovery by providing corridors for the reestablishment of historic populations.

Table 1. Summary of ERPP Habitat Restoration Targets for the Sacramento-San Joaquin Delta Ecological Management Zone

Habitat Type	North Delta Acreage	East Delta Acreage	South Delta Acreage	Central and West Delta Acreage	Total Acreage
Tidal Perennial Aquatic	1,500	1,000	2,000	2,500	7,000
Shoal	0	0	0	500	500
Nontidal Perennial Aquatic (deep open water)	0	200	200	100	500
Nontidal Perennial Aquatic (shallow open water)	1,000	300	300	500	2,100

Table 1. Summary of ERPP Habitat Restoration Targets for the Sacramento-San Joaquin Delta Ecological Management Zone

Habitat Type	North Delta Acreage	East Delta Acreage	South Delta Acreage	Central and West Delta Acreage	Total Acreage
Delta Sloughs	10-30 miles (61-182 acres)	10-30 miles (61-182 acres)	25-50 miles (152-303 acres)	20-50 miles (121-303 acres)	65-160 miles (395-970 acres)
Delta Sloughs (Yolo Bypass)	50-100 miles (303-606 acres)	--	--	--	50-100 miles (303-606 acres)
Midchannel Islands	50 to 200	50 to 200	50 to 200	50 to 200	200 to 800
Fresh Emergent Wetland (tidal)	TBD [to be determined]	TBD	TBD	TBD	30,000 to 45,000
Fresh Emergent Wetland (nontidal)	2,000	1,000	4,000	10,000	17,000
Seasonal Wetland	Improve: 1,000 Restore: 2,000	1,000 6,000	500 12,000	1,500 8,000	4,000 28,000
Riparian and Riverine Aquatic	20-35 miles plus 500 acres (691-1,009 acres)	8-15 miles (116-218 acres)	25-45 miles (377-695 acres)	--	53-96 miles plus 500 acres (1,684-2,422 acres)
Inland Dune Scrub	0	0	0	50 to 100	50 to 100
Perennial Grassland	1,000	1,000	1,000 to 2,000	1,000 to 2,000	4,000 to 6,000
Wildlife Friendly Agricultural Land	TBD	TBD	TBD	TBD	40,000 to 75,000
Total acres of all habitats to be restored excluding wildlife friendly agricultural practices					91,732 to 110,998

Stage 1 Expectations

Stage 1 expectations for the Delta EMZ and the associated EMUs are not specifically called out in the Ecosystem Restoration Program Plan. However expectations for the first seven years are encompassed in the visions listed above.

Changes Attributable to ERP

North Delta Ecological Management Unit

Liberty Island Acquisition (**ERP-97-B03** and **ERP-00-F06**) has thus far resulted in the acquisition and protection of 4,941 acres of Liberty Island located in the Yolo Bypass. The process for reaching consensus on long-term ownership and management is still being worked out by the agencies involved. Three contiguous or nearby properties, Tracts 64, 66, & 68, remain unprotected. Tract 66 encompasses 268 acres and is still privately held. Two additional nearby properties (Tract 68 and 64) encompass 1,808 and 3,426 acres respectively. Tract 64 is north of Liberty Island and Tract 68 is located within Egbert Tract. ERP is continuing to work with The Trust for Public Lands to: acquire fee title interest in the remaining privately-owned parcel on Liberty Island (Tract 66); conduct restoration planning for Liberty Island; develop and implement a long term restoration plan for Liberty Island; and implement a monitoring program for the restoration.

The intent of funding the Liberty Island projects is to restore tidal influence to this strategically-located 5,209-acre island in the North Delta corridor. The island has naturally returned to tidal influence since breaching in 1997 and wildlife now use the habitat afforded by newly reestablished vegetation.

Through funding of *Stone Lakes NWR Land Acquisition* (**ERP-98-F12**), USFWS acquired fee title to approximately 555 acres of land within the boundary of the Stone Lakes National Wildlife Refuge to protect existing aquatic, wetland, and riparian habitats and restore a mosaic of aquatic, perennial and seasonal emergent wetland, riparian, and grassland habitats.

A series of projects, *Prospect Island Monitoring Plan Project* (**ERP-96-M26**), *Prospect Island Restoration Project* (**ERP-96-M02**), and *Prospect Island Habitat Protection Project* (**ERP-98-A01** and **ERP-98-A02**), were funded to design, implement, and monitor the restoration of approximately 1,300 acres of shallow water, tidal wetlands, and aquatic habitat on Prospect Island. A plan was developed but never implemented, due to threatened litigation and unresolved issues. Efforts were dropped on Prospect and turned to do monitoring on Liberty Island and get some initial biological studies conducted on the relatively newly breached island. The plan for Prospect would have included breaching the existing levees in two locations to restore full tidal action. Restoration would include approximately 130 acres of riparian habitat along levees and on several small interior islands which will be constructed using on-site materials from channel dredging activities. An alternative migration corridor for salmon would be developed by constructing a main channel across the 1,300 acre site and breaching the existing levees on both the Sacramento Deepwater Ship Channel levee side and the Minor Slough levee side. This project would also result in the removal of unscreened diversions. Planning and identifying a pilot project site were the initial funding

priorities. *Prospect Island Restoration Project* (**ERP-96-M02**) was to implement pilot restoration projects but was stalled due to an unplanned and misplaced breach prior to the project getting started. Much of the subsequent work involved management of the site in the interim. *Prospect Island Monitoring Plan Project* (**ERP-96-M26**) was reduced from actual restoration monitoring (active restoration has not yet begun) to production of a monitoring plan. *Prospect Island Habitat Protection Project* (**ERP-98-A01**) funds were used to close the breach in the Port of Sacramento's Miner Slough levee, dewater the island, sample and rescue the entrapped threatened or endangered species and repair the cross-levee breach. Restoration of the 1,300 acre island is on hold due to financial and liability issues.

Restoring Ecosystem Integrity in the Northwest Delta: Phase II (**ERP-02D-P54** and **ERP-02-P21**), *Hastings Tract Fish Screen (Phase I: Feasibility Study)* (**ERP-97-M06**), and *Hastings Tract Fish Screen (Phase II: Construction)* (**ERP-98-B27**) are contributing to the target to restore 1000 acres of native grasslands and vernal pools in the Cache Slough and Jepson Prairie area. **ERP-02-P21** is developing the monitoring and management plan in order to increase the quality and extent of native range types on 1,300 acres on the Jepson Prairie. **ERP-02-P54**, an ongoing project, is projected to acquire conservation easements on 800 acres along the Barker, Lindsey and Calhoun Sloughs; north Delta tidal channels located west of the Yolo Bypass. *Hastings Tract Fish Screen (Phase II: Construction)* (**ERP-98-B27**) and *Hastings Tract Fish Screen (Phase I: Feasibility Study)* (**ERP-97-M06**) were feasibility and construction projects to screen the Hastings tract and prevent entrapment of fish due to flow changes associated with tidal inundation and operation of water diversions in the sloughs.

Cache Slough Shaded Aquatic Habitat Enhancement Project (**ERP-98-B08**) was funded to assist with planning 2,000 feet of riverine canopy restoration along Cache Slough.

Together, projects in the Jepson Prairie, Liberty Island, Cache Slough, and Prospect Island areas can potentially meet and exceed most of the North Delta EMU habitat targets once carried out in full. These include:

- Expand the floodplain area by putting approximately 10% of leveed lands into the active floodplain of the Delta (Liberty Island had restricted height levees constructed on the property which isolated from the active floodplain, in severe wet years, the property overtopped and became inundated).
- Restore 50–100 miles of tidal channels (303–606 acres) in the southern Bypass within the north Delta, while maintaining or improving the flood carrying capacity
- Emulate natural seasonal patterns in Cache and Putah creeks by providing additional flows, when available from existing water supplies.
- Emulate natural stream channel configurations in Cache and Putah creeks, as well as in channels and sloughs of the upper Bypass, consistent with flood control requirements.
- Restore 1,500 acres of tidal aquatic habitat, 1,000 acres of perennial aquatic

habitat, 2,000 acres of fresh non-tidal habitats, 10-30 miles of sloughs, and 1,000 acres of perennial grasslands.

Full protection and restoration has not been accomplished yet. Much of the planning has been initiated or completed. However, with the exception of activities in the Jepson Prairie, on-the-ground restoration is on hold. The remaining obstacles center upon the need for consensus among the many stakeholders, and providing long term protection of conservation values on Prospect Island. The key issues that block consensus are liability and safety issues related to vegetation and inundation of the dedicated floodplains in the zone (the Yolo Bypass Flood Control Project). On a more positive note, the lower portions of the bypass that remain inundated due to natural flooding in the past are starting to revegetate on their own. Wildlife use of these areas has been documented by DFG. Recent research reports (Slotton 2007) indicate that the mercury from the upper bypass is not showing up in fish tissue in the naturally restored areas. Potential mercury transport is either being sequestered or is of very limited biological availability. There is speculation that vegetation and soils are mediating mercury bioavailability.

Watershed Restoration Strategy for the Yolo Bypass (**ERP-98-E11**) was funded to bring ecosystem management and local interests into focus and produce the Yolo Bypass Management Strategy. This document is already being used as a guidance and decision tool in other ERP grants.

Discover the Flyway II (**ERP-01-N40**) and *Discover the Flyway* (**ERP-98-B34**) funded education and outreach implemented by the Yolo Basin Foundation. Thousands of students and other groups continue to learn about and involve themselves in ongoing activities scheduled by the foundation and conducted in the Yolo Basin Wildlife area. The projects, though now closed, continue to operate and the teacher's guide, prepared as a *Discover the Flyway* (**ERP-98-B34**) grant deliverable, is still being used. In addition, 3000 grass plugs were planted at the wildlife area by student participants.

East Delta Ecological Management Unit

With funding from ERP projects, approximately 11,300 acres of land was acquired for restoration purposes. Because many of these lands are subsided or in floodplains, restoration is proceeding at a measured pace. Nonetheless, most of the ERP habitat acreage targets for the East Delta will be within reach as a result of the acquisitions and planning contributed by the ERP. The actual time it will take for restoration sites to reach maturity, and harbor the species identified for recovery in the ERPP, will vary according to site characteristics and funding availability.

The Staten Island Acquisition (**ERP-01-N23**) and the *Staten Island Wildlife-Friendly Farming Demonstration* (**ERP-02-P08**) were implemented to protect 9,106 acres of critical agricultural wetlands to be used by waterfowl and sandhill cranes, an at-risk

species. This project contributed to the fresh emergent (tidal) habitat and agricultural land habitat targets for the unit. *Staten Island Wildlife-Friendly Farming Demonstration* (**ERP-02-P08**) funded a cross levee with an additional pump installed to help improve the water management options on the island. The project is also contributing to the general target for agricultural land, which is to cooperatively manage 40,000-75,000 acres for both agriculture and wildlife in the Sacramento-San Joaquin Delta EMZ (CALFED 2000).

The increased period of inundation and more precise manipulation of water levels on agricultural fields will provide and maximize benefits to waterfowl and other target species while adequately maintaining the agricultural functions of the island in perpetuity. Flooding fields is expected to assist agriculture practices by reducing soil loss, subsidence, weed establishment and field preparation costs. This project also monitored the effects of these agricultural practices on the wildlife populations. While the project shows that bird abundance and use varies between crop type and crop residue management, consistently higher densities of birds were observed in the flooded agricultural fields.

The Tyler Island Levee Protection and Habitat Restoration Pilot Project (**ERP-97-N13**) explored two uses of non-traditional methods of protecting levees. One method consisted of using brush bundles to absorb wakes and the other used tule stands. Brush bundles reduced the energy of the boat wakes by 60% and increased the rate of deposition along the banks of the levees. Tule stands can reduce boat wake energy by 50% if the stands are more than 10 meters wide and have plant densities of about forty stalks/meter. It is suggested that the result will change as the tule plants mature. This project provides more information about the hydrodynamic impacts of brush bundles and tule stands, and their effective geometries. Design and placement of these systems is anticipated to improve with use and testing on future restoration projects.

The East Delta Habitat Corridor, Tidal Marsh, and Riparian Habitat Restoration (**ERP-99-N03**) project contributed to the Levees, Bridges, and Bank Protection stressor target. The Georgiana Slough is one of the few channels that has a significant number of natural berms and has not had much riprap stabilization done along its banks. The project restored 2000 linear feet along the Georgiana Slough by using alternative biotechnical methods. This included the use of brush boxes, brush bundles and ballast buckets with native plants. These were placed in a tiered fashion and the photos of this project indicate that where the efforts were made, they were effective.

A combined report for *Tyler Island Levee Protection and Habitat Restoration Pilot Project* (**ERP-97-N13**) and *The East Delta Habitat Corridor, Tidal Marsh, and Riparian Habitat Restoration* (**ERP-99-N03**) counts riparian bank restoration installation into the year 2000 as follows:

> "At the present time 11,788.64 feet of bank along Georgiana Slough

have been protected with brush box bank protection features, 11,539 feet of tules have been planted along Georgiana Slough and the North Fork Mokelumne River and 17,563 feet of berm habitat along Georgiana Slough have been planted with riparian trees".

However, it is difficult to distinguish which of those lengths were funded by ERP. The ERP database for project ERP-97-N13 indicates that 0.87 miles of riparian was restored along Georgiana Slough and 0.57 were restored on Tyler Island.

South Delta Ecological Management Unit

The Banta-Carbona Irrigation District (BCID) *Fish Screen Project* (**ERP-97-M07**) contributed to the ERP target to reduce losses of juvenile salmon, steelhead and delta smelt in the South Delta EMU from entrainment at water intake structures. The Banta-Carbona Irrigation District built a new positive barrier fish screen located 500 feet upstream of the District's Water Intake Channel on the San Joaquin River. This fish screen is 166 feet long and 31 feet high, the height of a 100 year flood on the San Joaquin River. The fish screen was completed in 2003 and used the standards for protection of MSCS species including juvenile salmon, steelhead and delta smelt. Monitoring of the fish screen has shown this project has succeeded in reducing out-migrating juvenile salmon and steelhead mortality rates.

Stanislaus – Lower San Joaquin River Water Temperature Modeling and Analysis (**ERP-02-P28**) has contributed to the improvements of this ecological process. This project focused on the Central Valley Stream Temperatures target, and performed modeling and analysis of various alternatives for water management in the Stanislaus River basin to: 1) determine the relationship between water operations and river temperatures through Mossdale; 2) refine and validate current water temperature criteria for Central Valley fall-run salmon and steelhead; and 3) simulate water operational strategies and assess cost versus benefit ratios of the various alternatives. The project concluded that the Districts could meet the CALFED Review Panel and CDFG-proposed temperature criteria during many months of the year using current operations and existing conditions. There are, however, three time periods when the Districts' and the CALFED Review Panel and CDFG temperature criteria do not agree: May 15-June 1, September 4-October 1 and October 2-November 30. Based on observations and data, the project has suggested alternative dates for the Districts to meet the objectives set by the CALFED Review Panel and CDFG. There are vast differences between the operational proposals made by the Districts and CDFG, so it isn't possible to assess the cost vs. benefit ratios of the various possible water operations alternatives, but this project concludes that water temperatures are not the limiting factor for the Stanislaus River (AD Consultants et al. 2007).

The ongoing *Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River* (**ERP-02D-C11**) is scheduled for completion in 2008.

This project will contribute to the recovery of the riparian brush rabbit, an at-risk species identified by the ERP, by improving the habitat necessary to sustain the population established in this area. This project will also contribute to the riparian and riverine habitat target of restoring approximately 50 acres of land-side of the levees within the South Delta EMU.

A series of twelve research projects were conducted to get a better understanding of Delta Hydrodynamics. The dissolved oxygen (DO) levels in the San Joaquin River Deep Water Ship Channel (DWSC) have been and continue to be a focus of ERP studies in the Delta (See Chapter 5.8.1 Dissolved Oxygen for more information).

Central and West Delta Ecological Management Unit

Under *Dutch Slough Tidal Marsh Restoration Project – Phase I* (**ERP-02-C07-D**), 1,166 acres that comprise the Dutch Slough site were acquired. These lands, when mature, will contribute to the goal of restoring tidal wetlands in the central and west delta. The 2006 feasibility study for the project estimates that the project will create approximately 660 acres of marsh and tidal channel habitat; and 80 acres of riparian, native grassland, and dune habitat with associated sinuous and branching tidal channel systems. There is the potential to restore a natural delta at the mouth of Marsh Creek. 210 acres of open water may also be restored. Dune and perennial grassland habitat areas exist at the site as well. The project therefore has potential to meet some or all of the general target to protect and restore 50 to 100 acres of low-to-moderate-quality Antioch inland dune scrub habitat (CALFED 2000a). The cost for implementing the preferred alternative is $25 million dollars. Restoration of the site must take into account flood and water seepage issues in the vicinity of the community of Oakley, and water supply infrastructure. The majority of estimated restoration costs are associated with the importation of fill materials for water containment and raising subsided areas to marsh plain elevation.

A permanent conservation easement was placed on 140 acres of shallow water tidal perennial aquatic habitat and 28 acres of shaded riparian habitat on the Fern-Headreach Island Complex along the main channel of the San Joaquin River in the Delta. This conservation action was accomplished with funding provided through *Fern-Headreach Tidal Perennial Aquatic and Shaded River Aquatic Conservation Project* (**ERP-98-F16**).

Phase II: Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands (Construction & Monitoring) (**ERP-01-N13**) and *Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands* (**ERP-97-N11**) developed and/or tested 14 biotechnical structures and identified opportunities and constraints for protection of DICI in the Central and West Delta. The interpretive report found that site-specific tule population status and trends are good measures of success of biotechnical fixes. Sediment accretion was not facilitated by the structures.

Feasibility Study of the Ecosystem and Water Quality Benefits Associated with Restoration of Franks Tract, Big Break, and Lower Sherman Lake (**ERP-01-C05**) exhaustively explored the options and costs of restoring flooded Delta Islands. The costs for restoring small portions of the flooded island varied by alternative, but were generally greater than $5 million dollars. Most of the alternatives require the intensive use of dredge materials for raising subsided soils to the level at which emergent vegetation can become established. Protection from wind waves would be needed. Uncertainties about the restoration trajectory and regional impacts remain. DWR is currently exploring pilot project on Franks Tract, based on the recommendations that came out of the final report for this project.

Another project that explored restoration strategies for Rhode Island, a DFG property on Old River, was funded by *Rhode Island Floodplain Management and Habitat Restoration – Phase I* (**ERP-98-F09**). The feasibility study noted use of the island by many species of interest, loss of habitat due to geomorphic processes and a recent fire.

Delta-wide Studies

Consistent with the ERP Stage 1 strategy of establishing a firm scientific footing for restoration actions, many of the projects funded by ERP during Stage 1 were investigatory or exploratory in nature. Projects included studies or pilot projects that are region wide in their geographic scope or application. For a discussion of ERP studies and projects that focus on food-web and contaminant loading related to Pelagic Organism Decline, see the chapter on the Suisun Bay Ecological Management Unit.

Many of the ERP-funded projects in the Delta Region addressed the cycling and transport of nutrients, detritus, and organisms; water quality; and dredging. Table 2 includes these studies under their specific headings, but the text section of this chapter does not discuss these projects. For a detailed discussion of these projects, see their specific chapters in this report.

The *Juvenile Salmon Migratory Behavior Study in the North and Central Delta Using Radio Telemetry* (**ERP-01-N48**) was conducted to improve the understanding of juvenile anadromous salmonids migratory behavior in the Delta. The project demonstrated that the fish utilized middle portions of the channels during migration. It was not, however, able to determine how the fish ultimately migrate downstream over time, because of the vast distances the fish moved upstream and downstream during both ebb and flood tides. This “distance traveled” information showed that the fish do not “hold in position” on flood tides and then only migrate on ebb tides.

Adult Fall-Run Chinook Salmon Movement in the Lower San Joaquin River and South Delta (**ERP-98-C11**) used ultrasonic transmitters to determine: 1) the relationship between fish movements and dissolved oxygen and water temperature, 2) identify

milling and straying behaviors, and 3) determine the rate at which salmon travel through the Sacramento–San Joaquin Delta. The study was conducted during one better-than-average rainfall year in the Sacramento and San Joaquin watersheds, which resulted in higher than normal flows which sustained good water quality during the fall salmon run. This study was unable to identify potential barriers related to water quality in the Stockton Deep Water Channel (SDWC) because most of the tagged salmon ascended the Sacramento River and the water conditions in the SDWC appeared to be favorable for salmon passage. The study results suggest that the salmon were not delayed in the SDWC and their average travel times were 2.1 days when the dissolved oxygen levels were above 5.0 mg/l. Several fish moved downstream after being tagged and some fish appeared to roam the Delta before committing to one river system. Most of the salmon tagged on the San Joaquin River exited the Delta on the Sacramento River, which indicates that the fish may be using the Delta Cross Channel and Georgiana Slough to cross back over to the Sacramento River. The salmon behavior was highly individualistic and their migration times and distance traveled were variable.

A series of culture of delta smelt projects were funded by ERP in order to provide a supply of smelt for research without further diminishing the natural population. The main objectives of the projects were to aid in species restoration by: developing a reliable and technically feasible method for culturing delta smelt, initiating a supply of all life stages in support of the research community, to provide information describing their basic life history, to provide a laboratory standard for evaluating on-going habitat restoration, and to create a refuge population.

Some factors were determined to be interfering with the success of the cultured delta smelt: a clean water source, the lack of a high-density rotifer-culture system necessary to supply quantities of live prey to the larvae, and the need to develop an appropriate larval rearing system for the larvae. Once these factors were acknowledged the success of the culture program increased dramatically. With the success of the culture program, there were eleven studies that were initiated with the supply of delta smelt to study (See Chapter 6.1 Delta Smelt for more information).

An ongoing delta smelt project, *Monitoring Responses of the Delta Smelt Population to Multiple Restoration Actions in the San Francisco Estuary* (**ERP-04-S15**), is striving to contribute more information to the at-risk native species identified by the ERP. This project plans to implement a state-of-the-art monitoring program to link key vital parameters for delta smelt collected by existing monitoring programs with survival to adulthood. This project also will make concurrent, linked measurements of the following population variables to help understand how environment, restoration, and management activities affect the fish: 1) growth efficiency and body condition; 2) impairments from exposure to toxic chemicals; 3) survival to the adult stage; 4) spawning success; and 5) food composition and abundance.

The first of the Breach Series of investigations, *Applied Research to Predict Evolution of Restored Diked Wetlands* (**ERP-96-M10**), examined restoration trajectories on diked and subsided lands breached in the Bay-Delta. At this early time in Stage 1 implementation the researchers reached three preliminary conclusions: that invasive species would predominate restorations; elevation change due to ambient conditions would be 1-4 cm per year; and more restricted specialists in the food web would not rebound until the later stages of ecosystem recovery. The work in the Breach series has been continued by a second (*Understanding Tidal Marsh Restoration Processes and Patterns: Validating and Extending the "BREACH" Conceptual Model* (**ERP-99-B13**), and soon to be third, ERP project.

An ERP-funded study of methods for reversing subsidence on Delta islands (*Demonstration of Techniques for Reversing the Effects of Subsidence in the Sacramento – San Joaquin Delta: Phase I – Twitchell Island* (**ERP-98-C01**) came to the following important conclusions: 1) initially high DOC loading due to wetland creation on subsided islands would diminish, within 7 years, to less than current levels; 2) rice straw may be a practical method for enhancing accretion rates on subsided delta islands that are still farmed; and 3) reliance on mineral sediments as fill materials is impractical due to compaction and depressed in situ biomass accumulation. This study also conducted research on DOC and THMP loading from flooded and restored Delta islands.

Rhode Island Floodplain Management and Habitat Restoration – Phase I (**ERP-98-F09**), at very little cost, documented a trend towards increasing elevation of a flooded and subsided Delta Island since acquisition by the state in the early to mid 1980's. Baseline bathymetric and biological data was gathered, and there may be value in follow-up monitoring for passive subsidence reversal and habitat trajectories. The conclusions of this report generally support the accretion conclusions of the Breach project discussed above.

In-channel island restoration and prevention of the loss of relict natural islands, were the subject of two projects funded in the central and west Delta. *Phase II: Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands (Construction & Monitoring)* (**ERP-01-N13**) and *Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands* (**ERP-97-N11**) developed and or tested 14 biotechnical structures and identified opportunities and constraints for protection of DICI in the Central and West Delta. The interpretive report found that site specific tule population status and trends are good measures of success of biotechnical fixes. The structures used in these projects did not facilitate sediment accretion. Larger equipment than was used would have been needed to install the size of biotechnicals required for sufficient protection and durability.

Franks Tract State Recreational Area Wetlands Habitat Restoration (**ERP-97-N12**) and *Feasibility Study of the Ecosystem and Water Quality Benefits Associated with*

Restoration of Franks Tract, Big Break, and Lower Sherman Lake (**ERP-01-C05**) produced engineering designs based upon more conventional, resource intensive, imported material approaches to island creation and protection. The typical alternative from those scenarios would have cost from 5 to 25 million dollars for relatively small areas of restored wetland or upland in the Delta.

Geomorphic and Geological Mapping for Restoration Planning, Sacramento – San Joaquin Delta Region (**ERP-02-P45**) explains that CALFED has the dual mission of preserving and restoring diverse habitats, while protecting the Sacramento-San Joaquin Delta water conveyance and levee system. Successful restoration of floodplain and riparian habitat depends on a thorough understanding of the physical processes that historically created and destroyed floodplains and associated habitats. This study provides regionally consistent, fully digital (GIS compatible) data on the distribution and composition of deposits in the lower Sacramento-San Joaquin Delta region, including the extent of the pre-development river and delta system, for restoration planning and engineering construction (Hitchcock et. al. 2005).

Sacramento River and Major Tributaries Corridor Mapping Project (**ERP-96-M16**) was a project that continued the riparian mapping project for the Upper Sacramento River watershed to identify and map areas of needed protection. This project also aimed to work cooperatively with local governments and resource agencies to develop a mechanism to protect the biological and water quality values associated with riparian habitats. The project has provided detailed mapping of existing riparian habitat and other vegetation profiles along the Sacramento River and its tributaries.

A series of studies in the South Delta found that DO fluctuates in the San Joaquin River study area with both season and flow, and confirmed that DO levels at times exceed the RWQCB objectives. The study team observed that, other than near the Port of Stockton, on most reaches the Low DO conditions are not as persistent as those on other rivers with substantial BOD loadings.

Expanded Prevention, Detection and Control of Purple Loosestrife in the California Bay-Delta Authority Watershed (**ERP-02D-P64**) continues and expands efforts to prevent, detect, and control purple loosestrife throughout the Delta. The ERP project funding is closed but the California Department of Food and Agriculture (CDFA) continues to operate the control program. As a result of these efforts the invasion has been controlled, although monitoring and treatment for banked seed germination is ongoing. Biological controls were effective. Imazypyr, recently approved for aquatic application has been found to be more effective for loostrife control than aquatic formulations of glyphosate. The effectiveness of Imazypyr in aquatic applications is supported by another Bay-Delta Region ERP project for invasive spartina control.

Life History of Egeria densa in the Delta: Factors Controlling Production and Fragment Viability (**ERP-02-P18**), which studied the physiology of Egeria invasions, was also

aimed at meeting invasive species control targets and visions throughout the Delta. Future actions that focus on control of Egeria should use the results of this project, as it identified periods in the lifecycle of Egeria during which the plant is most susceptible to interruption of its growth processes.

Distribution and Ecology of Lepidium latifolium in Bay–Delta Wetlands (**ERP-02-P09**) mapped the distribution of perennial pepperweed throughout the Delta and was able to draw some conclusions about the geographic, salinity and hydraulic conditions that favor pepperweed propagation and spread.

The *Water Hyacinth Education Program* (**ERP-98-B38**) was designed to educate the community regarding the deleterious effects of hyacinth in Delta waters. The Sacramento Regional County Sanitation District developed a full color brochure describing water hyacinth, its negative impacts, and how to help keep it out of our waterways. Several of the brochures produced have been distributed throughout the community.

An outreach proposal, *Reducing the Introduction and Damage of Aquatic Non-indigenous Species through Outreach and Education: Phase II* (**ERP-02-P37**), which sought to influence practices in industries that sell invasive species reached the conclusion that industry was unwilling to participate in invasive species control programs that relied on Best Management Practices. The project developed materials and conducted the outreach specified in the contract scope of work. However, the website created for the project does not appear to be maintained and has the appearance of an out of date site.

Project Summary Table

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Sacramento–San Joaquin Ecological Management Zone–wide Projects				
ERP-00-B03	**Culture of Delta Smelt Phase II and III** This project developed a functional culture system for delta smelt. Continuance of Phase I of ERP-98-C02.	10/31/2002	$811,380	Complete.
ERP-01-N48	**Juvenile Salmon Migratory Behavior Study in North and Central Delta using Radio Telemetry** This research project was conducted to improve the understanding of juvenile anadromous salmonids migratory behavior in the Delta to enhance ongoing and future Delta ecosystem restoration efforts.	1/15/2004	$210,000	Complete. Scope of work was changed to move the South Delta site to an additional Central Delta site.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02D-P64	**Expanded Prevention, Detection and Control of Purple Loosestrife in the California Bay-Delta Authority Watershed** This project will expand and continue the efforts for the prevention, detection and control of purple loosestrife.	3/31/2008	$328,136	Ongoing – Tasks are approximately 85% complete to date
ERP-02-P09	**Distribution and Ecology of *Lepidium latifolium* in Bay – Delta Wetlands** This project conducted research on distribution of perennial pepperweed (*Lepidium latifolium*) in the Bay- Delta and developed GIS mapping of this region - wide inventory.	7/14/2007	$223,050	Ongoing
ERP-02-P18	**Life History of *Egeria densa* in the Delta: Factors Controlling Production and Fragment Viability** This project developed a mechanistic understanding of the life history of a highly invasive aquatic plant, *Egeria densa* (Brazilian elodea); and improved management and restoration efforts in the Delta.	12/31/2006	$327,937	Complete.
ERP-02-P31	**Delta Smelt Culture and Research Program** The program created a reliable supply of live delta smelt at all stages to meet the needs of the research community.	10/31/2005	$400,000	Complete.
ERP-02-P37	**Reducing the Introduction and Damage of Aquatic Non-indigenous Species through Outreach and Education: Phase II** The project used workshops, industry magazine ads and articles, best management practices manuals, and enhancement of an existing website to educate industries, such as landscapers or hobby aquarium suppliers, that sell or distribute non-native species about the costs and consequences of unwanted introductions.	2/28/2006	$156,951	Complete. Information was distributed in several languages and an active project website provides the information to the public.
ERP-02-P45	**Geomorphic and Geological Mapping for Restoration Planning, Sacramento – San Joaquin Delta Region** This project mapped geomorphic landforms and geologic deposits along the lower Sacramento, San Joaquin and Cosumnes Rivers for input into ecosystem restoration planning and levee engineering. Detailed mapping (1:24,000) was completed for portions of nine 7.5 minutes quadrangles.	6/1/2005	$120,000	Complete. GIS database and metadata were made available for use by researchers and made available online for downloading.
ERP-04-S15	**Monitoring Response of the Delta Smelt Population to Multiple Restoration Actions in the San Francisco Estuary** This project will implement a state-of-the-art monitoring program to link key vital parameters for individual delta smelt with survival to adulthood at the population level. The plan is to measure five vital parameters for fish collected by the IEP, including growth and body condition, exposure to toxic chemicals, survival to the adult stage, spawning success, and feeding and food selectivity.	6/30/2009	$1,499,181	Ongoing. First invoice is in dispute. Deliverables are one year late.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-96-M03	**Riparian Habitat Restoration Verona-Collinsville (Phase I – Feasibility)** This project provided funding to conduct a feasibility study to identify and design plans for potential sites to be revegetated to increase the amount of shaded riverine aquatic habitat along the lower Sacramento River. An important goal of this project was the evaluation of the impact that riparian habitat restoration has on both the Sacramento Flood Control System and the non-project levees in the Delta and adjoining areas.	9/14/1999	$500,000	Complete. A demonstration project to evaluate the feasibility of levee revegetation was 90% completed before running out of funds.
ERP-96-M10	**Applied Research to Predict Evolution of Restored Diked Wetlands** This project analyzed historically-breached dike wetlands in Delta as a means to predict the feasibility, patterns and rates of restoration to natural function that would be expected from breached-dike restoration strategies.	12/31/1999	$475,000	Complete.
ERP-96-M16	**Sacramento River and Major Tributaries Corridor Mapping Project** The California State University, Chico Geographic Information Center created a GIS package detailing riparian corridors along the Sacramento River and its major tributaries in portions of Glenn, Sutter, Colusa, Yuba, Yolo and Sacramento counties.	12/31/1999	$145,200	Complete.
ERP-97-N12	**Franks Tract State Recreational Area Wetlands Habitat Restoration** This project restored the deeply flooded habitat to tidal perennial aquatic, shaded riverine aquatic, and mid channel island shoal and shoal habitats in Franks Tract State Recreation Area.	12/31/2002	$293,052	Complete.
ERP-98-B38	**Water Hyacinth Education Program** The project involved the distribution of educational materials to Delta residents, which encouraged waterway users to help achieve long-term control of hyacinth in the Delta region.	12/31/2001	$9,598	Complete.
ERP-98-C01	**Demonstration of Techniques for Reversing the Effects of Subsidence in the Sacramento – San Joaquin Delta: Phase I – Twitchell Island** Evaluated techniques to reverse the subsidence of Delta Islands.	12/31/2006	$3,886,995	Ongoing. Scope of Work change was not approved; invoices are in dispute.
ERP-98-C02	**Culture of Delta Smelt, *Hypomesus transpacificus*, at Delta Site, in Support of Environmental Studies and Restoration** This project developed culture methods to supply all life-stages of delta smelt for research studies.	10/1/1999	$194,870	Complete.
ERP-98-C11	**Adult Fall-Run Chinook Salmon Movement in the Lower San Joaquin River and South Delta** This project was to evaluate adult Chinook salmon migration and delays through the lower San Joaquin River and South Delta to determine the effects of the South Delta Temporary Barriers, Head of Old River Barrier and/or low DO conditions.	5/31/2001	$285,000	Complete. Project focused on the Stockton Deep Water Ship Channel, not the barriers.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-F09	**Rhode Island Floodplain Management and Habitat Restoration – Phase I** This project evaluated floodplain and shaded riverine aquatic habitat within/adjacent to Rhode Island in the central / western Delta for the purpose of restoring and improve floodplain functions and shallow water and riparian habitat.	6/30/2000	$25,000	Complete.
ERP-99-B13	**Understanding Tidal Marsh Restoration Processes and Patterns: Validating and Extending the "BREACH" Conceptual Model** The inter-disciplinary team involved in this project addressed considerable uncertainty in predicting the outcome and ecological benefit of restoring shallow-water tidal habitat in three different regions of the Bay Delta: the Delta, Suisun Bay, and San Pablo/North Bay.	6/30/2004	$1,093,292	Complete. Final Synthesis Report completed.
Sacramento–San Joaquin Delta Ecological Management Zone–wide Projects Cycling and Transport of Nutrients, Detritus and Organisms				
ERP-01-C07	**Transport, Transformation & Effects of Selenium and Carbon in the Delta: Implications for Ecosystem Restoration.** This project evaluated the transformation of selenium and carbon in the Delta and determined how transport and transformation of selenium affected critical food webs in the Delta. Phase I of this project is ERP-97-B06.	6/14/2005	$2,862,707	Complete.
ERP-02-P33	**Primary Production in the Delta: Monitoring Design, Data Analysis and Forecasting** This project studied the mechanisms governing phytoplankton primary production and biomass in the Delta.	3/31/2007	$315,811	Complete.
ERP-02-P40	**Trophic Transfer in the San Francisco Bay / Delta: Identifying critical processes for the Ecosystem Restoration Program** This research project focused on factors affecting production of methyl mercury and its bioaccumulation in the food web, and focused on two contrasting Delta sites – Franks Tract and the Cosumnes River.	6/30/2007	$2,264,824	Complete.
ERP-97-B06	**Assessment of the Sacramento – San Joaquin River Delta as Habitat for Production of the Food Resources that Support Fish Recruitment** Evaluated habitat influences on the production and utilization of organic matter as food source in the Delta and improve modeling capabilities. Obtained or measured food quality and quantity from various locations and habitat types.	9/30/2001	$923,429	Complete. Eight presentations made at the annual meeting of the Estuarine Federation Conference in 2001.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-B17	**Dissolved Organic Carbon Release from Delta Wetlands, Part I** This project evaluated the concentration, quantity, and microbial alteration of organic carbon from different carbon sources to the Delta and effects on drinking water quality and the food web.	12/31/2006	$1,582,669	Ongoing.
ERP-99-B18	**An Evaluation of the Potential Impact of the Chinese Mitten Crab on the Benthic Communities in the Sacramento – San Joaquin Delta and Suisun Bay** The purpose of this project provided information regarding the relationship between the Chinese mitten crab (*Eriocheir sinensis*) and the benthic invertebrate community with the Sacramento – San Joaquin Delta and Suisun Bay.	3/31/2003	$178,764	Complete.
ERP-99-N09	**Effects of Introduced Species of Zooplankton and Clams on the Bay- Delta Food Web** This research project studied the effects of introduced species on the food web of the San Francisco Bay – Delta, with particular emphasis placed on fish species of concern; delta smelt, longfin smelt, and striped bass. Research emphasis was on the clam, *Potamocorbula amurensis*, and several introduced species of zooplankton, in altering the food web of the three selected fish species.	3/31/2004	$653,384	Complete.
Sacramento–San Joaquin Delta EMZ–wide Water Quality Projects				
ERP-00-G01	**Dissolved Organic Carbon Release From Delta Wetlands, Part I (Compositional Characteristics); Part II (Fluxes and Loads from Tidal and Non-tidal Wetlands and from Agricultural Operations)** This project focused on the amounts (loads) of Dissolved Organic Carbon and disinfection by-products contributed to tidal and non-tidal wetlands and agricultural operations.	12/31/2006	$3,571,121	Ongoing. Several journal articles published from the information collected for this project.
ERP-02-P35	**Selenium Effects on Health and Reproduction of White Sturgeon, *Acipenser transmontanus*, in the Sacramento – San Joaquin Estuary** This project researched the key areas of scientific uncertainty about the toxic effects of selenium accumulation in white sturgeon, a valuable species in the Bay – Delta ecosystem.	11/30/2004	$150,047	Complete.
ERP-02-P42	**Pyrethroid Insecticides: Analysis, Occurrence, and Fate in the Sacramento and San Joaquin Rivers and Delta** The project developed multi-residue methods for analysis of pyrethroid insecticides in water, sediments and biota.	1/4/2008	$800,000	Ongoing.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-B02	**Sedimentation Movement and Availability and Monitoring in the Delta** This project described the movement and availability of sediment in the Delta, as needed for habitat restoration.	6/30/2001	$1,047,010	Complete.
ERP-97-C06	**Role of Contaminants in the Decline of Delta Smelt in the Sacramento – San Joaquin Estuary** This project evaluated the potential impact of contaminants on Delta Smelt and their potential role in its decline.	6/30/2001	$437,326	Complete.
ERP-98-C09a	**Delta Dredging Reuse Strategy** This project developed a Delta Dredge Reuse Strategy that analyzed the regulatory and technical considerations of contaminants in dredging and dredge material reuse.	6/30/2002	$24,000	Complete.
ERP-98-C09b	**Delta Dredging Reuse Strategy** This project developed a Delta Dredge Reuse Strategy that analyzed the regulatory and technical considerations of contaminants in dredging and dredge material reuse.	6/30/2002	$276,000	Complete.
ERP-98-C09c	**Delta Dredging Reuse Strategy** This project developed a Delta Dredge Reuse Strategy that analyzed the regulatory and technical considerations of contaminants in dredging and dredge material reuse.	6/30/2002	$200,000	Complete.
ERP-99-N08	**Assessment of Pesticide Effects on Fish and their Food Resources in the Sacramento – San Joaquin Delta** This project developed data to apply toxicity values to resident species in the Sacramento – San Joaquin Delta and identified trends in water quality contaminants.	12/29/2003	$1,706,670	Complete.
North Delta Ecological Management Unit				
ERP-00-F06	**Liberty Island Acquisition** This project acquired fee title interest in the remaining two privately-owned properties on Liberty Island, estimated at 449 acres; and to conduct restoration of tidal shallow water habitat, tidal emergent wetlands, and seasonal wetlands for aquatic and terrestrial species.	9/30/2007	$2,625,153	Ongoing. Land acquisition completed.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-01-N40	**Discover the Flyway II** The Discover the Flyway program took an ecosystem approach to educating teachers, students, and the general public about wetland ecosystems and habitats primarily in the Yolo Basin Ecological Management Zone.	8/1/2005	$197,391	Complete. Grade 3-6 curriculum created: Living with Water, the Story of Yolo Basin and its People.
ERP-02-C04-D	**Two-dimensional Detailed Hydraulic Model for Determining Flood Conveyance Impacts of Ecosystem Restoration Projects in the Yolo Bypass** The objective of this project was the topographic update and improvement of the exisiting Yolo Bypass RMA-2 2-D hydraulic model. The model's geometry was updated and refined, calibrated, validated, and tested.	6/1/2006	$500,257	Complete.
ERP-02D-P54	**Restoring Ecosystem Integrity in the Northwest Delta: Phase II** This project is to acquire conservation easements within the Cache Slough complex, along the Barker, Lindsey and Calhoun Sloughs, North Delta tidal channels located west of the Yolo Bypass.	8/31/2008	$1,781,658	Ongoing. The acquisition is underway. Two tasks are complete.
ERP-02-P12	**Sustainable Restoration Technologies for Bay/Delta Tidal marsh and Riparian Habitat** This project protected natural embankment and reconstruction through passive recruitment of new sediment to create new riparian and shaded riverine aquatic habitat in aquatic channels.	12/30/2006	$1,800,000	Complete.
ERP-02-P21	**Restoring Ecosystem Integrity in the Northwest Delta: Phase II** The project's goal is to manage and restore up to 1300 acres of perennial grassland/vernal pool complex in Solano County, CA, it also developed a management plan for the Pembco property or other acquisition within the Jepson Prairie – Prospect Island Corridor.	8/31/2008	$246,370	Ongoing. All tasks are near completion.
ERP-96-M26	**Prospect island Monitoring Plan Project** This project prepared a monitoring plan to evaluate the biological, chemical and physical effects of the Prospect island Restoration Project will be developed under this contract. The monitoring plan included evaluations of the extent of benefits of conversion of agricultural land to shallow water tidal habitat to aquatic, terrestrial and avian species.	6/30/1998	$35,000	Complete.
ERP-96-M27	**Inventory of Rearing Habitat for Juvenile Salmon in the North Delta Project** This project inventoried rearing habitat for juvenile Chinook salmon and other native fishes in the northern Sacramento – San Joaquin Delta.	9/30/1998	$24,500	Complete.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-B03	**Liberty Island Acquisition** This project was to protect and restore tidally influenced wetlands, riparian corridors, and upland habitats on Liberty island in the Yolo Bypass.	9/30/2003	$8,926,000	Complete. Land acquisition completed.
ERP-97-M06	**Hastings Tract Fish Screen (Phase I: Feasibility Study)** This project evaluated diversion and screening alternatives to reduce the entrainment of smelt in the Cache and Lindsey Slough area in the NW Delta.	9/30/2001	$27,000	Complete. Final Environmental document submitted.
ERP-97-N10	**Restoring Ecosystem Integrity in the Northwest Delta – Jepson Prairie Restoration and Habitat Conservation Plan.** This project restored habitat along two northwest Delta sloughs and adjacent perennial grasslands at Jepson Prairie.	9/30/2002	$292,801	Complete. Final Reports included Restoration Plans and Monitoring Plans.
ERP-98-A01	**Prospect Island Habitat Protection Project** This project provided for levee repair and island pump out.	6/30/2000	$2,000,000	Complete. Levees repaired and island pumped out.
ERP-98-B08	**Cache Slough Shaded Aquatic Habitat Enhancement Project** This project provided for the planning phase to restore approximately 2,000 linear feet of levee bank to shaded riverine aquatic habitat.	12/31/2001	$85,000	Complete. Final Engineering and Environmental Reports Submitted.
ERP-98-B27	**Hastings Tract Fish Screen (Phase II: Construction)** Project planned and designed fish screens on Hastings Tract gravity intake pipes and relocated the pipes from Cache Slough to Lindsey Slough.	4/1/2004	$38,474	Not implemented. Funds were used for design, biological consultation and permits only. Construction was not completed.
ERP-98-B34	**Discover the Flyway** This project increased student awareness of wetlands and wildlife issues in the Yolo Basin.	12/31/2001	$49,000	Complete. Teachers curriculum created, titled “Reading, Writing, Wildlife and Wetlands: Teachers Workbook.”
ERP-98-E11	**Watershed Restoration Strategy for the Yolo Bypass** This project provided for a facilitated broad based local stakeholder group in development of watershed plan.	3/31/2002	$287,353	Complete.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-E16	**Lower Putah Creek Watershed Stewardship Program** This project developed a community based watershed stewardship program from the lower Putah Creek through a collaborative process involving stakeholders, landowners, state and federal resources agencies, and local groups.	3/31/2002	$100,500	Complete.
ERP-98-F12	**Stone Lakes NWR Land Acquisition** The project acquired fee title to approximately 555 acres of land within the boundary of the Stone Lakes National Wildlife Refuge to protect existing aquatic, perennial and seasonal emergent wetland, riparian and grassland habitats.	9/30/2003	$2,626,505	Complete. Land acquisition completed.
East Delta Ecological Management Unit				
ERP-00-F07	**McCormack-Williamson Tract Restoration Planning, Design and Monitoring Program II** This project performed baseline studies necessary for project planning and design, and develop a long-term monitoring program for the 1,600 acre McCormack-Williamson Tract Delta Island.	12/31/2007	$355,000	Incomplete. Several planning documents were not submitted.
ERP-00-F08	**McCormack-Williamson Tract Restoration Planning, Design and Monitoring Program I** This project performed baseline studies necessary for project design, and the development of long-term monitoring program for the 1,600 acre McCormack-Williamson Tract Delta Island.	8/1/2003	$556,200	Incomplete. Several planning documents were not submitted.
ERP-01-N23	**Staten Island Acquisition** This project facilitated the acquisition and restoration of the 9,106 acre Staten Island located in the Sacramento – San Joaquin Delta to protect critical agricultural wetlands used by waterfowl and sandhill cranes. Phase II of this project ERP-02-P08.	1/31/2006	$35,110,873	Complete. Several individual reports submitted but no final report was submitted.
ERP-02-P08	**Staten Island Wildlife-Friendly Farming Demonstration** The goal of the project is to improve wildlife-friendly agriculture to foster recovery of at-risk species and to investigate effects of agriculture on water quality.	6/30/2007	$1,757,459	Ongoing. Final Monitoring and Water Quality Reports have been completed. Draft Final Report will have adjusted due date.
ERP-02-P25	**McCormack-Williamson Tract Restoration: Wildlife-Friendly Levee Management** This project re-sloped 20,000 linear feet of the back slope of the levees on the McCormack-Williamson Tract (MWT) to a 5:1 slope using on-site fill to increase the strength and stability of the MWT levee system while increasing riparian habitat.	12/31/2008	$2,476,835	Ongoing. Project is 50% complete.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-N13	**Tyler Island Levee Protection and Habitat Restoration Pilot Project** This project evaluated alternative vegetative and biotechnical techniques for restoring and stabilizing levee and bank erosion and riparian and shallow water habitat.	5/31/2002	$885,202	Complete.
ERP-98-C17	**Assist in Developing Appraisal & Planning with The Nature Conservancy for the McCormack-Williamson Property** The California Department of Water Resources provided services and support for the acquisition and initial site planning for the McCormack-Williamson Tract, including an appraisal, a legal transaction review, and initial planning activities.	11/30/2001	$24,000	Complete.
ERP-99-F03	**Part B: The McCormack-Williamson Tract's Wildlife-Friendly Levee Management Project** The Nature Conservancy initiated startup stewardship, coordinated with agencies for restoration planning, and implemented a wildlife-friendly levee program.	12/31/2004	$860,778	Complete.
ERP-99-F04	**Part A: McCormack-Williamson Tract Acquisition** This project resulted in the acquisition of the McCormack-Williamson Tract.	12/31/2004	$5,356,000	Complete. Land acquisition complete.
ERP-99-N03	**East Delta Habitat Corridor, Tidal Marsh and Riparian Habitat Restoration** This tidal marsh and riparian restoration project improved habitat conditions along 14 miles of Georgiana Slough.	9/30/2003	$1,100,000	Complete.
South Delta Ecological Management Unit				
ERP-02D-C11	**Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River** This project is restoring riparian habitats along the lower Stanislaus and San Joaquin Rivers adjacent to the Caswell State Park and the San Joaquin River National Wildlife Refuge.	11/30/2008	$5,465,944	Ongoing.
ERP-02-P28	**Stanislaus – Lower San Joaquin River Water Temperature Modeling and Analysis** This project performed modeling and analysis of various alternative for water management in the Stanislaus River basin to: 1) Determine the relationship between water operations and river temperatures through Mossdale; 2) Refine and validate current water temperature criteria for Central Valley fall-run salmon and steelhead; and 3) simulate water operational strategies to assess cost versus benefit ratios of various water operational alternatives.	10/31/2006	$878,827	Complete.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-M07	**Banta-Carbona Irrigation District (BCID) Fish Screen Project** This project completed the design and construction of an improved fish screen at the BCID's water diversion facility on the San Joaquin River, in order to reduce associated mortality of out-migrating salmon. Passage effectiveness monitored by CDFG.	12/31/03	$1,168,875	Complete. Fish screen completed and fully operational.
Central and West Delta Ecological Management Unit				
ERP-01-C05	**Feasibility Study of the Ecosystem and Water Quality Benefits Associated with Restoration of Franks Tract, Big Break, and Lower Sherman Lake** This feasibility study evaluated the potential to create ecosystem, water quality/supply, recreational, and other benefits at Lower Sherman Lake, Big Break and Franks Tract, by modifying remnant levees to inhibit salt trapping and restoring tidal marsh habitat.	6/30/2005	$1,218,105	Complete. Pilot projects being explored from recommendations in the Final Report.
ERP-01-N13	**Phase II: Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands (Construction & Monitoring)** This pilot project demonstrated that biotechnical methods can be used in lieu of riprap or other hard surfaces to protect valuable tidal wetlands associated with in-channel islands in the Delta.	9/30/2006	$1,145,400	Complete.
ERP-01-N29	**Kirker Creek Watershed CRMP Program** The goal of the Kirker Creek Watershed Coordinated Resource Management & Planning (CRMP) Program is to facilitate, coordinate, and support the efforts of landowners, municipalities, community organizations, industry, and citizens of the Kirker Creek Watershed and developed a watershed management plan using the CRMP process.	7/16/2004	$220,402	Complete. Kirker Creek Watershed Management Plan completed and distributed to stakeholders within the watershed.
ERP-02-C07-D	**Dutch Slough Tidal Marsh Restoration Project – Phase I** This project acquired three contiguous parcels totaling 1,166 acres that comprise the Dutch Slough site.	12/31/2006	$23,550,000	Complete. Land acquisition complete.
ERP-02-P03-D	**Dutch Slough Tidal Marsh Restoration Project** The purpose of this project is to develop a restoration plan for 1,166 acre site adjacent to Dutch Slough and the mouth of Marsh Creek in the western Delta.	11/2/2008	$1,500,000	Ongoing. All tasks are near completion.
ERP-97-N11	**Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands** This project demonstrated effective biotechnical methods to reduce erosion of in-channel islands and adjacent delta island banks.	5/29/2000	$270,270	Complete. Future projects were identified to implement.

Table 2. Sacramento–San Joaquin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-F09	**Rhode Island Floodplain Management and Habitat Restoration – Phase I** This project evaluated floodplain and shaded riverine aquatic habitat within/adjacent to Rhode Island in the central/west Delta for the purpose of restoring and improve floodplain functions and shallow water and riparian habitat.	6/30/2000	$25,000	Complete. Feasibility study completed.
ERP-98-F16	**Fern-Headreach Tidal Perennial Aquatic and Shaded River Aquatic Conservation Project** Acquired permanent conservation easement for Fern-Headreach Island Complex on 168 acres along the main channel of the San Joaquin River in the Delta.	6/30/2000	$425,000	Complete. Land acquisition completed.

Other programs contributing to ERP Visions

The ERP works with the following, and many other, state, federal and non-profit entities in achieving its restoration vision for the Delta:

- Central Valley Regional Water Quality Control Boards
- California State Water Resources Control Board
- The California State Coastal Conservancy
- The California Department of Fish and Game
- The Bay Development and Conservation Commission
- The University of California
- The Center for Collaborative Policy
- The Public Policy Institute of California
- The Delta protection Commission
- The California Department of Water Resources
- University of California Cooperative Extension
- AmeriCorps
- National Association of Conservation Districts
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service
- The Wildlife Conservation Board
- Natural Resources Conservation Service
- United States Army Corps of Engineers
- United States Department of Agriculture
- United States Environmental Protection Agency
- United States Fish & Wildlife Service
- The Nature Conservancy
- Ducks Unlimited

- California Fish and Wildlife

Status of Area/Topic Today

North Delta Ecological Management Unit

Meeting restoration, acquisition and preservation goals has proceeded more rapidly in the North Delta than in the other EMUs. Encouraged by the salmon smolt survival study and other wildlife monitoring results, restoration investments in the Yolo Basin have been a key focus of Stage 1 activities in the Sacramento-San Joaquin Delta. The intensive activity in the North Delta and the Yolo Bypass reflects the ERP commitment to base its restoration actions on conclusive science.

Stakeholder concerns related to mercury, invasive species, flood protection, seepage, and uncertainties over the scale of structural changes and restoration trajectories are indicated in August 2001 "Yolo Bypass Management Strategy Report". A sense of apprehension is evident in stakeholder comments about the impacts of ERP activity in the Bypass. Among the many recommendations offered in the report is the suggestion that the Yolo Bypass Working group "provide a forum for the coordination of pilot habitat enhancement sites that could be used to assess [outcomes]".

A planning grant to assist Reclamation District 2060 with the bank repair and riparian restoration was completed. However, it is not known whether the project has been implemented. It may be that the District is unable to fund such a project with its assessments or that the area is passively restoring to riparian canopy.

East Delta Ecological Management Unit

The Staten Island Wildlife-Friendly Farming Demonstration project stated that there is a need for further study of the effects of winter flooding on the quality and quantity of organic carbon and nutrients discharged from Staten Island into the Delta waterway. This project did establish that the water quality was influenced by river water during the irrigation season and by groundwater during the winter and pre-irrigation seasons. These source waters have different characteristics and therefore need further investigation.

Detailed baseline and implementation monitoring data exists for the Brush Box and other soft armoring implemented along Georgianna Slough and Tyler Island. Given that; it may be valuable to continue monitoring these sites, or a sampling of them, for some time to determine the long-term sustainability of the restoration measures. It is worth noting that ERP chose to fund these resourceful and low cost biotechnical solutions instead of the type of engineering-intensive, fill-based solutions developed in

other ERP studies for channel island and submerged island restoration, such as for Franks Tract.

Activity on the McCormack Williamson projects has been delayed by recent developments. The Draft Conveyance Program Plan Year 7 states:

> "No funding is currently available for completion of the EIR beyond completion of Public Draft environmental document. No implementation funding for design and construction has been secured. No long-term landowner for Staten or McCormack-Williamson Tract has been identified. No federal lead agency has been identified. The lack of inclusion of North Delta Flood Control and Ecosystem Restoration Project in the CBDA 10-yr action plan has been perceived by many as general loss of CALFED support."

For the *McCormack-Williamson Tract Restoration Planning, Design and Monitoring Program II* (**ERP-00-F07**) it has been noted, "the final deliverables will not be completed nor will progress beyond the public draft for the North Delta Flood Control and Ecosystem Restoration Project." The extent to which these issues will affect the other ERP project in the area should be determined.

An isolated water transfer facility, if constructed, would likely pass through this zone. The immediate impacts of such a route would no doubt be mitigated but the hydrodynamics and fluviogeomorphic alterations due to the facility could interfere with crucial ecosystem functions and processes. Revisiting the targets is one way to deal with these potential changes. Because ERP and DFG have a voice at the table for discussions regarding the isolated facility option, their representatives can ensure that any impacts the facility has on ecosystem restoration are mitigated or avoided. Aside from addressing the potential impacts, a planning response from ERP may be in order.

South Delta Ecological Management Unit

A majority of the projects implemented in the South Delta EMU were focused on the dissolved oxygen issue in the San Joaquin River Deep Water Ship Channel.

Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River (**ERP-02D-C11**), an ongoing implementation project in the South Delta, is focused on the habitat restoration target goal for riparian and riverine habitat. This project is a start, restoring 50 acres of the 377-695 acre target goals for this unit. Further restoration projects targeting riparian and riverine habitats will greatly benefit many at-risk species that are the focus of the ERP.

The water diversion stressor target for the South Delta EMU has specific programmatic actions for the replacement or upgrade of the Central Valley Project and State Water

Project intakes with positive-barrier, fish bypass screens and state of the art fish holding and transportation systems. There is also a programmatic action for the upgrade for fish screen upgrades to the Pacific Gas and Electric Company's Contra Costa power plant. Projects involving these specific water diversions could benefit the juvenile fish of species of special concern within this unit.

Central and West Delta Ecological Management Unit

The islands protected by conservation easement under the *Fern-Headreach Tidal Perennial Aquatic and Shaded River Aquatic Conservation Project* (**ERP-98-F16**) are not scheduled for any further restoration activity and remain in private ownership. Such acquisitions may be important to preserve land from development. It should be noted that the contamination assessment report for the acquisition observed that the entire island was ringed on its levees by stands of Himalayan blackberry and Arundo.

The Rhode Island feasibility study, *Rhode Island Floodplain Management and Habitat Restoration – Phase I* (**ERP-98-F09**), noted that the island and environs are used by splittail, salmon and delta smelt. Swainson's hawks have been sighted on the island and at least three native plants occur there. Although Rhode Island is protected from development; environmental processes and invasive species may pose a threat to threatened species that have found refuge on the island. The recommendations of the feasibility study were to reinforce levees to encourage accretion and protect existing upland refugia.

Due to subsidence and flooded island issues, restoration activities to date in the Central and West Delta have lagged the other EMUs. Future activities and planning, perhaps more than in other units, depend on completion and interpretation of the numerous studies discussed in the Delta Region Studies chapter. The complex and dynamic nature of the tidally-influenced and heavily-used Bay-Delta system resists facile characterization, isolation of variables, and the resulting statistical confidence in study results and models.

Delta-wide Studies

Projects conducted during Stage 1 to rear Delta smelt for research needs, combined with ERP-funded POD studies, have expanded the knowledge base about stressors that are impacting Delta smelt survival and recruitment in the Delta.

The cost to restore flooded and subsided Delta islands varies widely with the approach taken. Some of the planned restorations encompass a wide range of current conditions and future trajectories. None of the study results or interpretive reports from the body of work funded by ERP during Stage 1 challenged the concept that the least subsided, least costly and least risky (in terms of threats to infrastructure and property) restoration projects will be the easiest to implement. Other considerations, such as the

impacts of a proposed isolated facility will have to be addressed in future planning, resource management and funding efforts.

Based on limited data from the *Juvenile Salmon Migratory Behavior Study in North and Central Delta using Radio Telemetry* (**ERP-01-N48**) salmon migration study, it may be that a combination of a neap tide, reduced exports, and increased San Joaquin River flows are beneficial for outmigrating smolts; but more research is needed to confirm this. Of particular interest is using recently-developed equipment and analytical techniques to evaluate how fish are diverted at key Delta channels and flow splits by measuring fish movements and flow structure concurrently (Vogel 2004).

The third phase of the projects to monitor the "Breach" restoration trajectory is under development at the time of this writing. The focus of this phase is Liberty Island where a natural flood ten years ago has resulted in an unexpected explosion in tidal wetland habitat. The natural breach has presented an excellent opportunity to monitor landscape evolution from known initial conditions that were essentially a blank slate.

One result of the long working relationship ERP has had with the Breach project is development of a new and promising spatial modeling tool that incorporates a shallow-water hydrodynamic module, a soil-building component to account for elevation changes, and a vegetation module that computes above and below biomass. The tool is expected to expand the range and scope of predictive modeling and enable restoration managers and practitioners to run different restoration scenarios on a diverse array of site-specific boundary conditions in the Bay-Delta.

The Delta Dredging and Reuse Strategy begins with the statement:

> "Dredging has been key in making the Delta what it is today. Dredging is necessary to maintain channel capacity for flood flows and provide materials for the maintenance of over a thousand miles of Delta levees which are essential for protecting residents and land uses from catastrophic flooding and protecting the drinking water of millions of people from saltwater intrusion."

The Public Policy Institute of California made a convincing argument in its publication, "Envisioning Futures for the Sacramento-San Joaquin Delta (Lund et al. 2007), that the Delta today is a disaster waiting to happen – and that levees and dredging are a major part of the problem.

Agencies with jurisdiction over beneficial reuse of dredge spoils appear to have taken heed of some of the dredge reuse strategy recommendations. Reuse in restoration has begun in the ERP-funded Bel Marin Keys project; is scheduled in the Montezuma Wetlands Project; and is proposed to resume in other Suisun Marsh channels.

Monitoring these activities for wildlife and water quality impacts may provide a proving ground for the strategy recommendations.

Most of the ERP-funded designs that rely on importation of large quantities of dredge materials for subsidence reversal or restoration of flooded islands have not moved to planning or implementation phases.

Several of the studies funded by ERP have suggested benefits from saline tidal flows in controlling invasive species. Allowing salinity fluctuations to mimic or return to their natural range should be examined in the context of benefits to native species and control of invasive species.

The final report for *Distribution and Ecology of Lepidium latifolium in Bay – Delta Wetlands* (**ERP-02-P09**) states that "salinity is one variable that may be a predictive factor for *L. latifolium* distribution, however, no detailed salinity data layer currently exists for the San Francisco Bay Delta. Soil type is another variable that should be included in future modeling attempts." Additional studies on salinity effects will help to determine whether tidal restoration and management strategies that mimic natural salinity variation are potential tools in fighting the *Lepidium* invasion. An eradication program that sets criteria and priorities for control by region would be a logical next step.

Planned Projects for Implementation

North Delta Ecological Management Unit

The planning grant to assist Reclamation District 2060 with the bank repair and riparian restoration along Cache slough was completed. However, it is not known whether the project has been implemented. The District may be unable to fund such a project with its assessments, or the area may be passively restoring to riparian canopy.

East Delta Ecological Management Unit

None.

South Delta Ecological Management Unit

Very little was done for any of the ecological processes deemed important for this unit. More needs to be done to meet the habitat requirements for the unit, as well. To the extent that San Joaquin river flows are related to local fish kill and upstream passage problems for salmon, a solution that integrates DO solutions with ongoing efforts to prevent dewatering of upper reaches of the river would seem advisable.

Central and West Delta Ecological Management Unit

Studies on Delta hydrodynamic and biological processes have concluded that more data is needed and investigations should continue.

The cost for restoring Rhode Island in 1999 was estimated at $613,000 for a variety of measures. The project does not appear to be a priority for DFG or ERP funding, perhaps because passive restoration is underway. It would be useful to continue to monitor the site for the establishment of invasive weeds that may overrun the site and/or expand to other sites from a foothold on Rhode Island.

Delta-wide Studies

The *Juvenile Salmon Migratory Behavior Study in North and Central Delta using Radio Telemetry* (**ERP-01-N48**) was originally going to study salmon migration in the South Delta, as well as the North and Central Delta zones. The project for the South Delta area was initially delayed by weather; and then, due to the interest of the USFWS, the proponents were asked to relocate the Old River site to the Lower San Joaquin River area. Two studies were completed for the Central Delta and one for the North Delta. Therefore, studies are still needed in the South Delta area.

The cultured delta smelt projects provide a small safeguard against the possibility of the species extinction. Funding should continue for the culture of delta smelt and to gain additional knowledge about the at-risk species.

The *Adult Fall-Run Chinook Salmon Movement in the Lower San Joaquin River and South Delta* project (**ERP-98-C11**) was conducted for one year in a better-than-average rainfall year so the conditions studied were not the normal conditions within the SDWC. Further studies need to be conducted during dry year conditions or when water exports are exceeded; when the dissolved oxygen levels are below the current dissolved oxygen standards within the SDWC. Although described as study objectives in the project proposal, the effects of the three South Delta temporary barriers and the head of Old River barrier on the adult upstream migrations were apparently not examined. More monitors need to be installed within the Delta to determine the effects of the straying/milling behaviors of the salmon. The runs on the Sacramento River far exceed those on the San Joaquin River, and San Joaquin fish could moving up later than Sacramento River fish, so collection rates of San Joaquin River fish at Prisoners Point could be highly misleading. Salmon collection may need to be spread out more evenly over the entire fall-run upstream migration time period to catch more San Joaquin River fish and provide a more accurate study sample.

Impediments to Implementation

The main impediment to completing restoration plans in the North and East Delta is the lack of a common set of goals among all the stakeholder interests in the region.

Subsidence is greatest in the Central and West Delta. Elevations below sea level put restoration and conservation investments in this area at high risk of loss during flooding due to catastrophic levee failures.

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APPENDIX A

A.2. SUISUN MARSH/NORTH SAN FRANCISCO BAY ECOLOGICAL MANAGEMENT ZONE

Introduction

Suisun Marsh/North San Francisco Bay Ecological Management Zone

The Suisun Marsh/North San Francisco Bay Ecological Management Zone (EMZ) is the westernmost zone of the Ecosystem Restoration Program (Figure 1). Its eastern boundary is the Collinsville area, and its western boundary is the northwestern end of San Pablo Bay. The northern boundary follows the ridge tops of the Coast Ranges and includes the Petaluma River, Sonoma Creek, the Napa River, Suisun Bay and marsh, and San Pablo Bay. The Suisun Marsh/North San Francisco Bay Ecological Management Zone (EMZ) is comprised of five ecological management units (EMU's) that include:

- Petaluma River EMU
- Napa River EMU
- Sonoma Creek EMU
- San Pablo Bay EMU
- Suisun Bay and Marsh EMU

Suisun Marsh and North San Francisco Bay are the portions of San Francisco Bay downstream of the Delta and upstream of Central San Francisco Bay. These areas include San Pablo and Suisun bays, the adjacent Suisun Marsh, and the Contra Costa shoreline. North Bay was once bordered on the north by extensive marshes. Baylands alteration has now reduced the marshes to northern San Pablo Bay and Suisun Bay, including Petaluma, Napa, and Suisun Marshes. Healthy marshes provide many ecological benefits including very high productivity, flood moderation, and shoreline protection. Many of the tidal emergent marshes have been reclaimed for agriculture, salt production, duck clubs, and managed freshwater marshes. These lands are protected from flooding by hundreds of miles of levees. Remnants of the tidal salt marshes remain along the margins of San Pablo and Suisun bays. The largest intact undiked wetlands remaining in Suisun Marsh are associated with Cutoff Slough and Hill Slough in north central Suisun Marsh.

Suisun Marsh and North San Francisco Bay support many species of native and non-native fish, waterfowl, shorebirds, and other wildlife. This ecological management zone also supports many native plant communities, including several significant rare and endangered plants that are dependent on wetland processes. All Central Valley anadromous fish migrate through the North Bay and depend on the North Bay and

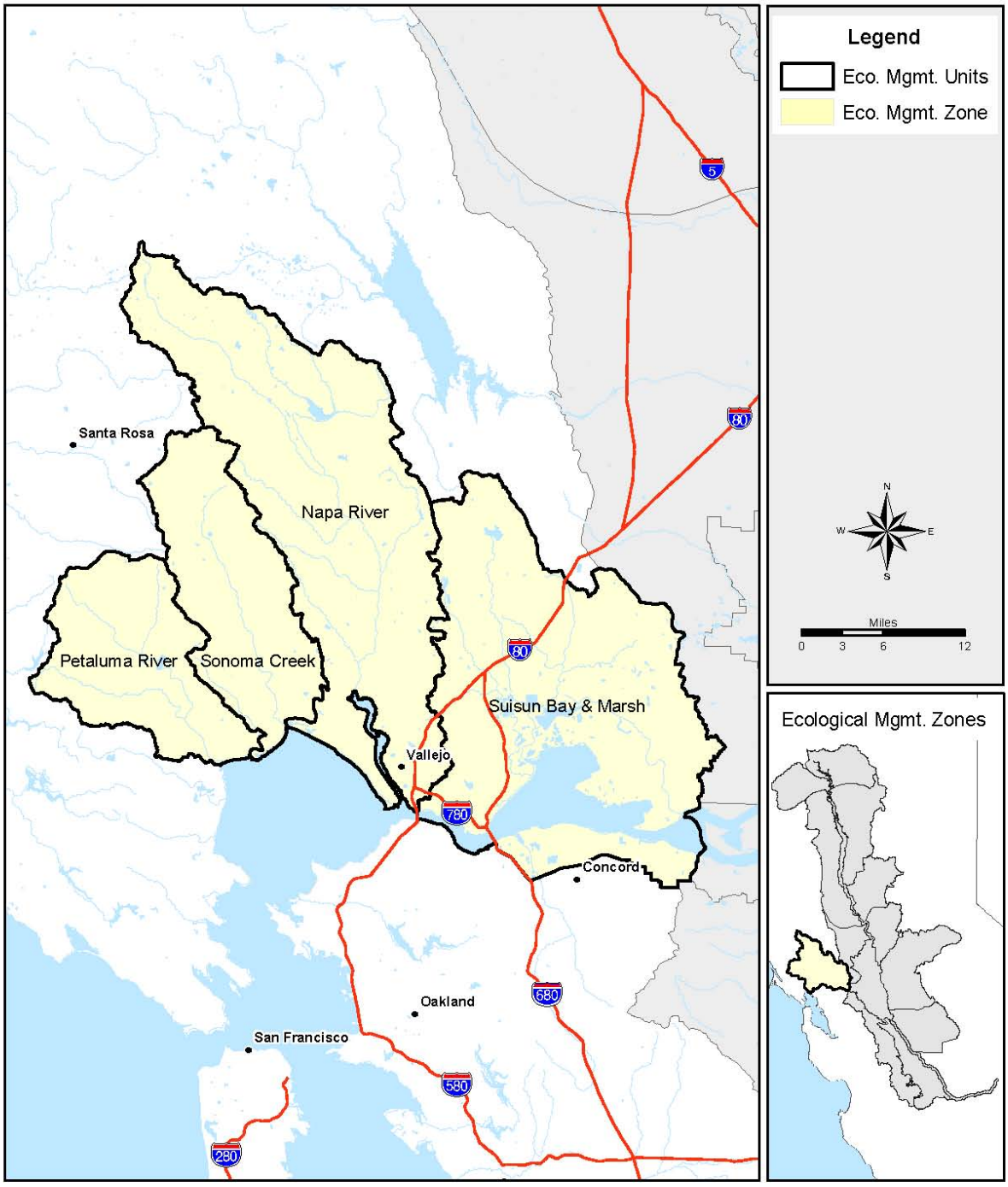

Figure 1.
Suisun Marsh & North San Francisco Bay Ecological Management Zone
California Department of Fish and Game
Ecosystem Restoration Program

CALFED BAY-DELTA PROGRAM

Figure 1. Suisun Marsh/North San Francisco Bay EMZ Map

marshes for some critical part of their life cycle. Many Pacific Flyway waterfowl and shorebirds pass through or winter in the North Bay and marshes. The North Bay and adjacent marshes are important nursery grounds for many marine, estuarine, and anadromous fish species. Four runs of Chinook salmon, as well as steelhead, green sturgeon, white sturgeon, striped bass, lamprey, and American shad migrate through the Delta on their journey between the Pacific Ocean and Central Valley spawning rivers. Young salmon may spend important weeks and months feeding in the North Bay and marshes before migrating to the ocean. Many sturgeon and striped bass spend much of their lives in the North Bay. Various marine (ocean) species depend on the North Bay as a nursery area for young, including Pacific herring, northern anchovy, and Dungeness crab. Native resident fish, including longfin smelt, delta smelt, and splittail, spend much of their lives within the North Bay and marshes.

Ecological factors having the greatest influence on fish and wildlife in the North Bay and Marsh include freshwater inflow from rivers, wetlands, riparian vegetation, and aquatic habitat diversity. Stressors include water diversions, poor water quality, legal and illegal harvest, wave and wake erosion, and introduced non-native plant and animal species. Stressors to Suisun and North Bay saline emergent plant communities, which support sensitive plant and wildlife resources, include freshwater discharges that are outside of the natural variability of seasonal runoff. For example, fresh wastewater treatment outfalls sustained outside of the normal runoff season have been proven detrimental to saline emergent wetlands. Stressors may also include water management activities that result in increased depth and duration of flooding in high marsh zone beyond the range of natural variability and seasonality.

Historically, San Francisco Bay included more than 242,000 acres of tidally influenced bayland habitats and approximately 90,000 acres of adjacent habitats (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999). Tidal marsh (190,000 acres) and tidal flats (50,000 acres) accounted for 98% of the bayland habitats. Today, only 70,000 acres remain. In the Suisun Bay and Marsh, tidal marsh and tidal flat habitats have declined from 68,000 acres to approximately 15,000 acres. Similar declines have occurred in the North Bay region, with tidal marsh and tidal flats declining from approximately 68,000 acres to 25,000 acres (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999).

Tidal saline emergent wetland habitat in the Bay has been drastically reduced as a result of land reclamation. This habitat type is essential to estuary functions and the health of many fish, waterfowl, and wildlife species. Wetlands also enhance water quality in the Bay by filtering out sediments and contaminants.

Riparian and shaded riverine aquatic (SRA) habitats have been greatly reduced as a result of development along streams in areas above the lower marshes, sloughs, and Bay shorelines. SRA habitat has value to many special-status plant and animal species. In addition, SRA habitat is important for juvenile Chinook salmon and many other

resident and anadromous fish using the Bay.

Grasslands associated with wetland margins are important habitats for some special-status plant and wildlife species. Wetlands should be restored along with the associated aquatic and upland habitats.

Open water habitats in managed wetlands, such as ponds, provide valuable waterfowl and wildlife habitats. This habitat type should be included in restoration efforts involving non-tidal saline emergent wetlands.

Sloughs are an important native habitat for fish and wildlife. Many slough complexes in the wetlands along the North Bay have disappeared as a result of land reclamation and levee construction. Restoring tidal wetland-slough complexes will provide valuable habitat for fish, including Chinook salmon, striped bass, delta smelt, and longfin smelt.

Habitat improvements will benefit the salt marsh harvest mouse, Suisun song sparrow, California clapper rail, and California black rail, as well as many native waterfowl and wildlife species living in and around the North Bay. Improving freshwater inflow and habitat will benefit delta smelt, splittail, Chinook salmon, striped bass, longfin smelt, other anadromous and resident marine and estuarine fishes, and larger marine invertebrates (e.g. shrimp, crabs, and clams) of the Bay, as well as the estuarine foodweb (e.g. algae and planktonic and bottom-dwelling animals) on which the fish depend. Separate visions have been prepared for many of these processes, stressors, habitats, and species.

Numerous regional studies and research activities sponsored by the Interagency Ecological Program (IEP) and the Pelagic Organism Decline (POD) efforts are described at the end of this chapter.

Suisun Bay and Marsh Ecological Management Unit

The boundaries of the Suisun Bay and Marsh EMU are Collinsville on the east, the Contra Costa County shoreline to the south, the Benicia Bridge to the west, and the ridge tops of the Coast Ranges to the north. The marshland and bay are in a valley, bordered on the north and south by the Coast Ranges. The predominant habitat types in this zone are tidal perennial aquatic habitat, tidal brackish emergent wetland, seasonal non-tidal wetland, and grassland. The marsh is primarily a managed wetland, with levees to control water level and scheduled seasonal flooding with fresh water.

Historically, the eastern portion of Suisun Marsh was predominantly tidal fresh and brackish water marsh. The western portion of the marsh was predominately fresh and brackish marshland with more saline marsh existing on the western edge. Within these broad marshes were sloughs, channels, ponds, and small bays. Except for parts of Suisun Bay, the segment had relatively few tidal flats. Large areas of moist grasslands

connected the baylands with upland areas (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999).

An extensive network of sloughs conveys tidal flows and some freshwater flow into the marsh. Montezuma Slough, the largest of these, is connected to Suisun Bay at its eastern and western ends. The slough is an important nursery area for many fish, including Chinook salmon, striped bass, splittail, and delta smelt. The Suisun Marsh Salinity Control Structure was constructed near the eastern slough entrance and began operation in the fall of 1988 to limit the tidal influx of saltwater from the Bay into Suisun Marsh. The salinity control structure operates from September through May by closing during flood tides and opening during ebb tides to keep salinity levels in the slough low throughout the managed wetland flooding season.

Efforts in the 1970s resulted in protecting the Suisun Marsh, the largest remaining brackish marsh in California. The marsh is an extremely important resource for migratory waterfowl, associated wildlife (including several threatened and endangered species), and many fish species. The marsh also harbors sensitive plant species and communities, including several rare species. The Suisun thistle is a Suisun endemic and is found nowhere else in the world. The Suisun Marsh Protection Plan played a key role in reducing development pressure and other adverse impacts associated with human disturbance, such as accidental fires, careless application of pesticides and herbicides, and urban runoff.

Sonoma Creek Ecological Management Unit

The Sonoma Creek EMU is located southwest of the Napa River EMU. The main habitat types in the area are tidal and seasonal marsh, tidal sloughs, and upland areas, such as vernal pools, grassland, and savanna. Historically, this area was nearly all tidal salt marsh and tidal brackish marsh. Some areas of moist grasslands existed to the north and west along upper Sonoma Creek and in the drainages surrounding Lake Tolay.

The lower portions of the unit are baylands, composed of tidal sloughs with fringing marshes, some diked managed wetlands, diked farm lands (mostly oat and hay), and surrounding uplands characterized by grasslands, vernal pools, and oak woodlands that are quickly being converted to vineyards. Tidal marshes and channels are reduced as a result of reclamation. Seasonal wetlands develop during the rainy season on reclaimed agricultural lands. Urban development along upper Sonoma Creek is associated with the city of Sonoma. Vineyards are the predominant land use in the upper watershed, particularly on the valley floor. Oak woodlands, chaparral, and mixed conifer habitats characterize the mountains of the watershed. As in the Napa River EMU, much of the vernal pool, seasonal wetland, and oak savanna habitat previously present on the valley floor has been eliminated as a result of agricultural and urban development.

San Pablo Bay Ecological Management Unit

The San Pablo Bay EMU includes San Pablo Bay and the adjacent diked and non-diked mudflat and marsh baylands. Habitat varies from deep bay marine habitat to edge mudflats and marsh/slough complexes. Bay habitat varies from nearly fresh water at its eastern end, during periods of high freshwater outflow, to nearly seawater salinity levels (32 parts per thousand) during the periods of lowest outflow at the western end of San Pablo Bay. Salinity in the bay is stratified (layered) during high outflow conditions, but is not stratified in dry periods/years. The mixing zone is upstream of San Pablo Bay in dry years.

Historically, this unit supported large tidal marshes that were bordered by extensive mudflats (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999). Although it is generally less productive than the less saline Suisun Bay to the east, San Pablo Bay is a productive estuary that has important spawning and rearing habitat for many marine, estuarine, and anadromous fish and marine estuarine invertebrates (e.g. shrimp, crabs, and clams).

Napa River Ecological Management Unit

The Napa River EMU is within the Napa River watershed and includes the river, an extensive marsh/slough complex, and the lower river estuary connecting to San Pablo Bay. Historically, this area was nearly all tidal salt marsh and tidal brackish marsh dominated by the flow patterns of the lower Napa River (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999).

In recent times, most of the baylands had been reclaimed for salt or agricultural production. Diminished networks of sloughs fringed by saline emergent marsh have persisted. The sloughs have become silted as a result of lost tidal prism. The baylands are surrounded by uplands composed primarily of grasslands that are rapidly being converted to urban and agricultural (vineyard) uses. In the north, natural upper river watershed habitats have been reduced by agricultural and urban development and flood control measures. The main stem of the Napa River has in recent times incised at a pronounced rate. Extensive reaches in the heart of the watershed are targeted for major restoration.

Vernal pools and other seasonal wetland habitats characteristic of the upper watershed have been almost entirely eliminated in the Napa River EMU. The Napa River historically consisted of a fairly broad riparian corridor dotted with an abundance of depressional wetlands. Programs to restore some of the wetland character and riparian and shaded riverine aquatic habitat will be an important component of future restoration planning, particularly in the upper Napa River area to provide habitat for fish and wildlife species. Excellent spawning and rearing habitat is available on many tributaries of the Napa River, however the intervening reaches that connect perennially

wet reaches suffer from degraded habitat. Reduced flows due to over-allocation and groundwater depletion must also be addressed in order to insure sound restoration investments.

Until recently, the tidal marshes of this area were of limited size and habitat quality due to past reclamation. Vestigial tidal marshes are typically linear with little channel development. The larger sloughs have silted up due to a reduced tidal prism.

Petaluma River Ecological Management Unit

The Petaluma River is located in southern Sonoma County and a portion of northeastern Marin County. The Watershed encompasses a 146 square mile basin, approximately 19 miles long and 13 miles wide, with the City of Petaluma near its center.

The headwaters and ephemeral tributaries of Petaluma River begin on the steep southwest slopes of Sonoma Mountain. The confluence of Willow Brook, Liberty Creek, and Weigand's Creek form the headwaters of the Petaluma Watershed just upstream of Rainsville Road and Stony Point Road. The Petaluma River itself flows across the Denman Flat area and through the City of Petaluma. Tidal influence extends upstream of the confluence with Lynch Creek (beyond the railroad crossing).

Mountainous or hilly upland areas comprise 56% of the watershed. Thirty-three percent of the watershed is valley, and the lower 11% are salt marshes. Sonoma Mountain, at 2,295 feet elevation, is the highest point in the watershed. The Petaluma River empties into the northwest portion of San Pablo Bay.

The lower 12 miles of the Petaluma River flow through the Petaluma Marsh, the largest remaining salt marsh in San Pablo Bay. The marsh covers 5,000 acres and is surrounded by approximately 7,000 acres of reclaimed wetlands. Prior to reclamation, marshland elevations ranged from mean sea level to 3 feet above mean sea level.

The Petaluma River EMU is located west of the Sonoma Creek unit on the northwest margin of San Pablo Bay. The habitat types in this watershed are marsh wetlands and uplands, such as grassland. The lower portion of the watershed is composed of tidal marshes and sloughs, and diked seasonal wetlands and historic baylands that have been reclaimed for agriculture. Historically, tidal marsh was the dominant habitat type in this ecological management unit, salt marsh existed near the mouth of the Petaluma River, and small tidal flats existed at the river mouth (San Francisco Bay Area Wetlands Ecosystem Goals Project 1999). The diked agricultural lands intermittently pond water during the rainy season, which provides habitat for shorebirds and waterfowl. Open grasslands and oak savannas characterize the surrounding uplands.

Applicable ERP Vision

Suisun Marsh/North San Francisco Bay Ecological Management Zone

The vision for the Suisun Marsh/North San Francisco Bay EMZ includes the concept of "whole marsh management", a more natural freshwater outflow pattern from the Delta in dry and normal rainfall years, restoring tidal and non-tidal wetlands, restoring tidal perennial aquatic habitat, and screening unscreened and poorly screened diversions.

The vision focuses on improving the natural freshwater inflow pattern to San Francisco Bay and restoring important, tidally-influenced aquatic and wetland habitats, and adjacent uplands. Other focal points are reducing stressors, such as non-native marine invertebrates in ship ballast water and contaminants in municipal, industrial, and agricultural discharges into the Bay, as well as reducing losses of juvenile fish and their food organisms at unscreened diversions.

Suisun Bay and Marsh Ecological Management Unit

The vision for the Suisun Bay and Marsh EMU is to restore tidal marsh and to restore and enhance managed marsh, riparian forest, grassland, and other habitats.

Efforts and opportunities to restore tidal action to select managed wetlands and promote natural riparian and wetland succession in Suisun Marsh will be expanded. Shallow-water, wetland, and riparian habitats within the marsh and along the shorelines of the Bay will be protected and improved, where possible. Upland habitats adjacent to riparian and wetland habitats will also be protected and improved. Efforts will focus on increasing the acreage open to tidal flows (e.g. by removing or opening levees) and providing connectivity among habitat areas to aid in the recovery of species, such as the salt marsh harvest mouse, clapper rail, and black rail. Those habitat areas will provide essential shelter and nesting cover during high tides. Improving marsh and slough habitats will benefit Chinook salmon, striped bass, delta smelt, splittail, and other estuarine resident fish in the marsh and Suisun Bay.

Management of non-tidal wetlands will continue, but with consideration for maintaining the natural hydrologic regime and salinity levels of the slough and marsh. Efforts to screen diversions in the marsh will also continue to minimize the entrainment of juvenile fish. Water quality standards specified in the 1995 Water Quality Control Plan are currently being re-evaluated.

Water diversions from Suisun Bay used for cooling at the Pittsburg power plant will be conducted with minimal adverse effects on eggs, larvae, and juvenile fish. New fish screening technology or alternative sources of cooling water (such as cooling towers) will be considered.

Oil refinery operations in the Bay will be modified to reduce discharges of high levels of contaminants, such as selenium.

Suisun Marsh and Bay will function as high quality spawning and rearing habitat and an effective fish migration corridor. A healthy Suisun Marsh-Bay ecosystem will be an important link in the estuary foodweb by improving primary and secondary productivity. Marsh and Bay productivity will improve, and acreage of tidal wetlands and associated tidal perennial aquatic habitat will increase.

Sonoma Creek Ecological Management Unit

The vision for the Sonoma Creek EMU is to restore large patches of tidal marsh along the entire shoreline of San Pablo Bay, restore tidal marsh along Sonoma Creek, establish managed marsh or enhanced seasonal pond habitat for shorebirds, enhance riparian habitat along Sonoma Creek, and enhance marsh/upland transitional habitats.

Existing habitat will be maintained and current and future restoration efforts will be expanded in Napa/Sonoma Marsh. The marsh has degraded. Dikes and levees have disrupted the natural sediment supply essential for maintaining-marsh habitat. Leveed, historic marshland will be opened to tidal action, creating larger, more contiguous marsh areas. An expanded marsh/slough complex will support greater salt marsh harvest mouse and clapper rail populations, as well as splittail, delta smelt, juvenile Chinook salmon, and striped bass.

San Pablo Bay Ecological Management Unit

The vision for the San Pablo Bay EMU is to restore tidal marsh along the bayshore and to establish managed marshes or enhance seasonal pond habitat on agricultural baylands not restored to tidal action.

The ecological health of San Pablo Bay and its function as an important nursery area for marine, estuarine, and anadromous fish can be improved by increasing freshwater inflow in spring during years with low and normal freshwater outflow, protecting and expanding tidal marsh/slough habitat complexes along the margins of the bay, and reducing the input of pollutants into the bay. Removing dikes and levees along the Bay's shoreline, where appropriate, will aid in the recovery and expansion of tidal emergent wetland habitat.

Included in the discussion for this unit are upland and transitional habitats that are not covered in the other EMU's within the Suisun Marsh/North San Francisco Bay EMZ. Inclusion of such adjacent uplands insures that the ERP projects funded in habitats tangent to the Bay will be addressed.

Napa River Ecological Management Unit

The vision for the Napa River EMU is to restore large areas of tidal marsh to benefit salt marsh harvest mouse and California clapper rail, manage inactive salt ponds to benefit waterfowl, restore a continuous band of tidal marsh along the bayshore to benefit fish species, improve tidal circulation, manage diked wetlands and seasonal wetlands to improve seasonal ponding for shorebirds, wading birds, and waterfowl, enhance riparian vegetation and marsh/upland transitional habitats, and provide upland buffers.

Restoration efforts will be focused in the Napa Marsh Wildlife Area, Cullinan Ranch, and Scaggs Island. Habitats should be protected and natural expansion and succession should be supported to restore large, contiguous (connected) areas of tidal saline emergent wetland, riparian, and upland habitats. Restoring tidal action to additional portions of the marsh and improving water quality will enhance the health of the marsh. This, in turn, will aid in the recovery of species, such as the salt marsh harvest mouse and clapper rail in the southern portion of the EMU. Fish species, such as Chinook salmon, striped bass, splittail, and delta smelt, will benefit from the improved health of the marsh and associated improvements in the tidal slough complex and lower river estuary.

Petaluma River Ecological Management Unit

The vision for the Petaluma River EMU is to restore a continuous band of tidal marsh along the bayshore from Tolay Creek to the Petaluma River, restore tidal marsh along the Petaluma River, establish managed marsh or enhanced seasonal pond habitat on agricultural baylands not restored to tidal habitat, protect moist grasslands, enhance riparian vegetation and marsh/upland transitional habitats, and provide upland buffers and provide natural transitional habitat between marshes and upland areas. Petaluma Marsh and its associated tidal slough network will be expanded. Outside of Petaluma Marsh, marsh habitat areas are sparse and low quality because dikes and levees have disrupted the natural tidal flow and sediment supply essential for maintaining tidal emergent wetland habitat.

Stage 1 Expectations

Stage 1 expectations were not specifically listed in the Ecosystem Restoration Plan Volume II (CALFED 2000b). However, ERP has noted expected progress during the first 7 years within the visions listed above.

Changes Attributable to ERP

Suisun Marsh/North San Francisco Bay Ecological Management Zone

The project *Understanding Tidal Marsh Restoration Processes and Patterns: Validating and Extending the "BREACH" Conceptual Model* (**ERP-99-B13**) investigated hydraulic and geomorphic processes, marsh expansion processes (including interactions between tule and submerged aquatic vegetation), and continued prior measurements of elevation change. An inventory of "restoring" marsh and natural marsh reference sites was compiled. Twelve sites, including 7-8 restoration, 2-3 reference, and 1-2 managed/seasonal/salt pond wetlands were monitored and geomorphic assessment was conducted for all sites. Terrestrial, avian, and aquatic species characteristics and response to restoration were monitored. An interpretive report on sedimentation rate and species composition changes was submitted. The regional importance of this work is the documentation of the uniquely high sediment availability in the Petaluma River. The species benefits from tidal marsh restoration are more complex, as indicated in the interpretive reporting for this project. Different avian guilds are associated with open water and fully vegetated marsh. Hence, populations will transition as the marsh matures. It was found that mature tidal marsh had the lowest diversity and abundance of water birds due to the general lack of open water habitat, and also tended to have lower diversity and abundances of land birds. However, California black rail, clapper rail, and salt marsh harvest mouse habitat is expected to expand as a direct result of ERP-funded activities. This study also observed that for restored marshes approaching eight years maturity, fish species assemblages increasingly resemble reference site assemblages. The fish species assemblage trends in mature restored marshes were towards increasing percentages of native fish species.

Portions of 200 acres of restored tidal marsh were planted with native brackish marsh vegetation in Shell Marsh along the Contra Costa shore of Southern Suisun Bay. The project *Biological Restoration and Monitoring in the Suisun Marsh/North San Francisco Bay Ecological Zone: An Ecosystem Approach to Improved Effectiveness of Bay/Delta Restoration* (**ERP-98-F22**) also monitored the restoration enhancement effects for two years after implementation. Early monitoring data documented that increases in abundance of wildlife occurred in the restored and replanted sections of the marsh. Increased productivity also provided benefits to native fish. The vegetation trajectory for the restoration differed significantly from pre-project expectations. *Typha* species populations exploded in many areas as tidal exchange decreased soil salinity. *Salicornia* coverage declined as salinities decreased and *Typha* area increased. The biological monitoring was discontinued after the end of the agreement term.

San Francisco Bay Area Wetlands Ecosystem Goals Project (**ERP-98-E03**) and *Species and Community Profiles Report of the San Francisco Bay Area Wetlands Ecosystem Goals Project* (**ERP-99-B10**) were two phases of the work that produced the San Francisco Bay Goals Project documents. These widely cited comprehensive wetland and

species account documents are used to guide planning, acquisition, and restoration in the Bay Delta.

The results of *Effects of Introduced Clams on the Food Supply of Bay-Delta Fishes* (**ERP-99-F11**) included conclusions on the effects of invasive clam proliferation. The study found that:

- The clam *Potomo corbula amurensis* continues to have a significant effect on the estuarine ecosystem, particularly on the lower trophic levels at low salinity, in Suisun Bay and the Western Delta, particularly in summer.
- Clam effects cannot be understood except in the context of variable freshwater flow.
- The effects of the clams in the lower estuary are somewhat less.
- Clam grazing has caused such a decrease in phytoplankton in the northern estuary that distributions of silica, an essential nutrient for diatom growth, have been drastically altered. In fact, it is possible to infer the loss of diatom production by the change in silica depletion in the northern estuary.

In a related project, *Effects of Introduced Species of Zooplankton and Clams on the Bay-Delta Food Web* (**ERP-99-N09**), researchers studied the effects of introduced species of zooplankton and clams in the foodweb of the Bay-Delta, with emphasis on the effects to fish species of concern.

In response to science panel review recommendations from earlier work, ERP is also funding *Monitoring Responses of the Delta Smelt Population to Multiple Restoration Actions in the San Francisco Estuary* (**ERP-04-S15**). The project methodology will combine information from the histopathology of fish tissues, gut analysis, and otolith characterization. This work has just begun but promises to shed more light on smelt natal origins related to condition, feeding success, metabolic stressors, and other fish survival factors that are not completely understood.

Substantial amounts of funding supported three projects focused on the coordination of eradication efforts, as well as follow-up monitoring, for two non-native, invasive plant species. Those projects are *Arundo Donax Eradication and Coordination* (**ERP-00-F11**), *Invasion Dynamics of Perennial Pepperweed, Lepidium latifolium, and Their Consequences for Protection of Natural and Restored Wetlands in the San Francisco Esturary* (**ERP-02D-P58**), and *Arundo Eradication and Coordination, Phase II* (**ERP-02D-P68**).

Suisun Bay and Marsh Ecological Management Unit

Sixty-seven acres of diked baylands in the northern end of Suisun Marsh were restored to tidal exchange as a result of ERP funding of the *Suisun Marsh Property Acquisition & Habitat Restoration* (**ERP-01-C04**) project. This area, known as Blacklock, is already seeing intensive use by fish. Vegetation colonization is expected on the site by pioneer-

type species as sediments slowly accrete in the subsided interior of Blacklock.

Integrated Pest Management Partnership to Improve Water Quality in Suisun Bay and Local Creeks (**ERP-98-B09**) is an outreach program that encouraged pesticide operators and nurseries to reduce their use of toxic pesticides. This project contributed to the target to reduce contaminant stressors in the Suisun Bay and Marsh EMU. Organophosphate pesticide concentrations, measured in influent to the Central Contra Costa Sanitary District treatment plant that discharges to Suisun Bay, declined coincidental to project implementation.

The ERP target to improve management of seasonal wetlands on 32,000 acres has been addressed in part by the project *Update Individual Ownership Adaptive Management Habitat Plans* (**ERP-02-P23**). This project will provide the elevation and infrastructure base maps needed to integrate improved flood and drain practices in accordance with previously developed managed wetland habitat enhancement plans. It is expected that baseline information for all of the properties in the Suisun Resource Conservation District will be documented by the end of this project.

Numerous diversions in the Marsh have been screened to prevent fish stranding on the managed wetlands during flood and drain operations. Most of these screens were funded through other programs. At least five diversions were screened using ERP funds through the project *Suisun Marsh Fish Screen Project* (**ERP-95-M07**).

Three site-specific restoration planning projects received ERP funds during Stage 1. *Hill Slough West Habitat Restoration Demonstration Project* (**ERP-01-C09**) produced a plan for what was originally planned to be restoration of a 207-acre diked wetland in the northern Suisun Marsh (just south of Highway 12 and west of Grizzly Island Road in Suisun City), on land owned and managed by the Department of Fish and Game (DFG). Subsequent developments have enlarged the scope of the project and plan to include land to the east of the road, also owned by DFG. The new plan will require raising one mile of Grizzly Island Road. The increased costs of the project will be covered, at least in part, by ERP funds. This 800-acre site will provide a buffer between the Marsh and the development occurring directly to the north.

The greatest strides in making progress towards meeting all of the Stage 1 habitat acreage targets for Suisun Marsh are expected to follow from the comprehensive planning efforts conducted under *Suisun Marsh Implementation Plan (Center for Collaborative Policy)* (**ERP-04D-S21**), *Suisun Marsh Implementation Plan* (**ERP-05D-C02**), and *Suisun Marsh Implementation Plan* (**ERP-06D-S21**). The *Suisun Marsh Implementation Plan Year 1 (CDWR)* (**ERP-05D-S01**) project has been funded as part of this planning process, but is not yet executed. The planning process is being conducted under the umbrella of a charter group that includes private property owners and habitat and water project agencies. These projects fund participation in plan scoping and the consultant-supported preparation of the programmatic environmental

and planning documents.

The charter entities recognized that early difficulties in reaching a consensus on plan elements would not be resolved without facilitation. The planning process has made significant headway since enlisting the services of a professional facilitation team under the ERP funded project *Suisun Marsh Implementation Plan (Jones & Stokes)* (**ERP-04D-S20**).

Reintroduction of Endangered Soft Bird's Beak to Restored Habitat in Suisun Marsh (**ERP-99-N05**), a study of soft birds beak (*Cordylanthus mollis* sp. *mollis*), was funded as a contribution towards CALFED objectives for improved terrestrial ecosystem quality through native species recovery and conservation. North Bay and Suisun tidal marshes supporting the remaining natural populations of soft bird's beak provided critical ecological data to facilitate rare plant restoration. Results provided evidence that our relict tidal marshes are in precipitous decline and that restoration efforts that focus on creating and expanding existing tidal wetlands may be premature, as we must first enhance and protect these remaining historic habitats. The project demographic evaluation of vulnerable life stages detected significant threats at the seedling life stage. High seedling mortality was strongly correlated with the presence of exotic winter annual plants, which are unsuitable hosts for this endangered, native, parasitic plant. Muted tidal regimes resulting from regional hydrologic alterations and local restoration projects are also influencing the mortality and decline of soft bird's beak.

Distribution and Abundance of Shrimp, Plankton and Benthos in Suisun Marsh (**ERP-02-P32**) was selected for funding in order to contribute to the Bay-Delta aquatic foodweb general targets to restore chlorophyll "a" and zooplankton species in San Pablo and Suisun bays, and in the Delta, to levels that occurred in the 1960s and early 1970's. (CALFED 2000a). The results of this project, which studied the distribution and abundance of shrimp, plankton and benthos in Suisun Marsh, as well as the results of *Shallow Open Water Habitats: Hydrodynamics and Benthic Grazing* (**ERP-02-P22**), which looks at productivity in the context of bay energetics, and *Determining the Mechanisms Relating Freshwater Flow and Abundance of Estuarine Biota (the "Fish-X2" relationships) Phase I* (**ERP-02-P19**), which studied productivity and X2 relationships**,** will be pivotal for evaluating the IEP/POD-related work funded by ERP.

Sonoma Creek Ecological Management Unit

The restoration on Tolay Creek, funded by *Tolay Creek Restoration Project* (**ERP-97-N19**), resulted in the preservation of 431 acres of tidal wetlands, 123 acres of which were newly restored. *Ecological Monitoring of Tolay & Cullinan Ranch Tidal Wetlands Restoration* (**ERP-01-N19**) conducted post-project monitoring of the restoration area.

Irrespective of the Stage 1 prioritization to restore saline emergent wetlands, five times as much funding was dedicated to the riparian and riverine aquatic topic as was

dedicated to saline emergent wetland in this Unit. At least 2,600 linear feet of a mix of riparian and riverine aquatic habitat was restored as a result of three projects, *Tolay Creek Restoration Project* (**ERP-98-E02**) and *Sonoma Creek Watershed Conservancy* (**ERP-00-E04** and **ERP-01-N27**).

The stewardship projects on Sonoma Creek also created 7 Best Management Practices (BMP) projects for landowners and initiated an invasive weed eradication program with the Sonoma Ecology Center.

San Pablo Bay Ecological Management Unit

The *Hamilton Wetlands Restoration Planning* (**ERP-98-C03**) project is the only ERP-funded project located wholly upon the San Pablo Bay. This planning project revised a prior EIR for the Hamilton Army Base Wetlands and provided funds for permitting. The project also developed planning materials to bring the adjacent Bel Marin Keyes Project under the scope of the existing USACOE Hamilton project.

Several other ERP projects produced benefits for the San Pablo Bay. Other capacity building, planning, and restoration activities are included in the write up for this management unit because the subject streams and wetlands are adjacent to or flow into the San Pablo Bay. Limiting factors analysis and planning for restoration to benefit salmonids on Corte Madera Creek and its six major tributaries was funded by *Local Watershed Stewardship: Steelhead Trout Plan, Corte Madera Creek Watershed, Marin County, California* (**ERP-98-E07**).

The non-native *Spartina* invasion in San Pablo Bay and the Bay-Delta region has been characterized, monitored, and controlled with ERP funding during Stage 1. The *Invasive Spartina Project* (**ERP-01-C01**) explored eradication efficacy of different methods and determined the size of the invasion to be 791 acres as of 2005. Phase II of the *Spartina* project, *Monitoring for Invasive Spartina Control in the San Francisco Estuary* (**ERP-04-S02**), oversaw the switch to a more effective herbicide. Monitoring of the invasion has continued to identify new infestations in previously uninfested areas, but overall the invasions appear to have been contained. Treatments appear to be effective and are repeated as necessary according to the monitoring input. Eradication work has been conducted on all known patches of invasive non-native *Spartina*.

ERP expanded stewardship in the San Pablo Bay Unit by supporting education and outreach projects in schools. The projects contributed to the active involvement of young citizens in estuary habitat conservation projects, increased their appreciation for estuary resources, and increased understanding of restoration activities.

Estuary Action Challenge Environmental Education Project (**ERP-99-B21**), *Estuary Action Challenge Environmental Education Project* (**ERP-01-N34**) and *Estuary Action Challenge Environmental Education Program* (**ERP-02-P10**) provided support to

primary and secondary schools in San Pablo and Richmond. About 240 third graders participated in pollution education and stewardship activities, and 300 tree frogs raised from tadpoles were released in riparian areas. *Estuary Action Challenge Environmental Education Program* (**ERP-02-P10**) reports that overall the Earth Island projects reached 3,000 elementary school students, 120 teachers, and over 200 parents. Accordingly, the children in the Earth Island projects conducted the only on-the-ground restoration activities that directly benefited wildlife in the San Pablo EMU. The other projects were either planning or capacity building in nature.

It is not so straightforward a task to document progress towards the target of restoring 10-15 miles of riparian and riverine aquatic habitat in San Pablo Bay. However, there are numerous urban creeks that enter San Pablo Bay such as Pinole, Wildcat, San Pablo, Corte Madera, and Novato creeks. The *Estuary Action Challenge Environmental Education Project* (**ERP-01-N34**) and the *Estuary Action Challenge Environmental Education Program* (**ERP-02-P10**) projects worked with elementary school teachers and students to explore, clean up, and restore creek and bay habitats in Richmond, San Pablo, Oakland, and Berkeley areas and therefore contributed toward reaching this target.

Napa River Ecological Management Unit

In the upper reaches of the Napa River EMU, bank stabilization, riverine aquatic, and riparian revegetation projects were implemented on two creeks that are tributary to the Napa River. These creeks provide spawning and rearing habitat for Chinook salmon and steelhead. The *Napa River Watershed Stewardship* (**ERP-98-E01**) project, managed by the Napa County Resource Conservation District (NCRCD), completed several demonstration restoration projects that were not extensive. Rock weirs and pool creation were the focus of one project, while bank resloping, revegetation, and removal of eucalyptus were the focus of the other ERP-funded riparian project. A second phase of this stewardship project, *Napa River Watershed Stewardship Year 2* (**ERP-99-N20**), focused on planning and capacity building. Some of those planning projects have been carried out and resulted in bio-engineered bank stabilization and revegetation of riparian areas. Some plans, such as the *Selby Creek Stream Habitat Restoration and Riparian Revegetation Project* (**ERP-05-S23**) (not yet executed), remain to be implemented. *The Fish Friendly Farming Environmental Certification Program* (**ERP-05-S26**) (not yet executed) will also build upon the planning work of the NCRCD and implement restoration of riparian and riverine aquatic habitats.

Capacity building and a watershed coordinator were funded through two of the 11 grants in the Napa River EMU. Outreach to private landowners was conducted with the objective of spreading information concerning management practices that are protective of riparian and anadromous fish habitat. Extensive meetings were conducted to involve local growers in discussions about how conservation practices can be integrated into operations in ways that benefit the landowner. These meetings, while funded by the

ERP grant, were a continuation of ongoing efforts by the NCRCD to integrate conservation practices into vineyard management and development operations.

Cullinan Ranch Restoration (**ERP-97-N18**) provided planning and engineering support for the Cullinan Ranch Restoration. The engineering and planning to date, funded by ERP, helped to identify the opportunities and constraints for tidal restoration at the site. Planners have delayed implementation as assessment of all restoration options continues. In the interim, an extensive network of robust fresh water seasonal wetlands and habitat has established itself on the highly subsided site. Although this area remains dry during the year, it is grassland and therefore meets the 1000 acre perennial grassland target for this Unit.

The knowledge base for restoration was expanded by *Ecological Monitoring of Tolay and Cullinan Ranch Tidal Wetlands Restoration* (**ERP-01-N19**), a monitoring project that was conducted partially within the Napa River EMU. This project proposed to monitor terrestrial, avian, and aquatic species characteristics, as well as hydraulic and geomorphic processes in response to restoration activities at Cullinan Ranch. The Cullinan ranch was not restored in time for the biological monitoring to yield restoration response data. The decision was made, with ERP input, to instead use the funds to conduct detailed baseline, pre-restoration monitoring. The monitoring reports have been submitted to the ERP archives.

The *South Napa River Tidal Slough and Floodplain Restoration Project* (**ERP-98-F23** and **ERP-99-B11**) will restore over 460 acres of wetlands and tidal flow to 2.3 miles of historic slough habitat through acquisition, feasibility planning, and on-the-ground restoration activities.

Petaluma River Ecological Management Unit

In the upper reaches of the Petaluma River watershed, bank stabilization and riparian revegetation projects were implemented on 4 creeks that are tributary to the Petaluma River. Some of these creeks provide spawning and rearing habitat for Chinook salmon and steelhead. An exact measurement of the extent of these restoration projects is not available, but photo monitoring indicates the projects were not extensive.

The project *Petaluma Marsh Expansion Project – Marin County* (**ERP-98-F13**) has a goal of preserving over 181 acres of baylands west of the Petaluma River by restoring and permanently protecting land as part of the Petaluma Marsh. Interpretive reports, guidance, and manuscripts for peer-reviewed journals will be produced as part of the ongoing *Integrated Regional Wetland Monitoring / Petaluma Marsh Expansion Project* (**ERP-04-S03**). This project will monitor and evaluate the Petaluma Marsh Expansion Project (**ERP-98-F13**).

The project *Mercury and Methylmercury Processes in North San Francisco Bay Tidal*

Wetland Ecosystems (**ERP-02D-P62**) studied mercury transport and transformations in the Petaluma River Marshes. This project improved understanding of the complex role of plant root zones in both the methylation of mercury and the diminishment of readily available "methylatable" reduced mercury. A net transport of mercury from root zone elevations to the water column was observed.

Regional/IEP/POD Studies

The changes attributable to the collective IEP partners are best summarized in the jointly issued IEP/POD Synthesis. The latest version of the Synthesis available to the public is the 2005 edition.

The ERP, as a CALFED partner in the IEP, has advanced the collective understanding of POD stressors by funding research related to primary productivity, benthic grazing rates of invasive clams, primary productivity, contaminants, and other studies. The method for synthesizing results and information from contributing IEP researchers and agencies and melding all into the POD synthesis report is not described. Therefore the weight given to the conclusions of constituent ERP projects is not clear.

Many preliminary studies in the ERP portfolio focused on determining the effects of contaminants on various fish species in the Delta. The toxicological studies found evidence of toxic effects on fish populations. Additionally, toxicity thresholds for fish and prey species were documented. Many ERP-funded studies beginning in 1997 note that the lack of data on toxicity and urban and agricultural runoff characteristics limits understanding of pyrethroid impacts to POD species and the Delta ecosystem in general.

Project Summary Table

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Suisun Marsh / North San Francisco Bay Ecological Management Zone				
ERP-00-F11	***Arundo donax* eradication and coordination** This project covered three years of effort by the Sonoma Ecology Center (SEC) for eradication and monitoring, data collection and repository, coordination, training, development of a regional strategy and recommendations, providing technical expertise, technical coordination and planning of future eradication work, development of an online information clearing house, and organization and dissemination of Arundo-related information. This project directed funds to the Sonoma Creek and Napa River watersheds, which are prepared to immediately carry out Arundo eradication.	3/26/2006	$1,063,595	Complete.
ERP-02D-P58	**Invasion Dynamics of Perennial Pepperweed, *Lepidium latifolium*, and Their Consequences for Protection of Natural and Restored Wetlands in the San Francisco Estuary** The primary goal of this project is to determine the demographic and ecological properties responsible for the success of Lepidium latifolium (LI) to support the development of strategies to control or exclude the species in tidal wetlands in the San Francisco Estuary.	10/31/2007	$178,701	Ongoing.
ERP-02D-P68	***Arundo* Eradication and Coordination, Phase II** During Phase I, SEC was funded to support and coordinate planning efforts, eradication and monitoring protocols, and treatment efficacy, as well as fund eradication work with 5 partners: Sonoma Creek, Putah Creek, Walnut Creek, San Francisquito Creek and Napa River. Phase II provides funding for ongoing monitoring and followup treatments for Phase I projects, and adds 5 new partners.	3/15/2009	$2,033,859	Ongoing.
ERP-04-S15	**Monitoring Responses of the Delta Smelt Population to Multiple Restoration Actions in the San Francisco Estuary** This project will support implementation of a state-of-the-art monitoring program to link key vital parameters for individual delta smelt with survival to adulthood at the population level. The plan is to measure five vital parameters for fish collected by the IEP, including growth and body condition, exposure to toxic chemicals, survival to the adult stage, spawning success, and feeding and food selectivity.	6/30/2009	$1,499,181	Ongoing.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-B02	**Monitor and Describe the Movement of Sediment Needed for Habitat Restoration in the Delta and Suisun Bay** The objective of this project is to describe the movement and availability of sediment for ecological benefits. Tasks include site installation of sediment measurement devices, data collection, and data analysis.	6/30/2001	$1,047,010	Complete.
ERP-98-B39	**Water Challenge 2010 Exhibit** Funds a traveling environmental exhibit titled "Water Challenge 2010", which will increase public awareness, knowledge and appreciation of Bay-Delta natural resources. This model is based in Sausalito**.**	12/31/2001	$64,500	Complete.
ERP-98-E03	**San Francisco Bay Area Wetlands Ecosystem Goals Project** This project will provide funds to enable the collection of data to be use in the creation of habitat goals which will be used by private, local, state, and federal entities seeking to protect and improve the San Francisco Bay Area's wetlands.	Unknown	$76,000	Complete.
ERP-98-F22	**Biological Restoration and Monitoring in the Suisun Marsh/North San Francisco Bay Ecological Zone: An Ecosystem Approach to Improved Effectiveness of Bay/Delta Restoration** This project restored, maintained, and monitored two restoration projects (totaling 272 acres) in eastern San Pablo Bay and southern Suisun Bay with the objectives to restore emergent and immersed marshland, monitor the restored ecosystems, and improve restoration successes.	9/30/2001	$772,667	Complete.
ERP-99-B10	**Species and Community Profiles Report of the San Francisco Bay Area Wetlands Ecosystem Goals Project** This project will provide funds for the completion of the Species and Community Profiles Report as part of the Goals Project to provide information on over 97 species of plants and animals providing scientific information on species needs, distribution, life history, and population trends.	9/30/2001	$30,614	Complete.
ERP-99-B13	**Understanding Tidal Marsh Restoration Processes and Patterns: Validating and Extending the "BREACH" Conceptual Model** The inter-disciplinary team involved in this project addressed considerable uncertainty in predicting the outcome and ecological benefit of restoring shallow-water tidal habitat in three different regions of the Bay Delta: the Delta, Suisun Bay, and San Pablo/North Bay.	6/30/2004	$1,093,292	Complete.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-F11	**Effects of Introduced Clams on the Food Supply of Bay-Delta Fishes** This research project analyzed existing data and use relatively simple models to examine the effects of the introduced clam Potamocorbula amurensis on food webs supporting longfin, delta smelt, and striped bass with the intent to fill key knowledge gaps to improve conditions for these fish species.	12/31/2003	$100,490	Complete.
ERP-99-N09	**Effects of Introduced Species of Zooplankton and Clams on the Bay-Delta Food Web** This research project will study the effects of introduced species on the food web of the San Francisco Bay-Delta, with particular emphasis placed on fish species of concern; delta smelt, longfin smelt, and striped bass. Research emphasis will be on the c	3/31/2004	$653,384	Complete.
Suisun Bay and Marsh Ecological Management Unit				
ERP-01-C04	**Suisun Marsh Property Acquisition & Habitat Restoration** This project attempts to acquire property in the Suisun Marsh, along Hill Slough, currently managed as seasonal wetland and restore the area to a fully functioning self-sustaining tidal wetland ecosystem which includes low-marsh, high-marsh, and upland transition zones, increasing the area and contiguity of saline emergent wetlands thereby assisting in the recovery of at-risk species.	6/30/2006	$536,750	Complete.
ERP-01-C09	**Hill Slough West Habitat Restoration Demonstration Project, Phase II** Complete the environmental documentation and permitting for a multi-phased project to restore tidal action to seasonal and permanent wetlands in the Suisun Marsh.	11/30/2006	$87,000	Ongoing.
ERP-02-P19	**Determining the Mechanisms Relating Freshwater Flow and Abundance of Estuarine Biota (the "Fish-X2" relationships) Phase I** Abundance or survival of several estuarine biological populations in the San Francisco Estuary is positively related to freshwater flow. The relationships have been described in terms of 'X2', the location of the 2 psu (practical salinity units) isohaline. This project is phase I of a research program. The ultimate purpose of this project is to contribute to the understanding of the factors that control the distribution and abundance of estuarine species, how these factors vary with X2, and how they might change in the future.	6/30/2007	$509,222	Ongoing.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P22	**Shallow Open Water Habitats: Hydrodynamics and Benthic Grazing** The objective of this project is to develop, via field observation and modeling, a detailed view of how tides and wind-generated waves determine the physical structure and hydrodynamics of shallow estuarine waters, and how these physical processes can act to constrain net primary production through their effects on grazing and light. Field experiments will be carried out in the shallows of Grizzly Bay and in Franks Tract.	5/31/2007	$616,605	Complete.
ERP-02-P23	**Update Individual Ownership Adaptive Management Habitat Plans** Project works to update 140 "Individual Ownership Management Plans for Private Properties" within the Suisun Marsh and to provide wetland management educational information for private landowners.	10/31/2007	$214,943	Ongoing.
ERP-02-P32	**Distribution and abundance of shrimp, plankton and benthos in Suisun Marsh** The project objectives are: 1) to evaluate the relationships between presence of alien species, on the local community structure and 2) to investigate the influence that habitat type and environmental conditions have on the type and abundance of species present in the tidal marsh community. Tasks include sampling site location selections, benthos sampling, mysid sampling, zooplankton sampling and a draft and final report on methodology, data summary and analyses and conclusions.	10/31/2007	$377,549	Ongoing.
ERP-04D-S20	**Suisun Marsh Implementation Plan (Jones & Stokes)** This project will prepare draft and final programmatic regional implementation planning documents for the Suisun Marsh Plan.	6/30/2008	$1,050,000	Ongoing.
ERP-04D-S21	**Suisun Marsh Implementation Plan (Center for Collaborative Policy)** This project will provide the facilitation and collaboration assistance supporting the preparation of regional implementation plans in the Suisun Marsh.	6/30/2008	$200,000	Ongoing.
ERP-05D-C02	**Suisun Marsh Implementation Plan** This work plan describes restoration planning and implementation activities to be undertaken in 2004-2005 and continuing in 2005-2006. These activities represent the next phase of longer-term efforts to complete regional restoration plans for ERP.	6/30/2006	$110,000	Complete.
ERP-06D-S21	**Suisun Marsh Implementation Plan** The primary objective of this project is to complete all the activities supporting the preparation of regional implementation plans in the Suisun Marsh.	6/30/2009	$310,000	Ongoing.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-95-M07	**Suisun Marsh Fish Screen Project** This project represents phase 1 (diversion evaluation and selection) of a larger program to construct fish screens on 5 diversions in the Suisun Marsh to reduce downstream migrant salmonid mortality and mortality of delta smelt and splittail.	12/31/1996	$450,000	Complete.
ERP-97-N16	**Bay Point Shoreline Restoration Plan** This project will develop a restoration plan for the Bay Point Regional Shoreline aimed a restoring tidal salt marsh habitat and ecosystem function.	10/31/2001	$185,000	Complete.
ERP-98-B09	**Integrated Pest Management Partnership to Improve Water Quality in Suisun Bay and Local Creeks** This project will increase awareness of users to detrimental impacts of the use and disposal of pesticides and provide education and outreach of integrated pest management (IPM) to improve water quality in the Suisun Bay and local creeks.	10/31/2001	$273,276	Complete.
ERP-98-F08	**Hill Slough West Habitat Restoration Demonstration Project** Complete the topographic surveys, hydrological evaluation, conceptual restoration plan, and monitoring plan for a multi-phased project to restore tidal action to seasonal and permanent wetlands in the Suisun Marsh at Hill Slough.	5/30/2002	$200,000	Complete.
ERP-98-F17	**Benicia Waterfront Marsh Restoration Project** This project will restore 8 acres of degraded salt marsh habitat along the Benicia waterfront in downtown Benicia for the benefit of several important plant and animal species.	2/28/2001	$59,000	Complete.
ERP-99-B18	**An Evaluation of the Potential Impacts of the Chinese Mitten crab on the Benthic Communities in the Sacramento-San Joaquin Delta and Suisun Bay** The purpose of this project is to provide information regarding the relationship between the Chinese mitten crab (Eriocheir sinensis) and the benthic invertebrate community within the Sacramento-San Joaquin Delta and Suisun Bay.	3/31/2003	$178,764	Complete.
ERP-99-N05	**Reintroduction of Endangered Soft Bird's Beak to Restored Habitat in Suisun Marsh.** This study provided critical ecological data to facilitate rare plant restoration; soft birds beak (Cordylanthus mollis sp. mollis); as a contribution towards CALFED objectives for improved ecosystem quality through native species recovery and conservation.	12/31/2002	$178,889	Complete.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Sonoma Creek Ecological Management Unit				
ERP-00-E04	**Sonoma Creek Watershed Conservancy** This project will implement riparian and aquatic habitat restoration activities and continue watershed stewardship and education programs in the Sonoma Creek watershed.	5/1/2004	$438,923	Complete.
ERP-01-N19	**Ecological Monitoring of Tolay & Cullinan Ranch Tidal Wetlands Restoration** This project will monitor the Tolay Creek (ERP-97-N19) and Cullinan Ranch (ERP-97-N18) Tidal Wetland Restoration Projects in the North San Francisco Bay.	6/30/2006	$593,931	Complete.
ERP-01-N27	**Sonoma Creek Watershed Conservancy** This project proposes to expand on the Conservancy's existing efforts to inform and engage the public in watershed issues while providing critical data for adaptive management.	10/30/2005	$545,170	Complete.
ERP-97-N19	**Tolay Creek Restoration Project** This project will restore and enhance 435 acres of saline emergent wetlands in the Tolay Creek floodplain for the benefit of threatened and endangered species.	9/17/2001	$283,000	Complete.
ERP-98-E02	**Sonoma Creek Watershed Enhancement Plan - Phase II** This project assisted in implementing restoration, monitoring, and educational outreach actions in the Sonoma Creek Watershed aimed at restoring the watershed through collaboration with a combination of public and private organizations.	12/31/2000	$302,000	Complete.
San Pablo Bay Ecological Management Unit				
ERP-01-C01	**Invasive Spartina Project** This project is an expanded effort to plan and implement control measures for Spartina alterniflora, contribute to the overall scientific understanding of the species, and build a bay-wide infrastructure to detect and prevent its future invasions.	10/31/2006	$1,793,661	Complete.
ERP-01-N34	**Estuary Action Challenge Environmental Education Project** EAC works with elementary school teachers and students to explore, clean up, and restore creek and bay habitats, reduce urban runoff pollution and address issues of water quality and safe bay food consumption. Programs will take place in various locations around the Bay Area.	11/30/2001	$50,000	Complete.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P10	**Estuary Action Challenge Environmental Education Program** This is a hands on environmental education project focusing on local water resources and environmental justice issues in underserved urban communities. In this contract work with elementary school teachers and students to explore, clean up and restore creek and bay habitats, reduce urban runoff pollution and address issues of water quality and safe bay food consumption will be performed.	7/10/2004	$120,000	Complete.
ERP-04-S02	**Monitoring for Invasive Spartina Control in the San Francisco Estuary** The primary project goal is to provide timely, high quality data regarding the location and extent of invasive Spartina to the San Francisco Estuary Invasive Spartina Project, so that it may plan and rapidly implement cost-effective weed control measures and determine when site-specific and regional control objectives have been met. In addition, the Monitoring Program will provide accurate data on the status of endangered California clapper rails at the Spartina treatment sites, to allow Spartina control to be implemented with minimum adverse effects on rails.	12/31/2008	$1,234,396	Ongoing.
ERP-98-C03	**Hamilton Wetlands Restoration Planning** This project provided planning and environmental documentation for the restoration of 2,500 acres of subsided, diked baylands to a mix of seasonal and tidal wetlands.	6/30/2002	$1,070,030	Complete.
ERP-98-E07	**Local Watershed Stewardship: Steelhead Trout Plan, Corte Madera Creek Watershed, Marin County, California** Developed a steelhead restoration plan for the Corte Madera Creek as part of a larger watershed management plan for the Corte Madera Creek watershed.	10/1/2000	$47,500	Complete.
ERP-99-B21	**Estuary Action Challenge Environmental Education Project** This project will help to fund educational outreach activities for the Estuary Action Challenge (EAC) program, enabling the EAC to promote environmental awareness of habitat restoration, pollution prevention, and safe bay food consumption through implementation and continued support of several outreach programs in collaboration with area teachers and students.	9/30/2000	$50,000	Complete.
ERP-99-B22	**Water Challenge 2010 Exhibit** Funds a second exhibit installed in the American River Water Education Center.	6/30/2002	$81,068	Complete.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Napa River Ecological Management Unit				
ERP-01-N19	**Ecological Monitoring of Tolay & Cullinan Ranch Tidal Wetlands Restoration** This project will monitor the Tolay Creek (ERP-97-N19) and Cullinan Ranch (ERP-97-N18) Tidal Wetland Restoration Projects in the North San Francisco Bay.	6/30/2006	$593,931	Complete.
ERP-02D-P71	**Napa-Sonoma Marsh Restoration Project - Construction Phase (Ponds 3,4, and 5)** The purpose of this project is to conduct phase I of the Napa-Sonoma Marsh restoration project, a Federal USACE project which entails the restoration of three former commercial salt ponds along the Napa River, totaling approximately 3,000 acres.	6/30/2007	$3,203,000	Complete.
ERP-02-P04-D	**Napa-Sonoma Marsh Restoration Project** The project is the restoration of three former commercial salt ponds along the Napa River, totaling approximately 3,000 acres, to tidal marsh. It is a phase of the Napa-Sonoma Marsh restoration project, a Federal USACE project. The project entails restoration of Ponds 3, 4, and 5, which includes construction of approximately two water control structures or levee breaches for salinity reduction; and levee breaches, ditch blocks, levee lowering, starter channels, and berms for habitat restoration. Phase I will provide for restoration of Pond 3 (1,300 acres) to tidal habitats, and salinity reduction in preparation for tidal habitat restoration in Ponds 4 and 5 (1,700 acres).	11/2/2006	$1,339,000	Complete.
ERP-97-N18	**Cullinan Ranch Restoration** This project, part I of a larger effort, aims at restoring tidal salt marsh habitat and ecosystem function in Cullinan Ranch. The project will prepare environmental permits and design engineering plans to restore 1,495 acres of saline emergent wetland habitat by supplying the necessary sediments through accretion to restore proper tidal elevation gradients at the project site.	6/17/2004	$368,500	Complete.
ERP-98-B13	**South Napa River Wetlands Acquisition** This project will protect and restore native marsh wetland habitat by acquiring and restoring 115 acres of land in the South Napa River Wetlands along the Napa River benefiting several federally-listed species. Once these lands are acquired, proposed restoration will modify or remove levees and other structure interventions to restore and enhance natural wetland functions. This project is related to additional restoration activities in the area under ERP-98-F14.	9/30/2000	$1,073,513	Complete.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-E01	**Napa River Watershed Stewardship** This project builds upon work in the Napa River watershed by continuing to address a broad range of ecological and biological issues relating to habitat restoration for anadromous fish and other priority species by promoting collaborative watershed stewardship.	12/31/2000	$250,000	Complete.
ERP-98-F23	**South Napa River Tidal Slough and Floodplain Restoration Project** This project represents the first phase in restoring over 460 acres of wetlands in the South Napa River Tidal Slough by funding acquisition of the property, preliminary design work, an environmental feasibility study, and environmental compliance documentation and permitting.	6/30/2001	$1,480,000	Complete.
ERP-99-B11	**South Napa River Tidal Slough and Floodplain Restoration Project** This is Phase 2 of the South Napa River Tidal Slough and Floodplain Restoration Project, which involved the restoration of tidal flow to 2.3 miles of historic slough habitat, and the restoration of nearly 483 acres of wetlands and uplands.	9/30/2005	$1,520,000	Complete.
ERP-99-N20	**Napa River Watershed Stewardship Year 2** This project builds upon work in the Napa River watershed by continuing to address a broad range of ecological and biological issues relating to habitat restoration for anadromous fish and other priority species by promoting collaborative watershed stewardship.	12/30/2001	$191,100	Complete.
Petaluma River Ecological Management Unit				
ERP-02D-P62	**Mercury and Methylmercury Processes in North San Francisco Bay Tidal Wetland Ecosystems** This study investigates mercury cycling in tidal wetlands of the Petaluma River, with emphasis on quantifying and understanding processes that influence the abundance of methylmercury.	5/14/2008	$1,941,293	Ongoing.
ERP-02-P14	**Bahia Acquisition and Tidal Wetland Restoration** The project will acquire the 631 acre Bahia site, which consists of historic tidal wetlands and adjacent uplands, and the initiate the restoration of the former wetlands to tidal marsh by developing a plan to restore 330 acres of currently diced wetlands to tidal action and implementing that plan.	6/12009	$3,345,000	Ongoing.
ERP-04-S03	**Integrated Regional Wetland Monitoring / Petaluma Marsh Expansion Project** This project will monitor and evaluate the Petaluma Marsh Expansion Project, ERP-98-F13, as a secondary site within the Integrated Regional Wetland Monitoring Project (IRWM).	6/30/2009	$235,000	Ongoing.

Table 1. Suisun Marsh/North San Francisco Bay Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-E04	**Petaluma River Watershed Restoration Program** This project provided funds to implement the restoration and monitoring projects identified in the Petaluma River Watershed Enhancement Plan with the goal of enhancing and restoring habitat and ecosystem function along the Petaluma River.	2/28/2001	$220,000	Complete.
ERP-98-F13	**Petaluma Marsh Expansion Project - Marin County** This project will preserve a total of 181.46 acres of baylands west of the Petaluma River at the Marin-Sonoma County border by restoring and permanently protecting land for the benefit of several important species as part of the Petaluma Marsh, the largest undiked tidal marsh remaining in the Bay.	3/31/2004	$503,635	Ongoing.

Other Programs Contributing to ERP Vision

Suisun Marsh/North San Francisco Bay Ecological Management Zone

One of the ERP targets was to acquire bay land between the mouths of the Petaluma River and Tolay Creek. A significant portion of this land has been acquired and designated as the "Sonoma Baylands". The Sonoma Land Trust has recently added the adjacent 600-acre Dixon Property. ERP was not involved in either acquisition.

Other agencies and programs that contributed to ERP visions are listed below:

- California Association of RCDs - www.carcd.org/index.htm
- California Coastal Commission - www.coastal.ca.gov/
- California Coastal Conservancy - www.coastalconservancy.ca.gov/
- California Department of Conservation - www.consrv.ca.gov/
- California Regional Water Quality Control Boards
  - North Coast Region - www.swrcb.ca.gov/rwqcb1
  - San Francisco Bay Region - www.waterboards.ca.gov/sanfranciscobay
- California Special District Association - www.csda.net/
- California State Water Resources Control Board - www.swrcb.ca.gov/
- University of California Cooperative Extension AmeriCorps - www.americorps.org/
- National Association of Conservation Districts - www.nacdnet.org/
- National Oceanic and Atmospheric Administration, National Marine Fisheries Service - www.nmfs.noaa.gov/
- Natural Resources Conservation Service - www.nrcs.usda.gov

- United States Army Corps of Engineers - www.usace.army.mil/
- United States Department of Agriculture - www.sc.egov.usda.gov/
- United States Environmental Protection Agency - www.epa.gov/
- United States Fish & Wildlife Service - www.fws.gov/
  - Partners for Fish and Wildlife Program - http://partners.fws.gov/

Suisun Bay and Marsh Ecological Management Unit

Other site-specific planning projects were conducted by and in the City of Benicia and East Bay Regional Parks District for a site near the disadvantaged, unincorporated community of Bay Pointe in Contra Costa County. What is notable about both of these projects is that the plans have been completed for some time but the proponents were unable to secure subsequent funding for implementation. A total of 43 acres of saline emergent wetland could be restored if funding were made available. Representatives for both projects indicate that plans remain valid and, except for funding, the projects are ready to go. Matching fund sources have been identified in both cases.

The Suisun Ecological Workgroup (SEW) was convened at the request of the State Water Resources Control Board as a component of the "Program of Implementation" in the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. SEW is an ad hoc multi-agency/organization work group whose goal is to review the scientific basis for the current salinity standards in Suisun Marsh and to make recommendations for comprehensive brackish marsh standards. The primary goals of the SEW are to characterize the brackish water ecosystem for Suisun Marsh, evaluate the effects of existing Western Suisun Marsh water quality standards on beneficial uses, determine and recommend appropriate resource-specific standards, recommend narrative standards for tidal wetlands, assess impacts of implementing appropriate resources-specific standards on other resources, develop appropriate multi-resource (ecosystem) water quality standards, consider alternative models, and recommend future studies and compliance monitoring programs.

Sonoma Creek Ecological Management Unit

ERP-funded activities are not the only efforts underway in the unit. It is difficult to account precisely for the amount of riparian and riverine aquatic habitat that has been restored since the inception of Stage 1 planning.

Tolay Lake and fringing uplands, totaling 1,760 acres, has been acquired by the Sonoma Land Trust. The plan is to cease the practice of draining the wetland for agricultural activities and to restore the natural cycle of seasonal water level fluctuation on the lake. The 1,500 acres of fringing uplands has the potential to meet the ERP target of 1,000 acres of perennial grasslands connected to floodplains. However, it has not been determined whether these grasslands are formed from perennial grasses, what the establishment and maintenance of perennial grasses in the unit will cost, and

where to obtain funding to establish and maintain perennial grasses.

San Pablo Bay Ecological Management Unit

None.

Napa River Ecological Management Unit

ERP-funded activities are not the only efforts underway in the unit, so it is difficult to account precisely for the amount of riparian and riverine aquatic habitat that has been restored since the inception of Stage 1 planning.

There is a sediment TMDL for the Napa River that may be the impetus for meeting such an ambitious aquatic habitat restoration goal. There are at least two stewardship groups that have formed to take dramatic, concerted, action to stabilize the main stem Napa River in its incising and highly eroding middle reaches. Sound and sustainable solutions that protect both habitat and property will require fluviogeomorphic and engineering expertise, as well as considerable funding support. Passive solutions will be sought in order to contain costs. In appropriate cases, some passive solutions may require great expense in terms of property loss.

In areas such as the North Bay, considerable capacity for watershed improvement already exists by virtue of the income and educational demographics, and social values in those counties. The further promotion and development of stewardship and watershed capacity in the EMU is being implemented by the NCRCD. Follow-up assessments of capacity and stewardship would best be obtained by a greater representative role for ERP and CDFG in the EMU.

Other agencies and programs that contribute to ERP visions are listed below:

- Napa County Resource Conservation District
- Napa County Land Trust
- Napa County Flood Control District
- USFWS
- CDFG
- SCC

Petaluma River Ecological Management Unit

None.

Regional/IEP/POD Studies

The Interagency Ecological Program (IEP) for the San Francisco Bay/Sacramento-San

Joaquin Estuary consists of ten member agencies, three State (Department of Water Resources, Department of Fish and Game, and State Water Resources Control Board), six Federal (Fish and Wildlife Service, Bureau of Reclamation, Geological Survey, Army Corps of Engineers, National Marine Fisheries Service, and Environmental Protection Agency), and one non-government organization (The San Francisco Estuarine Institute). These ten program partners work together to develop a better understanding of the estuary's ecology and the effects of the State Water Project (SWP) and Federal Central Valley Project (CVP) operations on the physical, chemical, and biological conditions of the San Francisco Bay-Delta estuary.

The IEP mission is to provide information on the factors that affect ecological resources in the Sacramento - San Joaquin Estuary that allows for more efficient management of the estuary. The following goals have been identified as part of achieving the mission:

- To provide for the collection and analysis of data needed to understand factors in the Sacramento-San Joaquin estuary controlling the distribution and abundance of selected fish and wildlife resources, and make the data readily available to other agencies and the public.
- To comply with permit terms requiring ecological monitoring in the estuary.
- To identify impacts of human activities on the fish and wildlife resources.
- To interpret information produced by the program and from other sources and, to the extent possible, recommend measures to avoid and/or offset adverse impacts of water project operation and other human activities on these resources. To seek consensus for such recommendations, but to report differing recommendations when consensus is not achieved.
- To provide an organizational structure and program resources to assist in planning, coordination, and integration of estuarine studies by other units of cooperating agencies or by other agencies.

Status of Area Today

Suisun Marsh/North San Francisco Bay Ecological Management Zone

The general target of restoring and maintaining healthy Bay-Delta hydrodynamics will be met through restoration of hydrodynamic patterns typical of those exhibited when the ecosystem was functioning in a healthy state (CALFED 2000a). As a direct result of ERP activities, a combined 865 acres of upland and marsh elevation lands were preserved. In addition, ERP actions supported the target to reconnect streams to their floodplains via restoration of 10% of the area where flooding was previously restricted by levees.

It is difficult to assess progress towards meeting the tidal aquatic and slough habitat targets. Depending upon sediment availability and energetics, marsh evolution

following tidal restoration will typically progress from an open water condition to intermediate open water and emergent vegetation, then to a new equilibrium of open water and saline marsh. In some respects it might be more accurate to report that, at this time, the breaches at Bahia and upstream met the open water goals but not the saline marsh targets. Regardless of such distinctions, it is apparent that the two ERP acquisition and restoration projects by themselves cannot meet both the saline marsh and the open water and tidal slough goals. However, diked baylands, with excellent restoration potential, have been banked in large holdings by other conservation partners in the unit. These holdings, when restored, will likely meet the ERP habitat restoration targets for the unit.

With the help of ERP, the tidal marsh restoration acreage objectives for the San Pablo Bay region have largely been met over the last few years. The State Coastal Conservancy and local land trusts have also funded acquisitions for ultimate restoration to tidal marsh. The Sonoma Land Trust is very active in the region and well supported. Extensive areas of marsh and uplands have been acquired within the last five years. Conservation entities, including the San Francisco Bay Joint Venture, are very actively implementing acquisition, preservation, and restoration strategies in this unit. However, many of these areas are not scheduled for restoration in the near future. Limited availability of funding will likely continue to delay restoration.

A significant amount of hydrodynamic and biological monitoring has already been done on the restorations in the North Bay. This completed monitoring can inform future restorations both within the Bay and to some extent in the Suisun Marsh as well. The areas that need to be targeted for future monitoring are mercury transformations and transport, invasive species, and species of special concern.

Risks from mercury mobilized as a result of restoration activities is believed to be low. Conceptual models and some early results of ongoing ERP-funded studies indicate that strategies can be developed to minimize mercury exposure from restoration. In addition, mercury is likely to be sequestered as the restored marshes mature.

Suisun Bay and Marsh Ecological Management Unit

Habitat restoration activity in the Suisun Bay and Marsh EMU has not advanced to the extensive implementation phase achieved in the North Bay. Opportunities for land acquisitions have been scarce.

With respect to salinity, the Suisun Ecological workgroup was tasked with drafting salinity standards for the marsh. In November of 2001 it presented its final report to the State Water Resources Control Board. The report reveals divergence in thinking on how much salinity variability is optimal for the ecosystem. The current thrust of the planning for salinity recommendations in the Marsh Plan is in staying with the recommendations that were in place at the time that the SEW was charged with

revising the standards. The report from November 2001 states that salinity standards appear to benefit management for migratory waterfowl at the expense of native vegetation structures that would have the potential to increase the diversity of wildlife.

A crucial issue for managed wetlands in the Marsh is the desire to dredge local sloughs as a source for levee maintenance material. A letter of permission is being sought from the Army Corp of Engineers. The letter would allow the resumption of local dredging activities on a limited yearly volume basis. Therefore, the Suisun Marsh Plan is being developed with two key assurances for landowners in the Marsh: that the recent moratorium on dredging of local channels will be lifted, and that land for tidal marsh restoration will only be acquired from willing sellers. There is also an assumption that fresh water supplies will continue uninterrupted for the purpose of lowering salinity on managed wetlands. These assurances and assumptions are consistent with the CALFED goals of reducing conflict and preserving all beneficial uses. The continued preservation of all historic beneficial uses is also consistent with the considerable investments in infrastructure that have been made to continue supplying fresh water to the Marsh during the period when it was naturally the most brackish. However, balancing the ecosystem needs while maintaining these assurances and investments will pose a considerable challenge both ecologically and financially.

Sonoma Creek Ecological Management Unit

The general target of restoring and maintaining healthy Bay-Delta hydrodynamics will be met through restoration of hydrodynamic patterns typical of those exhibited when the ecosystem was functioning in a healthy state (CALFED 2000a). Due to acquisitions completed in the EMU prior to Stage 1 planning, land sufficient to meet the goal of 1,000 acres of tidal marsh restoration is already available. An additional 1,100 acres of lands banked by DFG (Wingo Unit) and the Sonoma Land Trust (Sonoma Baylands) contain potential tidal restoration acreage sufficient to meet the stage 1 target of 500-1,000 acres, although much of this area is currently dedicated to remain diked, managed, perennial aquatic habitat. In addition, ERP actions supported the target to reconnect streams to their floodplains via restoration of 10% of the area where flooding was previously restricted by levees.

The acquisitions of sub-tidal acreage in the Unit include large areas of perennial aquatic habitat. Most of the existing open water will be preserved through active management of the tidal flows onto these lands. The target of 400 acres of open water is at least partially met for the unit through the Tolay project funded by ERP. Additional acquisitions by DFG fulfilled the remainder of the target acreage for perennial aquatic habitat, although these ponds are muted tidal, generally fresh water, and subject to fluctuations.

In terms of preservation, progress towards meeting the ERP objectives for tidal marsh in the Sonoma Creek EMU has been significant. Extensive areas of marsh and uplands

were acquired just prior to the drafting of Stage 1 plans. Conservation entities, including the Sonoma Land Trust and the San Francisco Bay Joint Venture, are very actively implementing acquisition, preservation, and restoration strategies in this unit.

San Pablo Bay Ecological Management Unit

The ERP target for restoring San Pablo Bay tidal marsh acreage is largely met by the Hamilton phase of the work alone. However, the Bel Marin Keys expansion proposes additional ecosystem and species benefits. Implementation of the planned expansion that was funded by the ERP Hamilton project should be supported by ERP as appropriate.

The timeline to restoration at Hamilton has been beset with numerous delays related to the stated intent to raise subsided elevations with Bay dredge spoils. In April 2007, the way for dredge spoil re-use was finally cleared and the first dredge materials were delivered to the site. The planning portions funded by ERP, completed over three years ago, were integral in assisting with moving the project forward to this point.

Napa River Ecological Management Unit

The Stage 1 implementation targets for the Napa River are to restore 400 acres of non tidal perennial aquatic habitat, 10-20 miles of tidal sloughs, 1,000-2,000 acres of saline emergent wetland, 10-15 miles of riparian and riverine aquatic habitat, and 1000 acres of perennial grassland. The general target of restoring and maintaining healthy Bay-Delta hydrodynamics will be met through restoration of hydrodynamic patterns typical of those exhibited when the ecosystem was functioning in a healthy state (CALFED 2000a). In addition, ERP actions supported the target to reconnect streams to their floodplains via restoration of 10% of the area where flooding was previously restricted by levees.

Approximately 9,850 of former salt ponds in the Napa River EMU have been acquired since the initial Stage 1 implementation planning. Another 595 acres of baylands diked for agriculture were also acquired. ERP funds were used to acquire approximately 595 acres of the total 12,100 acres. ERP funds were instrumental in restoring tidal circulation to 3,595 acres of formerly diked baylands in the estuarine reach of the Napa River. Therefore, the 1,000 - 2,000 acres of saline emergent wetland target has been met and exceeded. Restoration of the former salt ponds is effectively restoration of the bordering sloughs. Hence the 10-20 mile target for restoration of sloughs in the EMU has been met. Approximately 3 miles of tidal slough was restored in the American Canyon Wetlands project, which restored flow to an historic slough network. Numerous starter channels into formerly diked baylands have been excavated in the American Canyon, Salt Pond, and South Napa River restoration sites. The potential for slough development within the breached sites will contribute to the slough restoration target.

These habitat acreages are likely to change as the marshes mature. However, as restoration plans for the remaining acquisitions in the North Bay are finalized, it is expected that the ERP targets will be vastly exceeded. The local and regional impacts of restorations of this magnitude, implemented over a long period of time, are unknown. It is hypothesized that primary productivity will increase. Regional patterns of salinity and tidal exchange may also respond to the increased tidal prism in the western end of the Bay Delta estuary. Scalar transport models indicate the possibility that X2, the location of the 2 psu (practical salinity units) isohaline, may migrate westward as a result of the tidal marsh restorations in the North Bay. Mercury mobilization and transformation may also occur.

The extent to which these changes may alter the food web, hydrodynamics, and salinity regimes in the Delta and South Bay, where restoration of an additional 15,000 acres is underway, is also unknown. The year of 2007 will be the first year that the 1,000-2,000 acre target has been met for the Napa River EMU. Combined with the expanded tidal prism resulting from the other North Bay restoration sites, at least 4,000 acres of tidal restoration was implemented in 2006.

With the help of the ERP, the tidal marsh restoration acquisition acreage objectives for the San Pablo Bay EMU have largely been met over the last few years. The state coastal conservancy and local land trusts have also been funding acquisitions for ultimate restoration to tidal marsh. Additional funds to restore the Napa Plant site, 1,400 acres of highly saline ponds across the river from the Napa Salt Ponds, will be needed over a twenty year timeline.

Significant progress on meeting the 10-15 miles of riparian and riverine aquatic habitat is not easily verified. While some of the work funded by ERP did result in riparian projects, no more than a few acres were involved. The ERP has only funded one upland riparian project and is not engaged in comprehensive efforts to acquire and restore upland and riparian areas. The target for riparian restoration also indicates 40% should be no less than 5 yards wide and 1 mile long (CALFED 2000b). Such conditioning implies multiple restorations on the order of a mile in length. While the Napa River restorations meet this measure in the tidal reaches, hitting this target in the upper, non-tidal reaches is still desirable, though more problematic, and should be enthusiastically supported. Other entities within the watershed are working toward significant protection and restoration, but further coordination and exchange with those entities is needed to verify accomplishments.

Petaluma River Ecological Management Unit

A total of 109 acres along the Petaluma River were hydraulically reconnected with full tidal exchange. An estimated 200 acres were reconnected to provide muted tidal exchange in Bahia. As the Bahia restoration matures, there is potential for another 130 acres of tidal marsh. The projected 439 acres would be just short of the target of 500

acres minimum for the management unit.

Regional/IEP/POD Studies

The ERP is committed to following the IEP/POD review panel recommendations for research into pelagic organism decline in the Bay-Delta. Areas of study squarely in the ERP domain, but which have not received much consideration to date, may deserve attention in future funding and policy decisions as well.

Planned Projects for Implementation

Suisun Marsh/North San Francisco Bay Ecological Management Zone

Efforts to eradicate invasive species will continue through *Arundo donax Eradication and Coordination Program: Monitoring and Evaluation* (**ERP-04-S14**), a project that is funded but not yet executed. This project will implement the monitoring of *Arundo* eradication sites for restoration success.

The assumption that watershed capacity was increased by funding a watershed coordinator position at the Southern Sonoma RCD needs to be tested by follow-up assessments of capacity and habitat conservation activities subsequent to the grant closeout. In areas such as the North Bay, considerable capacity for watershed improvement already exists by virtue of the income and educational demographics, and social values in those counties. Since much of the land is privately held, assumptions about landowner commitment to habitat conservation are difficult to gauge, and ownership turnover rates must be factored in.

Significant progress on meeting the 10-15 miles of riparian and riverine aquatic habitat is not evident. While some of the work funded by ERP did result in some riparian projects, no more than a few acres were involved. The ERP has only funded one upland riparian project and is not engaged in comprehensive efforts to acquire and restore upland and riparian areas. The target for riparian restoration also indicates 40% should be no less than 5 yards wide and 1 mile long (CALFED 2000b). Such conditioning implies multiple restorations on the order of a mile in length. While some of the Petaluma River restorations approach this mark in the tidal reaches, this is a more problematic target in the upper, non-tidal reaches. Other entities within the watershed are working towards significant protection and restoration, but further coordination and exchange with those entities is needed to verify accomplishments.

Suisun Bay and Marsh Ecological Management Unit

As one of four projects funded, the *Suisun Marsh Implementation Plan Year 1 (CDWR)* (**ERP-05D-S01**) project, which is not yet executed, will contribute to the collaborative

effort to create a comprehensive plan for the Suisun Marsh.

The *Suisun Marsh Land Acquisition* (**ERP-06D-S16**) project, also funded but not yet executed, will acquire up to 500 acres of land in Suisun Bay in either fee title or conservation easement for restoration to self-sustaining tidal marsh.

The work conducted by *Update Individual Ownership Adaptive Management Habitat Plans* (**ERP-02-P23**) is only a first step in improvements to seasonal wetland management. Actual changes in habitat and use by more abundant and diverse wildlife populations will need to be verified by future monitoring. Additionally, the work performed by the project is subject to behavioral influences beyond the scope of the ERP. Further, the work is being applied to private properties, where jurisdictional enforcement is either not applicable or behaviorally problematic. Past and future efforts to improve seasonal wetlands must be closely monitored through coordination with SCRCD as a partner in the ongoing Marsh restoration planning.

ERP should reconsider its decision to limit its funding commitment to the planning phase of the Benicia and Bay Point restoration projects. It may be that intermediate-to-small projects such as these face considerable obstacles to secure funding from other sources. At the least, ERP funds spent on planning for these sites appear to have stopped paying dividends in the form of habitat restored.

Sonoma Creek Ecological Management Unit

ERP coordination of continued monitoring of perennial aquatic habitat use by wildlife is advised. The actual extent of the restorations and the benefits to ecosystem function and process restoration is difficult to quantify. Many of the projects were carried over from the initial planning and capacity building grant and still other projects were planned at the time of the last grant. The work was conducted on the main stream of Sonoma Creek and on a dozen or so tributaries. The work included installations to improve passage, spawning and rearing habitat for salmonids, as well as revegetation and bank reslope projects. The project reports note instances in which past restoration plantings were replanted to improve survivorship.

The upland and riparian restorations funded by ERP in the Unit are good candidates for a follow-up site assessment using California Rapid Assessment Methodology or photo monitoring to see how the plantings and resloped banks fared over time. Coordination with projects and agencies monitoring the use of restored perennial aquatic habitat by wildlife should also be supported.

San Pablo Bay Ecological Management Unit

The general target of restoring and maintaining healthy Bay-Delta hydrodynamics will be met through restoration of hydrodynamic patterns typical of those exhibited when

the ecosystem was functioning in a healthy state (CALFED 2000a). Plans call for the restoration of approximately 1,000 acres of bayfront tidal wetlands at Hamilton, and 1,200 acres of tidal wetlands at Bel Marin Keyes. The restorations will include expanding tidal prism in the Novato Creek flood plains. These tidal marsh restoration activities will take 30 years to implement and require the construction of over four miles of levees for flood and resource protection. Upon completion the project will have met the Stage 1 implementation target to restore 500-1,000 acres of tidal marsh.

Cullinan Ranch will require large funding commitments if it is to be actively restored. The project would benefit from high-level agency assistance and inter-agency coordination on the problem of reconnection to tidal prism through the barrier currently posed by highway 37 near the San Pablo Bay north shore. This barrier is a regional problem that also impacts upland connectivity in the Sonoma County area.

Napa River Ecological Management Unit

Restoration activities for the Scaggs Island property had not begun in earnest during Stage 1. This is a former US Navy installation that has some contaminant issues which will increase costs and complicate the restoration logistics.

Both the tidal and riparian restorations implemented to date will require more time to reach maturity. Follow-up monitoring would be advisable for the riparian restorations since revegetation projects commonly experience low rates of plant survival. A protocol such as the California Rapid Assessment Methodology would be an appropriate means of measuring the maturation rate. Some of the riparian projects were on private land, hence follow–up monitoring may be difficult to arrange.

Scaggs Island Restoration Project will require large funding commitments if it is to be actively restored. The project would benefit from high-level agency assistance and inter-agency coordination on the problem of reconnection to tidal prism through the barrier currently posed by highway 37 near the San Pablo Bay north shore. This barrier is a regional problem that also impacts upland connectivity in the Sonoma County area.

A genetic study on the Napa River Chinook salmon population was begun recently as run counts from the past three years seem to indicate that the Napa run may be remnant native fish. This effort deserves additional support in that the results may have a bearing on genetic diversity and otherwise complement the libraries for the Central Valley stocks.

The project *Selby Creek Stream Habitat Restoration and Riparian Revegetation Project* (**ERP-05-S23**) seeks to continue restoration efforts based on the Selby Creek Project (watershed plan) on Selby Creek in the Napa watershed. The project will gather technical information to describe the watershed, install bioengineering structures to control erosion and stabilize streambanks, expand and revegetate the floodplain, and

create fisheries habitat.

The *Fish Friendly Farming Environmental Certification Program* (**ERP-05-S26**) project is a restoration initiative that was funded but has not yet been executed. This project would continue and expand the Fish Friendly Farming program in the Napa River watershed. The program assesses the site conditions on Napa Valley farms, and develops plans for the application of BMPs (by private landowners) to improve water quality and associated salmonid habitat.

Rector Creek is the subject of a proposed Fish Friendly Farming restoration initiative that was funded by ERP. Steelhead live in the waters above the Rector Dam and reservoir, but there is no migratory connection over the dam. Numerous hydrodynamic obstacles to restoration of the below-dam reaches exist. But it would be better for the restoration process to proceed pro-actively with ERP involvement than to have to react as local and regional interests bring the issue to light.

Petaluma River Ecological Management Unit

One prominent gap in the ERP approach to restoration in the area is the tracking and eradication of invasive weeds in the Petaluma River EMU. The unit is outside the Delta, well covered by other conservation entities, and thus perhaps not a high priority for ERP. However, all waterbodies contiguous to the Delta are a potential source for invasive species propagation. Within the last 6 months, invasive *Spartina* colonies have been verified in the Petaluma River marsh. ERP is currently funding invasive *Spartina* monitoring and eradication in the bay area, but those activities have been focused outside the EMU until recently.

Impediments to Implementation

Suisun Marsh/North San Francisco Bay Ecological Management Zone

Both the tidal restoration and riparian restorations will require more time to reach maturity. Follow-up monitoring would be advisable for the riparian restorations since revegetation projects commonly experience low rates of plant survival. A protocol such as the California Rapid Assessment Methodology would be an appropriate means of measuring the maturation rate. Some of the riparian projects were on private land, hence follow-up monitoring may be difficult to arrange.

It is difficult to gauge the trend on the 1,000 acre perennial grassland target. Large areas of diked bayland that were dry-farmed for hay are slated for restored tidal flows. It is arguable the degree of wildlife benefits these grasslands produce. Some are disked and seeded annually, while others cut volunteer hay on an irregular cycle. The ecosystem functions provided by these lands will be lost following inundation.

Surrounding upland annual grasslands provide similar functions, though there will be a net loss.

With respect to upland acquisitions, a final area needing the attention of ERP is that of agricultural and urban management practices with respect to wetlands and wildlife habitats. Some initiatives to increase adoption of wildlife friendly practices have already begun in the EMZ, but guarantees of continued adherence to practices or maintenance of implementations is problematic on private lands. While ERP may not prioritize spending in this topic area, coordination with other entities implementing stewardship projects in this unit could be emphasized. Due to the problematic nature of restoration on private lands, land acquisition projects in this unit, and statewide in general, should be prioritized and supported as funding permits.

Suisun Bay and Marsh Ecological Management Unit

Lifting of the moratorium on dredging local sloughs and channels appears inconsistent with the general target for dredging and dredge disposal, which states the intent to "reduce the loss and degradation of habitat and to contribute sediments for the recreation of shallow water habitats" (CALFED 2000a). Further, sea level rise, construction of an isolated conveyance facility, and salinity changes due to tidal restoration in the marsh will all have to be accounted for in finding a new balance of ecosystem and other demands on Delta resources.

Sonoma Creek Ecological Management Unit

Many acquisition, preservation, and restoration strategies in this area are not scheduled for restoration in the near future. Many of the acquired lands are subsided and the position of Highway 37 in the landscape is a major impediment to reconnection of the diked baylands to San Pablo Bay, the historic tidal connection. Limited availability of funding and the lack of a logistically feasible long-term solution to the tidal connectivity problem will likely continue to constrain and delay restoration.

San Pablo Bay Ecological Management Unit

The 1,500 acres of baylands diked for agriculture on Cullinan Ranch (**ERP-97-N18**) have not yet been restored to tidal flows because the restoration design must take into account the fact that state Highway 37 cuts the area off from the natural source of tidal flow and sediment from San Pablo Bay. Alternative tidal reconnection routes, such as smaller sloughs to the north of the property, present different problems such as erosion of existing features due to the mismatch between increased tidal prism of the breaches and slough size.

Napa River Ecological Management Unit

Since much of the land is privately held, assumptions about landowner commitment to habitat conservation are difficult to gauge and ownership turnover rates must be considered. ERP needs to monitor grant funds to ensure that they are not used to convert existing habitat acreage to vineyard or other uses.

Napa residents approved a Regional Parks District in 2006. At the same time, there is pressure to discontinue the Williamson Act in California. This means that a change in the equilibrium of agricultural pressures and urban development may be changing the balance with habitat restoration activities. Additionally, although acreage targets provide administrative measures of project success, they do not necessarily ensure that functioning ecosystems are created. In the Napa River EMU, water availability and migration barriers remain impediments to restoration of full ecosystem functionality and the protection of restoration investments in the unit.

Petaluma River Ecological Management Unit

None.

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APPENDIX A

A.3. SACRAMENTO RIVER ECOLOGICAL MANAGEMENT ZONE

Introduction

The Sacramento River flows more than 300 miles from Lake Shasta to Collinsville in the Delta, where it joins the San Joaquin River. The river corridor encompasses more than 250,000 acres of natural, agricultural, and urban lands upstream of the city of Sacramento. Various cropland habitats occur on flat and gently rolling terrain adjacent to most of this zone that are irrigated with water diverted from the Sacramento River or its tributaries. Five National Wildlife Refuges (Sacramento, Delevan, Colusa, Sacramento River and Sutter) are located either adjacent to or within 5 miles of the Sacramento River. The Sacramento River Ecological Management Zone (EMZ) includes 242 miles of the main stem Sacramento River from Keswick Dam, near Redding, to the American River at Sacramento (Figure 1). The remaining 60 miles of the lower river downstream of Sacramento are included in the North Delta Ecological Management Unit (EMU). The main stem river planning area includes the river channel, gravel bars and vegetated terraces, the 100-year river floodplain, and the geologically defined band of historic and potential river migration (i.e. the meander belt). In the artificially narrow, leveed reach downstream of Colusa and extending to Sacramento, an approximately one-mile-wide band of river alluvium and historic and potential forest land that borders the levees is also included in this EMZ. This EMZ encompasses five EMUs:

- Keswick to Red Bluff Diversion Dam
- Red Bluff Diversion Dam to Chico Landing
- Chico Landing to Colusa
- Colusa to Verona
- Verona to Sacramento

The National Marine Fisheries Service (NMFS) has determined that critical habitat for the endangered Sacramento winter-run Chinook salmon includes the entire Sacramento River from Keswick Dam, river mile (RM) 302, to the Golden Gate Bridge. Other fish dependent on the Sacramento River Ecological Management Zone (EMZ) include spring-run Chinook salmon, late-fall-run Chinook salmon, fall-run Chinook salmon, steelhead, lamprey, green sturgeon, white sturgeon, American shad, striped bass, and a resident native fish community, including the Sacramento splittail. Due to declining populations, many of these are species of special concern or listed under provisions of the state or federal endangered species acts. One of the important attributes of the zone is its riparian forest, which supports a variety of Neotropical migrant bird species, the Valley elderberry longhorn beetle, and many other terrestrial species.

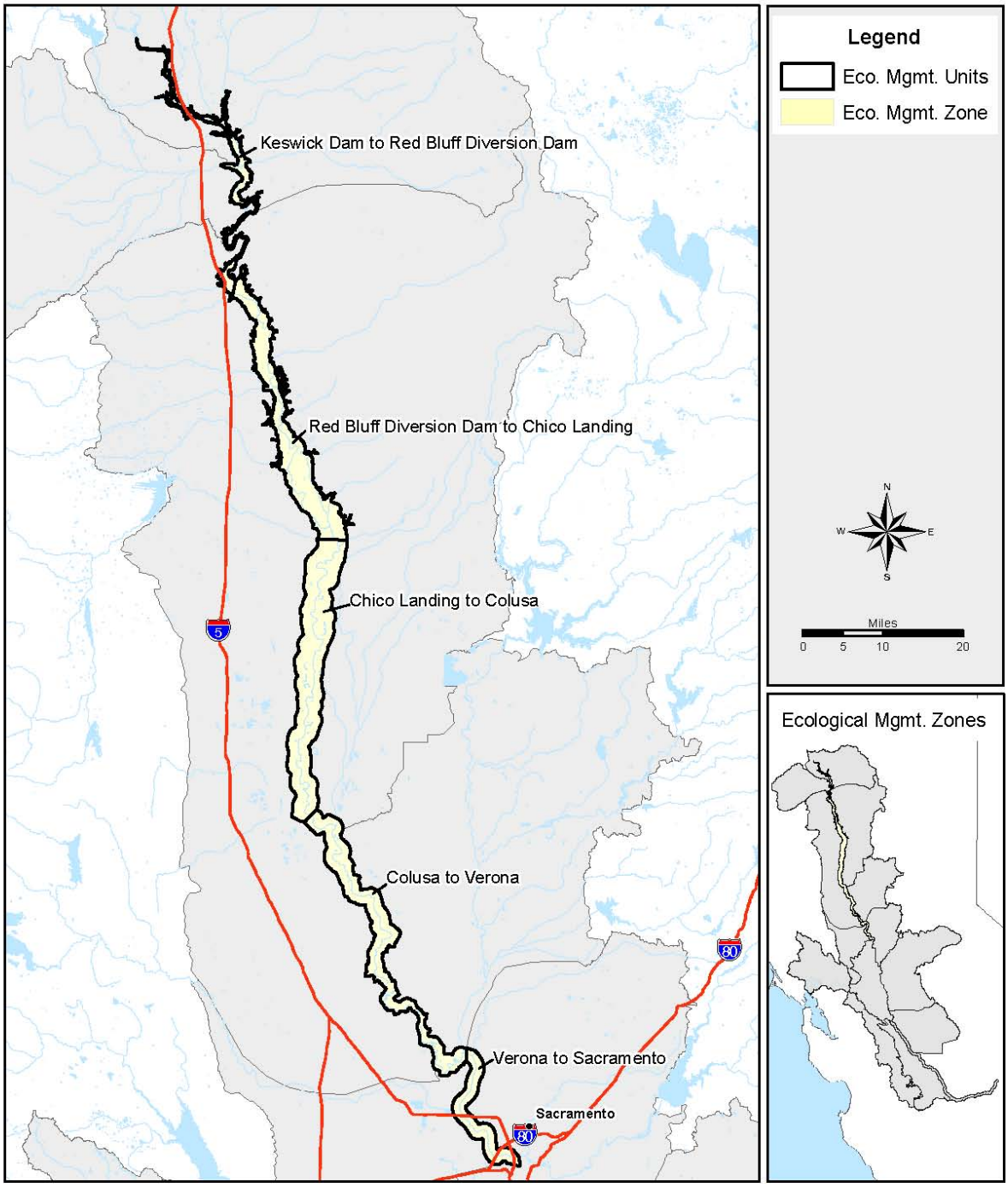

Figure 1. Sacramento River Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Sacramento River EMZ Map

Sacramento River flow is controlled during much of the year by water releases from Keswick and Shasta dams. Tributaries, including many with no major storage dam, provide a significant quantity of flow accretion, particularly through winter and spring months. Prior to the construction of Shasta Dam, the river flows near Redding had a typical winter and spring high-flow period and a summer low-flow period. Dry-year flows typically reached a peak near a monthly average of 10,000 cubic feet per second (cfs) in March. In more normal years, peak flows reached approximately 20,000 cfs in March. Low summer flows averaged less than 5,000 cfs in dry and normal years. Since completion of Shasta and Trinity dams, stream flows in the Sacramento River have changed markedly. Late-winter and spring flows in dry and normal years are stored in reservoirs and released during the late-spring through fall irrigation season. In addition to flows released for irrigation in recent years, flows in excess of 10,000 cfs have been augmented to assist in controlling temperature for survival of winter-, spring-, and fall-run Chinook salmon spawning, egg incubation, and early rearing in the upper portions of the Sacramento River EMZ.

Keswick to Red Bluff Diversion Dam EMU

The Keswick Dam to Red Bluff Diversion Dam EMU (59 river miles from RM 302 downstream to RM 243) includes the mouths of Ash, Bear, Cow, Inks, Stillwater, Anderson, Battle, and Paynes Creeks draining Mount Lassen, and of Spring, Clear, and Cottonwood creeks draining the Coast Range and Klamath Mountains. Much of the river in this reach flows through confined canyons, although portions have a broader floodplain. About four miles downstream of Keswick Dam, the Sacramento River widens to about 500 feet before entering the alluvial plains of the Sacramento Valley, downstream of the town of Red Bluff. This reach includes much urbanized and residential river frontage, but is not contained by levees as is common on the downstream reach. More than 75% of naturally spawning Chinook salmon in the Sacramento River use this reach, while the remaining spawners use the reach from the Red Bluff Diversion Dam, downstream to Princeton, near Colusa.

Red Bluff Diversion Dam to Chico Landing EMU

The Red Bluff Diversion Dam to Chico Landing Reach (49 miles from RM 243 to RM 194) includes the mouths of eastside tributaries of the Sacramento River that drain Mount Lassen and the northern Sierra Nevada, including Antelope, Mill, Deer, Pine, Rock, and Big Chico creeks. Westside streams that drain the upper valley and parts of the Coast Range include Elder and Thomes creeks. South of Red Bluff, the river meanders over a broad alluvial floodplain confined by older, more consolidated geologic formations (i.e. more cohesive deposits resistant to bank erosion). The extent of river floodplain and active channel meander belt from Red Bluff to Chico Landing has remained relatively unchanged and includes a significant amount of riparian forest and wildlife.

Chico Landing to Colusa EMU

The Chico Landing to Colusa reach (51 miles from RM 194 to RM 143) includes the mouth of Stony Creek and no other major tributaries. In this reach, most of the high flow during storm runoff events leaves the river along the east bank and enters the expansive floodplain of Butte Basin through three major flood relief outfalls at M&T Ranch, 3B's, and Parrot Ranch, and farther downstream through the Moulton and Colusa weirs near Colusa. Much of the river downstream of Chico Landing has been subject to flood control with an extensive system of setback levees, basin and bypass outflows, and streambank protective measures, such as riprap. However, considerable riparian forest remains within the levees along the active channel.

Colusa to Verona EMU

The Colusa to Verona reach (63 miles from RM 143 to RM 80) includes the mouth of Butte Creek at the Butte Slough outfall gate, but no significant tributary inflow until the Colusa Basin drain enters the river near Knights Landing at RM 90. In past years outflow at the Colusa Basin Drain has contributed to attraction of adult Chinook salmon from their normal migratory pathway of the Sacramento River. Fish that stray into the Colusa Basin Drain are subject to stranding and loss from the spawning population. High flows leave the river by way of the Colusa and Tisdale weirs. Farther downstream, most flow from the Sutter Bypass/Butte Slough and Sacramento River leaves the river again at the Fremont weir and flows down the Yolo Bypass to the Delta at Rio Vista. Most of the levees in this reach are built close to the main river channel, and little riparian forest or shaded riverine aquatic habitat remains.

Verona to Sacramento EMU

The Verona to Sacramento EMU (20 miles from RM 80 to RM 60) includes important tributary inflow from the Feather River (and from Sutter Bypass and Butte Creek during high flows) at RM 80 and from the American River at RM 60. High-flow outfall from the rivers and Sutter Bypass enters the Yolo Bypass via the Fremont Weir. As with the upstream reach, most of the levees in this reach are built close to the main river channel, and little riparian forest or SRA habitat remains.

Applicable ERP Vision

The vision for the Sacramento River EMZ includes improving, restoring, and maintaining the health and integrity of the Sacramento River riverine-riparian and tributary ecosystems to provide healthy conditions for sustainable fish and wildlife populations and the plant communities on which they depend. The vision can be obtained through preservation and restoration of erosional and depositional channel and floodplain forming processes, riparian and wetland habitats, spawning gravel recruitment,

reducing the extent and influence of stressors and managing stream flow and flow regime to benefit ecosystem health. Restoring the health and integrity of the Sacramento River EMZ will provide a productive and resilient foundation for the recovery of the Bay-Delta estuary and the associated fish, wildlife, and plant resources (CALFED Bay Delta Program, 2000a). In addition to the vision for the Sacramento River EMZ, individual visions have been developed for ecological processes, habitats, stressors, species, and EMUs. They will be described in detail below.

Keswick to Red Bluff Diversion Dam EMU

The vision for the Keswick Dam to Red Bluff Diversion Dam EMU is to protect ecological processes, where still intact; allow riparian forests to reach maturity; restore physical and successional processes; and protect and restore freshwater fish habitats that provide migration, spawning, and rearing for Chinook salmon and steelhead (CALFED Bay Delta Program, 2000a).

Red Bluff Diversion Dam to Chico Landing EMU

The vision for the Red Bluff Diversion Dam to Chico Landing EMU is to protect and expand the quantity and quality of the stream meander corridor; protect the associated riparian forest and allow it to reach maturity; install positive barrier fish screens to protect young fish; maintain flows that emulate the natural hydrology to the extent possible; and recover or contribute to the recovery of threatened, endangered, and special concern species (CALFED Bay Delta Program, 2000a).

Chico Landing to Colusa EMU

The vision for the Chico Landing to Colusa EMU is to improve habitat and increase survival of many important fish and wildlife resources by preserving, managing and restoring a functioning ecosystem that provides a mosaic of varying riparian forest age classes and canopy structure; maintaining a diversity of habitat types, including forest and willow scrub, cut banks and clean gravel bars, oxbow lakes and backwater swales with marshes, and floodplain valley oak/sycamore woodlands with grassland understory; maintaining uninterrupted gravel transport and deposition; supporting a complexity of shaded and nearshore aquatic substrate and habitats with well distributed instream woody cover and organic debris; setting back levees; and the installing positive barrier fish screens (CALFED Bay Delta Program, 2000a).

Colusa to Verona EMU

The vision for the Colusa to Verona EMU is to improve habitat and increase survival of many important fish and wildlife resources; set back levees to improve conditions for riparian vegetation and limited stream meander; provide flows that emulate the natural

flow patterns; and install positive barrier fish screens to protect young fish (CALFED Bay Delta Program, 2000a).

Verona to Sacramento EMU

The vision for the Verona to Sacramento EMU is to maintain a natural flow pattern; maintain high-quality nursery and migration habitat for adult and juvenile winter-run Chinook salmon and steelhead and other anadromous fish species; emulate the natural hydrologic regime to the extent possible; maintain natural stream meander processes and gravel recruitment and deposition; maintain a limited but continuous riparian corridor; provide water temperatures suitable to support Chinook salmon, steelhead, and other anadromous fish; reducing potential fish losses resulting from toxic residues from agricultural tailwater; and install positive barrier fish screens to protect young fish (CALFED Bay Delta Program, 2000a).

Stage 1 Expectations

Stage 1 expectations for the Sacramento River EMZ included efforts to protect, enhance and restore the meander belt between Red Bluff and Chico Landing, evaluate the feasibility of setting back levees between Chico Landing and Verona, and evaluating the feasibility of revegetating levees between Verona and Collinsville (CALFED Bay Delta Program, 2000b). The expectations also included an evaluation of the need to screen all diversions smaller than 100 cfs on both the mainstem Sacramento River and selected tributaries and an evaluation of alternative structural and operational actions to reduce or prevent fish from straying into the Colusa Basin Drain.

Changes Attributable to ERP

A total of 77 projects have been funded by ERP that would benefit the Sacramento River EMZ. The projects are focused on stream meander, natural floodplain and flood processes, Central Valley stream temperatures, riparian and riverine aquatic habitat, freshwater fish habitat and essential fish habitat, and water diversions.

Sacramento River EMZ-wide

As shown in Table 1, 31 projects were funded that would benefit the entire Sacramento River EMZ. The projects are focused on ecosystem processes, habitats and stressors. The majority of the projects have focused on research and monitoring (14 projects). The research and monitoring projects have provided valuable information regarding the Sacramento River EMZ. The remaining projects focused on implementation (six projects), planning (six projects), acquisition (four projects) and pilot/demonstration

(one project). Table 1 shows the ERP Targets for the Sacramento River EMZ (full text in previous section) and the projects that have contributed to each target.

The *Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed* (**ERP-02D-P57**) is a multi-phased project that has contributed important biological information on green sturgeon. In addition, *Spawning Areas of Green Sturgeon in the Upper Sacramento River* (**ERP-98-C13**) provided information useful for management activities. Green sturgeon is classified as an MSCS species and a CALFED at-risk species. The assessment focused on determining the biological characteristics of the green sturgeon and its habitats with the objective of providing information useful for their recovery and protection. The results of these assessments indicate that the reach of the Sacramento River adjacent to the Glen Colusa Irrigation District pumping plant holds a large aggregation of green sturgeon, which are vulnerable to sport angling. Protecting these fish from illegal harvest would assist in achieving the ERP target for harvest of fish and wildlife. When evaluating spawning areas for green sturgeon in the Sacramento River, it was concluded that they spawn both upstream and downstream of the Red Bluff Diversion Dam. However, the timing the closure of the gates at the Red Bluff Diversion Dam impedes the upward migration of some late-migrating green sturgeon. Keeping the gates open for an additional six weeks would enable those sturgeon to move upstream of the dam, assisting in achieving the ERP targets of reducing stressors. These studies also concluded that elevated water temperatures experienced by pre-larvae sturgeon can lead to deformities and/or death. This conclusion stresses the importance of meeting the target for stream temperatures.

The *Sacramento River Small Diversion Fish Screen Program - Mechanical Monitoring and Maintenance Project* (**ERP-00-R01**) was a demonstration project to provide guidance for successful monitoring for operation and maintenance of previously installed small diversion fish screens. Successful implementation of this project will contribute to the ERP goals of reducing stressors such as water diversions, thus increasing survival of salmonids.

The *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program* (**ERP-04D-S08a**, **-b**, **-c**) is an ongoing collaborative project between CDFG, PFMC, and USFWS that provides annual monitoring of abundance, migration timing, and distribution of adult winter, spring, late-fall, and fall-run Chinook salmon returning to spawn in the Upper Sacramento River Basin. Multiple years of continuous monitoring is needed in order to make effective decisions about fisheries management. Data obtained from this project also helps achieve ERP goals of recovery of at-risk native species and maintaining and/or enhancing populations of selected species for sustainable commercial and recreational harvest. This project also meets a MSCS milestone to monitor adult anadromous salmonids returns in each watershed within the MSCS focus area of the Sacramento River.

The purpose of the *Sacramento River Floodplain Acquisition and Riparian Forest Restoration Project* (**ERP-97-N02**) was to acquire fee title or permanent conservation easements on lands within the Sacramento River Conservation Area. The objectives of the project were to protect essential spawning, rearing and migratory pathways for Chinook salmon, steelhead, white and green sturgeon and Neotropical migratory birds and waterfowl; protect large continuous blocks of existing and restorable aquatic and riparian habitat; and protect and allow for recovery of the 150-year meander belt. Approximately 1,841 acres were acquired in fee title or acquired as permanent conservation easements. The project contributed to the ERP targets for natural floodplain and flood processes, riparian and riverine aquatic habitats, and freshwater fish habitat and essential fish habitat, while accomplishing a number of ERP goals such as recovery of natural processes, the recovery of priority species, and reconnecting the floodplain. As a continuation of **ERP-97-N02**, the *Floodplain Acquisition, Management, and Monitoring on the Sacramento River* (**ERP-98-F18**) project and the *Floodplain Acquisition and Sub-reach/Site Specific Management Planning on the Sacramento River- Red Bluff to Colusa* (**ERP-00-F03**) were funded. The projects acquired over 1,733 acres of lands adjacent to the Sacramento River, within the Sacramento River Conservation Area to protect, restore and improve essential spawning, rearing, and migratory habitat for Chinook salmon and other riparian species, as well as supporting the river's natural ecological processes. These projects contributed to the ERP targets for stream meander, natural floodplain and flood processes, riparian and riverine aquatic habitats, and freshwater fish habitat and essential fish habitat. Affected MSCS species include Chinook salmon, steelhead trout and white and green sturgeon.

The *Lower Sacramento River Riparian Habitat Restoration Project* (**ERP-96-M03**) had goals to increase the amount of shaded riverine aquatic habitat through revegetation of selected sites along the Sacramento River. Funding for this project supported completion of a feasibility study to identify potential sites of which five were chosen for revegetation. Plans and designs for revegetating these sites were developed to a level of detail to estimate the costs for plants at the water/revetment interface. In-water habitat, such as berms and fish groins, were also considered and evaluated. One of the candidate sites was developed further as a demonstration project. An important goal of this project was the evaluation of the impact that riparian habitat restoration has on both the Sacramento Flood Control System and the non-project levees in the Delta and adjoining areas.

The *Ecosystem and Natural Process Restoration on the Sacramento River: Active Restoration of Riparian Forest Project* (**ERP-97-N03a**) and *Sacramento River Floodplain Acquisition and Riparian Forest Restoration Project* (**ERP-97-N03b**) were both full-scale implementation projects. Overall, both projects restored approximately 377 acres of flood-prone, weed-dominated, and abandoned farmland habitat, into mixed riparian forest, along the Sacramento River. Over 18,000 native plants, such as arroyo willow, valley oak, cottonwood, Oregon ash, box elder, black willow, and native

grasses, were planted. Monitoring of the restored acres indicated good plant survival, attaining at least a 75% survivorship goal. The restored acres increased the extent of important riparian forest communities and provided important migration stopover and breeding habitat for Neotropical migratory birds. Both projects contributed to the ERP targets for stream temperatures, riparian and riverine aquatic habitats, and freshwater fish habitat and essential fish habitat.

The purpose of the *Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning and Coordination Project* (**ERP-97-C03**) was to implement the riparian ecosystem portion of the Upper Sacramento River Fisheries and Riparian Habitat Management plan (SB 1086) through the development of a local non-profit entity for watershed management and planning on the Sacramento River. A coordinator was hired to assist with watershed management and planning and the Sacramento River Conservation Area Forum (SRCAF) was established to coordinate conservation and restoration efforts within the Sacramento River Conservation Area, to encourage cooperative management and decision making between agencies, landowners, agricultural communities and local governments on natural resource issues within the floodplain of the Sacramento River. The overall goal of the management program of the SRCAF is to preserve remaining riparian habitat and reestablish a continuous riparian ecosystem along the Sacramento River between Redding and Chico, meeting ERP targets for riparian and riverine aquatic habitats and freshwater fish habitat and essential fish habitat. The *Sacramento River Conservation Area Program Project* (**ERP-01-N28**) continued the work started in *Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning and Coordination Project* (**ERP-97-C03**). Funding provided years two and three of the Sacramento River Conservation Forum. The SRCAF continued to meet and provided a means by which stakeholders could raise issues on Sacramento River management and mutually beneficial solutions could be sought. The SRCAF also expanded their focus and worked on providing resources, such as a programmatic Safe Harbor Agreements, to provide protection for landowners and listed species. The *Sacramento River Conservation Area Program Project* (**ERP-06D-S15**) will continue the SRCAF until 2010.

The *Sacramento River Restoration: Chico Landing Sub-Reach (RM 178-206)* (**ERP-02D-P65**) project is an ongoing effort, scheduled to end in 2010. This project plans to conduct restoration planning and research on three sites within the Chico Landing Sub-reach in preparation for future restoration. All sites are located within a portion of the Sacramento River Conservation Area.

To protect juvenile salmonids in a portion of the Sacramento River especially critical for the endangered winter-run Chinook salmon, ERP funded the *Water Diversion Screening project* (**ERP-97-C04a**). The project resulted in the construction and/or upgrade of 14 fish screens and one fishway in the section of the Sacramento River between Keswick Dam and the Red Bluff Diversion Dam. In addition to installing screens, the project also

completed an inventory to identify and prioritize water diversions for screening on the Sacramento River. A total of 53 diversions in Shasta and Tehama Counties were examined and catalogued. The diversions were prioritized based on the size and distance each diversion was from the area downstream of Keswick Dam, which provides the major spawning and rearing areas for MSCS species including winter-run and spring-run Chinook salmon. The list will be used for future project development. Overall, the project helped achieve the ERP target for eliminating stressors associated with water diversions, by reducing entrainment of juvenile salmon.

The *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development project* (**ERP-01-N30**) improved the accuracy and availability of soils data in the Bay-Delta region. The project obtained updated imagery, recompiled original soil survey atlas sheets, developed soil attribute tables, digitized soil boundaries and certified digital linework and attribute tables. The project produced two digital data layers, a Digital Orthophotoquad (DOQ) layer and a certified electronic digital soils data layer with accompanying soil property and interpretations attribute tables, for nine soil survey areas, located in the Shasta area, Glenn County, Nevada County, the Amador area, the Eastern Stanislaus area, the Merced area, the Madera area, Tehama County, and Sonoma County.

At the time of this writing, the *Sacramento River Riparian Monitoring and Assessment Consolidated Project* (**ERP-04-S11**) started in April 2007. The overall goal of this project is to evaluate whether the habitat and populations of certain endangered and other at-risk species are recovering, whether the ecological processes are being rehabilitated, protected and restored, and whether the impacts from non-natives invasive species are being reduced for ERP funded project sites within the Sacramento River EMZ. This level of information is critical for the evaluation of species of concern such as Valley elderberry longhorn beetle and Chinook salmon (both MSCS species), and assessing the overall success of ERP within the Sacramento River EMZ.

The *Geomorphic Model for Demonstration and Feasibility Assessment of Setback Levees: Bay-Delta River Systems Project* (**ERP-99-N18**) developed a meander migration model to examine the relationship between setback distance and habitat formation through a measure of the land reworked. Results suggest that management decisions concerned with land reworked could usefully identify the site-specific "restriction of cutoff" thresholds to optimize habitat benefits versus cost of acquired land.

The *Arundo Donax: Survey and Eradication Project* (**ERP-01-N04**) was originally intended to identify and eradicate areas infested by *Arundo donax* (giant reed) and *Tamarix* (salt cedar), on Red Bank Creek and Reed's Creek, tributaries to the Sacramento River. The project area encompassed approximately 630 acres of stream bed and banks and 16.7 km of stream channel. The degree of infestation of *Tamarix* discovered during the mapping and on-the-ground surveys caused project managers to

concentrate efforts on that species, testing eradication methods and revegetation success following eradication. The project also examined how native plant abundance and diversity varied among successfully eradicated areas that were actively vs. passively restored, through the implementation of two test sites on Red Bank Creek in areas of heavy *Tamarix* infestation. It was determined that mulching, along with herbicidal spraying, was much more effective at controlling *Tamarix* than spraying alone. Mulched and sprayed areas showed a 97% reduction in *Tamarix*; whereas, sprayed areas showed a 46% reduction. When native vegetation was allowed to recover naturally (passive restoration), mulched *Tamarix* achieved 63.3% native cover and 6.2 native species as compared to 34.5% native cover and 4.6 native species for dead standing *Tamarix* plots. Active restoration subplots (within the mulched *Tamarix* areas) were planted with native species such as cottonwood, several willow species and grasses. Active restoration mulched plots achieved 86.1% native cover and 8.4 native species as compared to 63.4% native cover and 6.2 native species for passively restored mulched plots. Thus, mulching following herbicide application is recommended as an eradication technique for *Tamarix* regardless of whether active restoration is employed. Also, active restoration will result in the greatest success of native species to replace *Tamarix*. This project contributed information that met the invasive riparian and marsh plant reduction target for the Sacramento River EMZ.

The overall goal of *Providing Landowner Incentives to Encourage Riparian Restoration and Natural River Processes on Working Landscapes* (**ERP-05-S25**) is to encourage and facilitate the stewardship and restoration of riparian habitat on agricultural lands within the Sacramento River Conservation Area, through the initiation of a Coordinated Conservation Effort that provides landowners incentives and assurances needed to incorporate habitat restoration into their agricultural activities.

Evaluations for the following projects can be found in the following report sections:

- *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs* (**ERP-02-P17**): American River EMZ
- *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**): American River EMZ
- *Hamilton City Flood Damage Reduction and Ecosystem Restoration* (**ERP-02-C05-D**): Sacramento River EMZ
- *Restoration of the Confluence Area of the Sacramento River, Big Chico and Mud Creeks* (**ERP-02-P16-D**): Sacramento River EMZ
- *Implementing a Collaborative Approach to Quantifying Ecosystem Flow Regime Needs for the Sacramento River* (**ERP-02D-P61**): Sacramento River EMZ
- *M&T/Parrott Pumping Station and Fish Screen Project* (**ERP-95-M05**): Sacramento River EMZ
- *Hamilton City Flood Damage Reduction and Ecosystem Restoration Project* (**ERP-05D-C01**): Sacramento River EMZ

Keswick to Red Bluff EMU

As shown in Table 1, 14 projects were funded by ERP that work toward meeting ERP targets in the Keswick to Red Bluff EMU. The majority of the funded projects were full-scale implementation projects, which contributed to several ERP targets. The remaining projects focused on monitoring (three projects), planning (two projects) and acquisition (one project). The monitoring projects provided valuable information regarding the Keswick to Red Bluff Diversion Dam EMU and the two planning projects lead to a full-scale implementation project to improve fish passage.

Four projects (in three phases) were funded to enhance the survival of returning adult salmon to the spawning habitat between the Anderson-Cottonwood Irrigation District (ACID) diversion dam (near Redding, California) and Keswick Dam on the Sacramento River by constructing two fish ladders and improving a screen at the ACID dam, improving fish passage. Two of the four projects were planning projects. The *Fish Passage Improvement Project under Bay Delta Project - Category III* (**ERP-98-B03**), a planning project, was Phase I of the overall project to improve fish passage. The tasks for Phase I included preliminary design of the fish ladder and screens, final design, environmental documentation, and permitting. The *Fish Passage and Fish Screening Improvement Project, Phase II* (**ERP-98-B24**), a planning project, completed the final design of the fish passage facilities, and provided environmental documentation, and permitting for the improved fish passage structures at the ACID diversion dam.

Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement (**ERP-01-N44** and **ERP-04D-S09**) are projects that have been obtaining juvenile winter Chinook production indices and correlating these indices with estimated escapement from adult counts at the Red Bluff Diversion Dam and the winter-run carcass surveys, since 1994. These projects also provide information to define seasonal and temporal patterns of abundance of winter-run Chinook (a MSCS species) passing Red Bluff Diversion Dam. Information on all life stages is essential in order to make effective management decisions on this endangered Chinook salmon run. Data obtained from these projects will help achieve ERP goals of recovery of at-risk native species. These ongoing projects also help contribute to the ERP target to reduce losses of juvenile salmon due to entrainment at water diversions.

The *Sacramento River Chinook Salmon Carcass Survey* (**ERP-01-N46**) was a three-year monitoring project that continued work that started in 1996. The objectives of the annual winter-run Chinook salmon (a priority MSCS species) carcass surveys were to 1) estimate the population of winter-run Chinook salmon in the mainstem Sacramento River based on a carcass mark and recapture survey, and 2) obtain base-line information on spawning distributions, environmental conditions during spawning and characteristics of the winter-run Chinook spawning population in the upper Sacramento River. The results of the survey estimate that there were approximately 8,224, 7464

and 8,218 winter-run Chinook salmon spawners in the Sacramento River between Keswick and the Red Bluff Diversion Dam during the survey periods of 2001, 2002 and 2003, respectively. Data obtained from this project helps achieve ERP goals of recovery of at-risk native species. This project also meets a MSCS milestone to monitor adult anadromous salmonids within the MSCS focus area of the Sacramento River.

The *Water Utility Fish Screen Rehabilitation Project* (**ERP-00-B01**) was a full-scale implementation project that contributed to the target of eliminating stressors associated with water diversions. The project installed a positive fish barrier screen on an intake structure within the Sacramento River. The barrier adhered to standards set forth by the National Marine Fisheries Service and Department of Fish and Game. The barrier reduced and/or eliminated entrainment losses of priority MSCS species including winter-run, spring-run, fall-run, and late-run Chinook salmon, and steelhead trout.

The *Riparian Corridor Acquisition and Restoration Assessment Project* (**ERP-99-B12**) was a two-phase acquisition project. The first phase resulted in the acquisition or conservation easements on approximately 1,412 acres of land, which included three miles of Sacramento River frontage and 4.5 miles of Battle Creek frontage. Phase two consisted of the preparation of a habitat restoration assessment of the Sacramento River area that encompassed the 1,412 acres of land and additional lands under Bureau of Land Management to determine restoration potential for the existing lands and future potential acquisitions within the affected area. The project area included ten miles of riparian and meander corridor; this habitat supports critical activities for a wide variety of species, including spawning and rearing areas for winter-run, spring-run, late fall-run Chinook salmon, steelhead, Pacific lamprey, nest sites for bank swallows, and habitat for the Valley elderberry longhorn beetle, all important MSCS species. This project contributed to the ERP targets for stream meander, riparian and riverine aquatic habitats, and freshwater fish habitat and essential fish habitat.

Several full-scale implementation projects were funded to provide education outreach programs through the *Sacramento River Discovery Center - the Expand Bird Monitoring, Develop a Native Grass Plot, and Enhance Public Involvement with Access to Native Plant Garden Surrounding the Discovery Center Project* (funded twice: **ERP-98-B33** and **ERP-99-B20**) and the *Watershed Education, Headwaters to Ocean Project* (**ERP-01-N33**). All of these related educational programs taught about the complexities of watersheds and the need to build partnerships with all watershed stakeholders to best manage resources for the health of the watershed system. Specific programs include bird studies in partnership with Point Reyes Bird Observatory, native grass studies and revegetation work with Los Robles Native Plants, and Discovery Garden, to be used as a model for developing sites using native and drought tolerant plants. In addition to the three programs just mentioned, *Watershed Education, Headwaters to Ocean Project* (**ERP-01-N33**) also introduced two additional programs – a program that involved mapping and eradication of several invasive plant species along the Sacramento River and a program that provided educational displays at several locations. For the bird

studies, student interns learned bird identification skills, and monitored and maintained bird boxes. In addition, over 200 school children participated in a bird program during the first year of the program. For the native grass studies, students broadcasted native grass seeds and inserted over 3,000 native grass plugs into an area approximately 1,200 square feet. The study indicated that all seedlings established themselves very well. The Discovery Garden program proved to be very successful. Students produced over 2,000 native plant seedlings and young cuttings for plant sales in the three year period of the project. Discovery Center, high school, and agency staff provided student and volunteer education about plant identification, propagation, annual care, and garden maintenance. For mapping program, students learned how to use GPS units and mapped the location of giant bamboo - *Arundo donax,* tree of heaven – *Ailanthus altissima,* and salt cedar – Tamarisk, all targeted invasive species, near the Discovery Center, along the Sacramento River. It was determined that the real problem with Tamarisk and Arundo exists upstream of the Discovery Center, along the Sacramento River and its tributaries. The Discovery Center and its volunteers can eradicate the species on site and on adjacent properties but the seed comes from upstream watersheds. Tackling the upstream invasive vegetation, then working slowly downstream is the long-term solution to the problem. This program contributed to the ERP target for Invasive Riparian and Marsh Plants as well as improving Freshwater Fish Habitat and Essential Fish Habitat.

Four projects (in three phases) were funded to enhance the survival of returning adult salmon to the spawning habitat between the Anderson-Cottonwood Irrigation District (ACID) diversion dam (near Redding, California) and Keswick Dam on the Sacramento River by constructing two fish ladders and improving a screen at the ACID dam, improving fish passage. Two of the four projects were full-scale implementation projects. The *Anderson-Cottonwood Irrigation District Fish Passage and Fish Screen Improvement Project, Phase III* (**ERP-99-B03**) and the *ACID Fish Passage Improvement Project, Phase III* (**ERP-99-N01**) included the construction of the fish passage facilities, construction management, mitigation and monitoring of the new facilities. Installation of the fish screens and ladders reduced entrainment of anadromous fish and promote safe passage for all runs of Chinook salmon, steelhead trout, green and white sturgeon, all priority MSCS species. These four projects (including 2 planning projects) contributed to ERP targets for reducing losses of anadromous fish due to entrainment at water diversions and dams and other structures. In addition, the overall project completed the ERP programmatic action which called for the upgrade of fish passage facilities at the Anderson Cottonwood Irrigation Diversion dam.

The *Small Fish Screen Diversion Program on the Sacramento River Project* (**ERP-98-R01**) is a continuation of *Sacramento River Small Diversion Fish Screen Program - Mechanical Monitoring and Maintenance Project* (**ERP-00-R01**). The purpose of the full-scale implementation project was to promote the installation and use of fish screens on small irrigation diversions and provide technical and financial assistance to

landowners who voluntarily requested assistance with fish screen installation. Installation of fish screens were completed on seven diversions and new applications were received from at least 17 farmers for participation in the program. Successful implementation of this project contributed to the ERP goals of reducing stressors such as water diversions, thus increasing survival of salmonids.

The Sacramento River: Gravel Restoration Project Below Keswick Dam (**ERP-95-M04**) was a full-scale implementation project that contributed toward the ERP targets for coarse sediment supply and freshwater fish habitat and essential fish habitat. Over 7,000 tons of gravel was placed into the Sacramento River downstream of Keswick Dam to improve spawning areas for Chinook salmon and steelhead, both MSCS species. The spawning and rearing habitat on the Sacramento River between Keswick Dam and Cottonwood Creek has been severely degraded due to blockage of stream gravel migration by Shasta and Keswick dams, gravel mining, bank protection and levee construction.

Red Bluff Diversion Dam to Chico Landing EMU

As shown in Table 1, five projects were funded by ERP that work toward meeting ERP targets in the Red Bluff Diversion Dam to Chico Landing EMU. Three of the funded projects were planning projects. These planning projects evaluated alternatives for operating the Red Bluff Diversion Dam (RBDD) in a way that maximizes fish passage while minimizing the impacts to agricultural water supply by means of a new screened intake structure to the Tehama-Colusa Canal and Corning Canal. The remaining projects focused on monitoring (one project) and acquisition (one project). The ongoing monitoring project provides valuable information on salmonid migration for the Red Bluff Diversion Dam to Chico Landing EMU. The acquisition project acquired an important parcel on the Sacramento River

The *Fish Passage Improvement Project at the Red Bluff Diversion Dam* (**ERP-98-B22**) was the first phase of a two phase project. This planning project examined alternatives for operating the Red Bluff Diversion Dam (RBDD) in a way that maximizes fish passage while minimizing the impacts to agricultural water supply by means of a new screened intake structure to the Tehama-Colusa Canal and Corning Canal. The primary biological/ecological objective of this project is to reduce or minimize the adverse impacts of the RBDD on juvenile and adult anadromous fish populations. The approach of this project was to identify concepts and potential sites for facilities that will provide a year-round water supply to the canals with reduced or eliminated reliance on gravity diversion a the RBDD. This project provided a project implementation plan, development of a biological monitoring plan and development of a preliminary concept report. The *Fish Passage Improvement at the Red Bluff Diversion Dam, Phase II project* (**ERP-99-B07**) and the *Fish Passage Improvement at the Red Bluff Diversion Dam: Balance of Phase II Funding project* (**ERP-01-N58**) continued the planning work started during *Fish Passage Improvement Project at the Red Bluff Diversion Dam* (**ERP-**

98-B22). Together, *Fish Passage Improvement at the Red Bluff Diversion Dam, Phase II project* (**ERP-99-B07**) and *Fish Passage Improvement at the Red Bluff Diversion Dam: Balance of Phase II Funding project* (**ERP-01-N58**) accomplished the following activities: preliminary design, evaluation and screening of alternatives, environmental documentation, public involvement, and, preliminary permitting. Additional funding would be needed to complete Phase III, final design of the intake structure; Phase IV construction of a new or improved facility outlined in Phase III; and, Phase V, post construction monitoring of the new or improved facilities. If construction of a new facility proceeded, the project would meet the ERP target for reducing losses of anadromous fish, including winter-run Chinook salmon (a MSCS species) due to entrainment at dams and other structures and water diversions. In addition, if construction was funded, the overall project would complete the ERP programmatic action which called for the upgrade of fish passage facilities at the Red Bluff Diversion Dam. However, at the time of this writing, funding for construction of a new facility has not been secured.

Juvenile Anadromous Salmonid Emigration Monitoring on the Sacramento River at the Glenn-Colusa Irrigation District Fish Screen Bypass Channel (**ERP-04D-S06**) is an ongoing project that continues an existing DFG juvenile salmonid monitoring site (screw trap) located at the Glenn-Colusa Irrigation District diversion on the Sacramento River near Hamilton City. The project has, and will continue to provide monitoring information to guide operational decisions for state and federal export facilities and Environmental Water Account assets. Data obtained from this project will help achieve ERP goals for recovery of Chinook salmon, an at-risk native species and MSCS species. This monitoring data will also supplement the data from other out-migrant monitoring projects being conducted in the Sacramento River Basin.

The *Sacramento River Meander Restoration project* (**ERP-97-N04**) acquired a 94.55 acre parcel adjacent to the Sacramento River. The property was added to the Sacramento River National Wildlife Refuge and we be managed in perpetuity by the U.S. Fish and Wildlife Service as part of its normal refuge operations. The acquisition of this parcel reconnects 600 acres of floodplain to the Sacramento River. Ten acres of the property were restored to mixed riparian forest, valley oak riparian forest, and willow forest, by planting native species such as valley oaks, arroyo willow, coyote willow and California rose. The project accomplished ERP goals and targets by achieving floodplain connectivity and restoring natural processes and habitat. The project also contributed to the ERP targets for stream meander, natural floodplain and flood processes, riparian and riverine aquatic habitats, and freshwater fish habitat and essential fish habitat.

Chico Landing to Colusa EMU

As shown in Table 1, 11 projects were funded by ERP that work toward meeting ERP targets in the Chico Landing to Colusa EMU (EMU). The majority of the funded projects

were planning projects (7 projects) and the remainder were full-scale implementation projects (four projects), which contributed to several ERP targets.

Consistent with the vision for this EMU to protect critical migration habitat required for winter-run, spring-run, and fall-run salmon, several phased projects were funded which resulted in planning and installment of positive-barrier fish screens at water diversions to protect juvenile fish:

- The *Princeton-Codora-Glenn Irrigation District and Provident Irrigation District Fish and Wetlands Restoration Projec*t (**ERP-96-M05**) and the *Princeton-Codora-Glenn Irrigation District and Provident Irrigation District Fish and Wetlands Restoration Project* (**ERP-96-M07**) were funded to support planning and construction for the consolidation and fish screening of 3 pumping sites in the Princeton-Codora-Glenn Irrigation District and Provident Irrigation District. Additional planning and design efforts were funded to develop a process to protect Princeton-Codora-Glenn Irrigation District and Provident Irrigation District's pumping plant and fish screen facility.
- The *Boeger Family Farms Fish Screen Feasibility Study* (**ERP-98-B02**) and the *Boeger Family Farms Fish Screen Phase II: Construction Project* (**ERP-98-B26**) were funded to support planning and construction for the screening of the Boeger Family Farm pumping plant, an agricultural water diversion on the Sacramento River near Colusa. Final fish screen installation resulted in reduced entrainment of out-migrating steelhead and winter-, fall-, and spring-run salmon.
- The *Princeton Pumping Plant Fish Barriers Feasibility Study* (**ERP-96-M04**) and the *Princeton Pumping Plant Fish Screen Facility Project* (**ERP-97-C02**) were funded to support planning and construction of a positive barrier fish screen for Reclamation District 1004's unscreened diversion on the Sacramento River. These projects involved the planning and construction of a new state-of-the-art screen facility and moving the point of diversion to a new, stable, less fishery sensitive area of the river. The objective of this project is to prevent entrainment of winter-, spring-, and fall-run Chinook salmon, steelhead, splittail, and other high risk species and to assure a reliable year-round supply of water for about 15,000 acres of agricultural land and 10,000 acres of migratory wetlands.
- The ongoing *M & T/Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project* (**ERP-02-P08-D**) will protect the existing M&T/Llano Seco fish-screen facility and its beneficiaries while investigating and identifying a technically and economically feasible long-term solution to adapt the fish-friendly pumping facility to the lateral migration of the Sacramento River.
- The *Tuttle Pump Relocation Project* (**ERP-00-B02**) consists of relocating Tuttle's diversion to the Maxwell Irrigation District's (MID) pumping facility complete with fish screen and removing the existing pumping facilities approximately 450 feet south of the District's plant, thus reducing entrainment risks. The MID fish screen has an automated air blast system to clean the screens which prevent fish

from being drawn into the irrigation pumps. The Tuttle Pump Relocation relocated two vertical turbine pumps (140 HP total) that were not screened, to planned locations within the Maxwell Irrigation District fish screen facility.

The *Sub-Reach Planning for the Sacramento River: River Mile 144-164 Project* (**ERP-02-P27**) is leading planning efforts for the Colusa-Princeton Sub-reach of the Sacramento River. This is a comprehensive approach to restoration planning that includes a high level of stakeholder involvement to develop conceptual restoration plans and analyzes potential benefits to, and impacts of, restoration implementation on surrounding landowners and land uses. This plan is a subset of the Sacramento River Conservation Area goals. This project's main focus is planning associated with the protection and recovery of the river meander zone along a 20 mile reach of the Sacramento River. This is consistent with the vision for this EMU to restore specific processes that maintain high-quality habitat for Chinook salmon and steelhead, which includes continuance of the natural river migration within its meander zone. Stakeholders are working together to find equitable solutions to land use strategies that will provide flood protection, river meander, bank, and riparian habitat restoration and protection.

The *Riparian Restoration Planning and Feasibility Study for the Riparian Sanctuary, Llano Seco Unit Project* (**ERP-02-P39**) and the *Riparian Sanctuary (Phase II) – Bringing Agricultural and Ecological Interests Together for Pumping Plant Protection and Riparian Restoration (Sacramento River Mile 178) Project* (**ERP-05D-S29**) were funded to identify feasible management options and develop a plan that will improve habitat and ecosystem processes on 950 acres of the Riparian Sanctuary at the Sacramento River National Wildlife Refuge, provide ecologically sound protections for the Princeton-Codora-Glenn Irrigation District and Provident Irrigation District's pumping plant and fish screen facility, and increase scientific understanding of riparian restoration.

Colusa to Verona EMU

As shown in Table 1, nine projects were funded by ERP that work toward meeting ERP targets in the Colusa to Verona EMU. The majority of the funded projects were planning projects (five projects), which contributed to several ERP targets. The remaining projects focused on implementation, research and monitoring. Table 1 shows the ERP Targets for the Sacramento River EMZ (full text in previous section) and the projects that have contributed to each target.

Consistent with the vision for this EMU to protect critical migration habitat required for winter-run, spring-run, and fall-run salmon, several phased projects were funded which resulted in planning and installment of positive-barrier fish screens at water diversions to protect juvenile fish:

- The *Feasibility Study for Intake Screen at Wilkins Slough Diversion Project* (**ERP-96-M19**) and the *Positive Barrier Fish Screen Project, Wilkins Slough Pumping Plant Project* (**ERP-97-C01**) analyzed the feasibility of designing and installing a positive fish barrier intake screen at Reclamation District 108's Wilkins Slough Diversion on the Sacramento River for protection of Chinook, splittail, and other fish species. Final construction of the positive fish barrier intake screen was completed in December 1999. The *Wilkins Slough Positive Barrier Fish Screen Sediment Removal System project* (**ERP-02D-P69**) supported the addition of sediment removal facilities to the existing fish screen at Reclamation District 108's Wilkins Slough Diversion Project, reducing unanticipated sediment buildup in the irrigation canal inland of the screen, which was impairing the screen's performance.
- The *Richter Brothers Anadromous Fish Screen Project* (**ERP-98-B01**) evaluated alternative concepts for the screening of three water diversion facilities owned by the Richter Brothers and Furlans on the Sacramento River near Knights Landing. The goals of this project were to ultimately reduce entrainment of out-migrating salmon and steelhead.
- The *Sutter Mutual Water Company Tisdale Positive Barrier Fish Screen and Pumping Plant Project* (**ERP-02-P24**) and the *Tisdale Positive Barrier Fish Screen/Pumping Plants Project - Phase IV* (**ERP-02D-P70**) completed a feasibility study and preliminary design to evaluate the engineering feasibility, environmental considerations, costs, and benefits of several potential alternatives in an effort to install a new screen structure at the Tisdale diversion on the Sacramento River in conjunction with an upgrade and modernization of the Tisdale Pumping Plants. The project resulted in a constructed a fish screen to minimize entrainment of fish at the Tisdale (960 cfs capacity) Irrigation Water Diversion on the Sacramento River's east bank, south of Meridian.
- *Reclamation District No. 108 Consolidated Pumping Facility and Fish Screen Project* (**ERP-02-P10-D**) and the *RD 108 Combined Pumping Plant/Fish Screen Project (Phase IV-Construction)* (**ERP-06D-S14**) provided for the overall planning, engineering design, and construction for the consolidation and screening of three (of seven) of Reclamation District No. 108's Sacramento River diversions. In lieu of constructing three fish screens, an alternative was developed that combines the existing Boyers Bend Pumping Plant, Howells Landing Pumping Plant, and Tyndall Mound Pumping Plant into one facility with a maximum capacity of 300 cfs.
- The *Meridian Farms Water Company - Positive Barrier Fish Screen Project* (**ERP-02-P15**) provided preliminary and final engineering design services for two new diversion and pumping facilities located at Meridian and Grimes.

Verona to Sacramento EMU

As shown in Table 1, seven projects were funded by ERP that work toward meeting ERP targets in the Verona to Sacramento EMU. The majority of the funded projects were planning project (four projects) and the remaining were full-scale implementation projects (three projects).

The *American Basin Fish Screen and Habitat Improvement Project (Phase I)* (**ERP-98-B29**), the *American Basin Habitat Improvement Project (Phase II)* (**ERP-01-N60**), and the *American Basin Fish Screen and Habitat Improvement Project (Phase III)* (**ERP-02-P09-D**) support the planning, feasibility, environmental permitting, removal of a diversion dam, consolidation of diversions, and the addition of state-of-the-art fish screens to Natomas Mutual Water Company's diversion on the Sacramento River, between Verona and the American River, and on the Natomas Cross Canal. When fully implemented these projects will remove migration barriers and prevent straying and entrainment of anadromous fish.

The *City of Sacramento Water Intake Fish Screen Replacement Projects: Sacramento River Water Treatment Plant* (**ERP-98-B28**) and the *E.A. Fairbairn Water Treatment Plant Project, and the Water Intake Fish Screen Replacement Project* (**ERP-01-N51**) supported the design and full-scale implementation of the E.A. Fairbairn Water Treatment Plant intake structure located on the lower American River, bringing that structure into compliance with current fish screen design standards.

The *Reclamation District 2035 Fish Screen Project Feasibility Study* (**ERP-98-N01**) and the *Reclamation District 2035 Fish Screen and Environmental Design Review Project* (**ERP-01-N55**) provided preliminary planning feasibility and design of a fish screen on Reclamation District 2035's diversion from the Sacramento River.

Project Summary Table

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Sacramento River EMZ-Wide Projects				
ERP-00-F03	**Floodplain Acquisition and Sub-reach/Site Specific Management Planning on the Sacramento River (Red Bluff to Colusa)** Planning for potential acquisition of nine parcels (1,733 acres) within the SB 1086 Sacramento River Conservation Area (Red Bluff to Colusa); baseline assessment and start-up stewardship for newly acquired parcels; site-specific management planning for the "Beehive Bend Subreach"; monitoring; and project management.	9/30/2003	$519,000	Complete
ERP-00-R01	**Sacramento River Small Diversion Fish Screen Program - Mechanical Monitoring and Maintenance Project -** Provided technical assistance, planning, engineering, design, environmental documentation, administration and oversight of projects to install fish screens for agricultural land users along the Sacramento River.	9/30/2003	$312,700	Complete
ERP-01-C02	**Real-Time Flow Monitoring.** Continued operation and maintenance of flow monitoring stations on five Sacramento River tributaries to provide data on minimum instream flows and water quality for the recovery of at-risk fish species in the creeks.	9/30/2005	$518,200	Complete
ERP-01-N04	**Arundo Donax: Survey and Eradication** Identified and eradicate areas infested by Arundo donax and Tamarix on Red Bank Creek, and Reed's Creek.	12/31/2006	$539,836	Complete. Final Report titled “Survey and Eradication of Arundo donax and Tamarix parviflora Tehama County”.
ERP-01-N28	**Sacramento River Conservation Area Program** Continued the efforts of the Sacramento River Conservation Area Program to act as a coordinating body between local, state, and federal agencies regarding restoration activities in the Sacramento River watershed.	6/30/2007	$1,034,249	Complete
ERP-01-N30	**Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development** Made soils information more accessible to individuals and groups engaged in ecosystem restoration projects in the Bay-Delta Region.	8/15/2004	$430,390	Complete. Final report titled “Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development”.
ERP-01-N52	**Sacramento River Fish Small Screen Project Vertical River Pump Diversions** A cooperative ongoing effort to provide information about vertical fish screens for small screen diversions (less than 40 cfs) to provide technical and financial assistance to landowners interested in installing fish screens along the Sacramento River.	10/31/2004	$1,800,000	Complete. Successfully installed 11 fish screens on small diversions resulting in the cumulative screening of 221 cfs.

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-C05-D	**Hamilton City Flood Damage Reduction and Ecosystem Restoration** Completed the Hamilton City feasibility study to restore connection to the floodplain and restore 2,600 acres of riparian habitat in the Hamilton city area.	6/30/2006	$438,500	Incomplete – lack of deliverables in CHRPD.
ERP-02D-P57	**Biological Assessment of Green Sturgeon in the Sacramento - San Joaquin Watershed** Continued research into the life history and habitat needs of green sturgeon. Investigated movements and distribution of these fish in the Bay-Delta system and describe their habitats, especially with emphasis on spawning sites.	1/31/2007	$1,271,272	Complete
ERP-02D-P61	**Implementing a Collaborative Approach to Quantifying Ecosystem Flow Regime Needs for the Sacramento River** Quantify key aspects of a "naturalized' flow regime that are compatible with flood damage reduction, agriculture, diversions, storage and conveyance.	3/31/2008	$1,571,438	Ongoing
ERP-02D-P65	**Sacramento River Restoration: Chico Landing Sub-Reach (RM 178-206)** This project conducted restoration planning and research on three sites within the Chico Landing Sub-reach (RM 178-206).	1/31/2010	$3,961,131	Ongoing
ERP-02-P16-D	**Restoration of the Confluence Area of the Sacramento River, Big Chico and Mud Creeks** Will complete phase II of a four-phase project to protect and restore 311 acres of floodprone, ecologically significant land located within the Sacramento River Conservation Area at the confluence of the Sacramento River, Big Chico and Mud Creeks.	6/30/2008	$2,603,377	Ongoing
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs** Synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region.	7/31/2007	$356,876	Ongoing. Final reports being reviewed.
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed** The goal of this project is to assess the role of vegetation in shaping the watershed's hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Ongoing

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-04D-S08a	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)** Will monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.	12/31/2008	$777,700	Ongoing
ERP-04D-S08b	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (CDFG)** Will monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons. The DFG contracted directly for the major equipment purchases to be made.	12/31/2008	$68,500	Ongoing
ERP-04D-S08c	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (USFWS)** The purpose of this project is to estimate the abundance of winter Chinook salmon spawners and to evaluate the winter Chinook propagation program at the Livingston Stone National Fish Hatchery.	3/31/2010	$496,210	Ongoing
ERP-04-S11	**Sacramento River Riparian Monitoring and Assessment Consolidated Project** Measures a range of physical and biological indicators for ERP and AFRP-funded projects within the Sacramento River Ecological Management Zone (Red Bluff to Colusa) and compares them to previous conditions and reference systems to test whether restoration actions have been successful in improving riparian forest conditions and forest interactions with aquatic processes.	6/30/2009	$1,261,057	Ongoing
ERP-05D-C01	**Hamilton City Flood Damage Reduction and Ecosystem Restoration Project** Will provide preconstruction, engineering, and design phases to prepare final design and plans and specifications for construction.	11/30/2008	$1,020,100	Ongoing
ERP-05-S25	**Providing Landowner Incentives to Encourage Riparian Restoration and Natural River Processes on Working Landscapes** Will encourage and facilitate the stewardship and restoration of riparian habitat on agricultural lands within the Sacramento River Conservation Area.	3/31/2010	$599,821	Ongoing
ERP-06D-S15	**Sacramento River Conservation Area Forum (SRCAF)** Continued the efforts of the Sacramento River Conservation Area Forum to act as a coordinating body between local, state, and federal agencies regarding restoration activities in the Sacramento River watershed.	3/31/2010	$656,277	Ongoing

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-95-M05	**M&T/Parrott Pumping Station and Fish Screen Project** Relocated M&T Ranches' Parrot-Phelan Pumping Station and installed fish screens on diversion structures to reduce fish entrainment on Big Chico Creek.	12/31/1997	$1,610,000	Complete
ERP-96-M03	**Phase I of the Feasibility Study of the Lower Sacramento River Riparian Habitat Restoration Project** Conducted a feasibility study to identify and design plans for potential sites to be revegetated to increase the amount of shaded riverine aquatic habitat along the lower Sacramento River. An important goal of this project was the evaluation of the impact that riparian habitat restoration has on both the Sacramento Flood Control System and the non-project levees in the Delta and adjoining areas.	9/14/1999	$500,000	Complete
ERP-97-C03	**Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning** Developed a non-profit watershed group to implement the goals of the Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB1086) to improve riparian habitat along the Sacramento River.	12/31/2000	$200,000	Complete
ERP-97-C04a	**Water Diversion Screening** This project installed two demonstration fish screens at water diversions located on the Sacramento River and conducted outreach activities to encourage other private owners to participate in voluntary screening of their diversions.	2/28/2002	$374,850	Complete
ERP-97-N02	**Sacramento River Floodplain Acquisition and Riparian Forest Restoration** Increased channel meander and flood zones and provided mapping of aquatic and terrestrial habitats. The project increased native riparian growth and reduced exotic distribution adjacent to the river.	1/1/2005	$9,905,438	Complete
ERP-97-N03a	**Ecosystem and Natural Process Restoration on the Sacramento River: Active Restoration of Riparian Forest** Restored 200 acres of flood-prone agricultural lands to native riparian forest along the Sacramento River between Keswick and Verona.	6/20/2002	$780,000	Complete
ERP-97-N03b	**Sacramento River Floodplain Acquisition and Riparian Forest Restoration** Restored 100 acres of flood-prone agriculture lands to native riparian forest along the Sacramento River between Keswick and Verona to increase shaded riverine aquatic habitat and improve degraded instream aquatic conditions.	12/31/2003	$512,500	Complete. Final report titled “Riparian Habitat Restoration: Sacramento River Wildlife Area, River Mile 169.5 R and 166.5 R”.

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-C13	**Spawning Areas of Green Sturgeon in the Upper Sacramento River** Characterized green sturgeon habitat and life history patterns in the upper Sacramento River to provide information useful to restoration and management activities in the area.	1/31/2002	$60,801	Complete. Final report titled "Spawning areas of green sturgeon, *Acipenser medirostris*, in the upper Sacramento River, California".
ERP-98-F18	**Floodplain Acquisition, Management, and Monitoring on the Sacramento River** Acquisition (via title or easement) of flood-prone lands adjacent to the Sacramento River between Keswick and Verona with the purpose of protecting and improving essential spawning, rearing, and migratory habitat for Chinook salmon and other riparian species.	9/30/2002	$1,000,000	Complete
ERP-99-N18	**Geomorphic Model for Demonstration and Feasibility Assessment of Setback Levees: Bay-Delta River Systems** Developed a geomorphic model to allow simulation and demonstration of the response of riverine systems to levee removal and setback.	6/11/2004	$104,458	Complete
Keswick to Red Bluff Diversion Dam Ecological Management Unit Projects				
ERP-00-B01	**Water Utility Fish Screen Rehabilitation** Installed a positive barrier fish screen structure on its intake structure at Pump Station #1 which meets National Marine Fisheries Service and California Department of Fish and Game screen criteria.	4/1/2006	$985,400	Complete
ERP-01-N33	**Watershed Education, Headwaters to Ocean** Five different education outreach programs conducted by the Sacramento River Discovery Center aimed at educating citizens about natural systems.	2/28/2005	$321,816	Complete. Final project reports titled "Expansion of Bird Monitoring and Volunteer Recruitment in Cooperation with the Point Reyes Bird Observatory", "Mapping and Eradication Plans for Non-Native Invasive Plants", and "Native/Drought Tolerant Plant Garden".
ERP-01-N44	**Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement** Developed juvenile production indices and correlates these indices with estimated escapement from adult counts at Red Bluff Diversion Dam and from the winter-run carcass survey.	12/31/2006	$2,443,005	Complete. Final report titled "Brood-Year 2005 Winter Chinook Juvenile Indices with Comparisons to Juvenile Production Estimates derived from Adult Escapement".
ERP-01-N46	**Sacramento River Chinook Salmon Carcass Survey** Estimates the abundance of adult endangered winter-run salmon with greater accuracy than current estimates, collects life history attributes, evaluates the effectiveness of the propagation program, and collects tissue samples for genetic analysis.	12/31/2006	$622,400	Complete. Final report titled "Sacramento River Winter-Run Chinook Salmon Carcass Survey – Summary Report for years 1996-2006".

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-04D-S09	**Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement** Will obtain juvenile winter Chinook production indices and correlate these indices with estimated escapement from adult counts at the Red Bluff Diversion Dam and the winter-run carcass survey.	6/30/2009	$2,067,266	Ongoing
ERP-95-M04	**Sacramento River: Gravel Restoration Project Below Keswick Dam** Restored several miles below the Keswick Dam on the Sacramento River by introducing spawning-sized gravel for natural redistribution and use by salmon as spawning habitat.	11/1/1995	$39,400	Complete
ERP-98-B03	**Fish Passage Improvement Project under Bay Delta Project - Category III** Planning phase for construction of fish passage improvement structures at the Anderson-Cottonwood Irrigation District main diversion dam for the benefit of anadromous fish. (Phase I)	3/31/1999	$325,000	Complete
ERP-98-B24	**Fish Passage and Fish Screening Improvement Project, Phase II** Final design, environmental documentation, and permitting for improved fish passage structures on the Anderson-Cottonwood Irrigation District diversion dam on the Sacramento River.	8/31/1999	$840,759	Complete
ERP-98-B33	**Expand Bird Monitoring, Develop a Native Grass Plot, and Enhance Public Involvement with Access to Native Plant Garden Surrounding the Discovery Center** Provided a public information/ education component of CALFED work to ensure that the improvements on the river and the maintenance of a sustainable, balanced, healthy river system are understood and supported by the general public.	9/30/2001	$49,640	Complete
ERP-98-R01	**Small Fish Screen Diversion Program on the Sacramento River** Reduced entrainment of outmigrating and resident fish by continuing to screen diversions on the mainstem Sacramento River in the area between Keswick Dam and the Red Bluff Diversion Dam.	9/30/2003	$1,240,991	Complete
ERP-99-B03	**Anderson-Cottonwood Irrigation District Fish Passage and Fish Screen Improvement Project, Phase III** Supported Phase III of the Anderson-Cottonwood Irrigation District Fish Screen Project to improve fish passage and habitat for salmon and steelhead on the Sacramento River by providing funds for the construction bidding process and construction phase of the project.	12/31/2005	$4,637,278	Complete

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-B12	**Riparian Corridor Acquisition & Restoration Assessment Project** Protected critical habitat through conservation easements and fee title acquisitions, and provide a foundation for ecosystem restoration specific to the project area. Approximately five miles of Sacramento River frontage, four and one-half miles of Battle Creek frontage, and one mile of Anderson Creek frontage was preserved.	4/30/2003	$2,052,237	Complete
ERP-99-B20	**Expand Bird Monitoring, Develop a Native Grass Plot, and Enhance Public Involvement with Access to Native Plant Garden Surrounding the Discovery Center** Supported on-going educational programs at the Sacramento River Discovery Center that teach students about the complexities of watersheds and the importance of building partnerships to best manage these resources.	9/30/2001	$38,400	Complete
ERP-99-N01	**ACID Fish Passage Improvement Project, Phase III** Construction of improved fish passage structures on the Anderson-Cottonwood Irrigation District diversion dam on the Sacramento River.	9/1/2002	$5,100,000	Complete
Red Bluff Diversion Dam to Chico Landing Ecological Management Unit Projects				
ERP-01-N58	**Fish Passage Improvement at the Red Bluff Diversion Dam: Balance of Phase II Funding** Minimized the impacts of the Sacramento River's Red Bluff Diversion Dam on upstream and downstream migration of juvenile and adult anadromous fish, while improving agricultural water supply.	9/30/2004	$734,000	Complete
ERP-04D-S06	**Juvenile Anadromous Salmonid Emigration Monitoring on the Sacramento River at the Glenn-Colusa Irrigation District (GCID) Fish Screen Bypass Channel** Will continue an existing juvenile salmonid monitoring project located at the Glenn Colusa Irrigation District diversion on the Sacramento River near Hamilton City.	4/1/2008	$90,072	Ongoing
ERP-97-N04	**Sacramento River Meander Restoration** Acquired 94.55 acres of agricultural land and restore natural floodplain and river meander to the site.	2/25/2001	$898,700	Complete
ERP-98-B22	**Fish Passage Improvement Project at the Red Bluff Diversion Dam** Identified the best alternative for operation of the Red Bluff Diversion Dam that maximizes fish passage for anadromous fish while minimizing adverse impacts to agricultural irrigation supply.	2/28/2000	$340,164	Complete

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-B07	**Fish Passage Improvement at the Red Bluff Diversion Dam, Phase II** Funds for a portion of Phase II of the Tehama-Colusa Canal Fish Passage Project at the Red Bluff Diversion Dam (RBDD), which involves modifying the RBDD to reduce or minimize the impacts of the RBDD on upstream and downstream migration of juvenile and adult anadromous fish migration.	3/31/2002	$1,839,888	Complete
Chico Landing to Colusa Ecological Management Unit Projects				
ERP-00-B02	**Tuttle Pump Relocation Project** Relocated Tuttle's diversion to the District's pumping plant and removed the existing pumping facilities approximately 450 feet south of the District's plant.	2/28/2003	$452,900	Complete
ERP-02-P08-D	**M & T/Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project** Protects the existing M&T/Llano Seco fish-screen facility and its beneficiaries while investigating and identifying a technically and economically feasible long-term solution to adapt the fish-friendly pumping facility to the lateral migration of the Sacramento River.	6/30/2008	$4,390,087	Ongoing
ERP-02-P27	**Sub-Reach Planning for the Sacramento River: River Mile 144-164** Will lead planning efforts for the Colusa-Princeton Sub-reach of the Sacramento River (RM 144-164). Sub-reach planning is site-specific at a spatial scale of approximately 20 river miles. This is a comprehensive approach to restoration planning that includes a high level of stakeholder involvement to develop conceptual restoration plans and analyzes potential benefits to, and impacts of, restoration implementation on surrounding landowners and land uses.	9/30/2008	$1,488,009	Ongoing
ERP-02-P39	**Riparian Restoration Planning and Feasibility Study for the Riparian Sanctuary, Llano Seco Unit** Identified feasible management options that will 1) improve habitat and ecosystem processes on 950 acres of the Riparian Sanctuary at the Sacramento River National Wildlife Refuge, Llano Seco Unit, 2) develop and evaluate ecological acceptable options that would improve pumping plant protection and, 3) increase scientific understanding of riparian restoration projects.	2/28/2006	$289,784	Complete

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-05D-S29	**Riparian Sanctuary (Phase II) – Bringing Agricultural and Ecological Interests Together for Pumping Plant Protection and Riparian Restoration (Sacramento River Mile 178) - Design Development and Environmental Compliance** Planning and design efforts to develop second phase of multi-phase process to protect PCGID-PID's pumping plant and fish screen facility and to meet Sacramento River National Wildlife Refuge habitat goals for the Riparian Sanctuary.	6/30/2010	$660,665	Ongoing
ERP-96-M04	**Princeton Pumping Plant Fish Barriers Feasibility Study** This project will design and construct a positive barrier fish screen at Reclamation District 1004's Princeton Pumping Plant, the District's primary water diversion on the Sacramento River, to prevent entrainment of winter-run Chinook salmon. The goal of the project is to decrease the number of fish being entrained by the diversion facility to help increase the genetic diversity of the species. Implementation of this project will not only improve fish habitat on the river, but also ensure a consistent water supply to approximately 11,000 acres of migratory wetlands. The final phases of this project were funded under ERP-97-C02. This phase deals solely with the "feasibility" portion of the aforementioned project.	12/31/1997	$75,000	Complete
ERP-96-M05	**Princeton-Codora-Glenn Irrigation District and Provident Irrigation District Fish and Wetlands Restoration Project** Environmental documentation and engineering feasibility of consolidation of three pumping plants along the Sacramento River to reduce entrainment of Chinook salmon and improve the aesthetics of the river.	8/31/1998	$75,000	Complete
ERP-96-M07	**Princeton-Codora-Glenn Irrigation District and Provident Irrigation District Fish and Wetlands Restoration Project** Construction phase of consolidating and screening three pumping sites on the Sacramento River to reduce entrainment of salmon and improve aesthetics along the river corridor.	12/31/1999	$5,500,000	Complete
ERP-97-C02	**Princeton Pumping Plant Fish Screen Facility** Relocate Reclamation District 1004's unscreened diversion on the Sacramento River and construct a new positive barrier fish screen to prevent entrainment of anadromous fish.	6/30/1999	$1,750,000	Complete
ERP-98-B02	**Boeger Family Farms Fish Screen Feasibility Study** Conducted the required initial studies for screening of the Boeger Family Farm pumping plant on the Sacramento near Colusa for the benefit of reducing entrainment of anadromous fish.	4/30/1999	$13,811	Complete. Final environmental documents complete.

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-B26	**Boeger Family Farms Fish Screen Phase II: Construction** Final phase of the Boeger Family Fish Screen project to construct a fish screen at their diversion structure on the Sacramento River to reduce entrainment of anadromous fish.	1/1/2004	$192,210	Complete
Colusa to Verona Ecological Management Unit Projects				
ERP-02D-P69	**Wilkins Slough Positive Barrier Fish Screen Sediment Removal System** Addition of sediment removal facilities to an existing fish screen at Reclamation District 108's Wilkins Slough irrigation water diversion on the Sacramento River's west bank, near Grimes.	9/15/2007	$535,000	Ongoing
ERP-02D-P70	**Tisdale Positive Barrier Fish Screen/Pumping Plants Project - Phase IV** This is Phase IV (Construction and Performance Evaluation) of a project that will construct a fish screen to minimize entrainment of fish at the Tisdale (960cfs) irrigation water diversion on the Sacramento River's east bank, south of Meridian.	12/31/2008	$8,256,500	Ongoing
ERP-02-P10-D	**Reclamation District No. 108 Consolidated Pumping Facility and Fish Screen** Environmental compliance, permitting, and final design for screening three of RD108's Sacramento River diversions.	6/30/2006	$690,000	Complete
ERP-02-P15	**Meridian Farms Water Company - Positive Barrier Fish Screen Project** This project will result in the completion of the engineering final design, conduct the final environmental analyses, and secure the necessary permits for the fish screen project for the positive barrier fish screen project.	11/30/2007	$750,000	Ongoing
ERP-02-P24	**Sutter Mutual Water Company Tisdale Positive Barrier Fish Screen and Pumping Plant** Created final designs, environmental documentation, and permitting for a fish screen structure at the Tisdale Pumping plants.	5/31/2005	$1,270,000	Complete
ERP-06D-S14	**RD 108 Combined Pumping Plant/Fish Screen Project (Phase IV-Construction)** Diversion consolidation and construction of a positive barrier fish screen.	6/30/2009	$14,247,500	Ongoing
ERP-96-M19	**Feasibility Study for Intake Screen at Wilkins Slough Diversion** Phase II (feasibility study) of a five-phase project to design and construct a state-of-the-art fish screen at Reclamation District 108's Wilkins Sough diversion facility on the Sacramento River to reduce entrainment of anadromous fish.	6/30/1997	$100,000	Complete

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-C01	**Positive Barrier Fish Screen Project, Wilkins Slough Pumping Plant** Constructed a positive fish barrier intake screen at Reclamation District 108's diversion structure at Wilkins Slough for the protection of Chinook, splittail, and other fish species.	12/31/1999	$2,500,000	Complete
ERP-98-B01	**Richter Brothers Anadromous Fish Screen Project** Evaluated alternatives for placing a positive barrier fish screen on three water diversion structures on the Sacramento River to reduce entrainment of anadromous fish.	8/15/1999	$49,000	Complete
Verona to Sacramento Ecological Management Unit Projects				
ERP-01-N51	**Water Intake Fish Screen Replacement Project** Ongoing effort to replace fish screens on the Sacramento River for the benefit of aquatic resources in the lower American and Sacramento Rivers. This project consisted of two components, replacing the intake and access bridge for the Sacramento River Water Treatment Plant (WTP) and modifying the intake at the EA Fairbairn WTP. The benefits of this project are expected to be realized as soon as it is completed, particularly for juvenile fish such as all four runs of Chinook salmon, steelhead trout, Sacramento splittail, and green sturgeon. Another benefit of this project is improved flood control.	5/28/2004	$6,142,142	Complete. Both fish screens were completed as of February 2004 and fully operational.
ERP-01-N55	**Reclamation District 2035 Fish Screen and Environmental Design review** Prevents the entrainment of fish in Reclamation District (RD) 2035's diversion from the Sacramento River via installation of a fish screen.	12/31/2003	$1,384,000	Complete
ERP-01-N60	**American Basin Habitat Improvement Project** Phase II of American Basin Fish Screen and Habitat Improvement Project. Final design and permitting for the American Basin Fish Screen and Habitat Improvement Project which will improve fish passage, reduce entrainment, and improve aquatic, riverine, and riparian habitats along the Sacramento River. Project was not completed within budget. A draft NEPA/CEQA document was prepared, but environmental permitting has not been completed. Additional funds for this project were obtained through USBR. Project phases I and III were funded through ERP-98-B29 and ERP-02-P09-D.	12/31/2006	$1,450,000	Project tasks were not complete at the end of the contract term. Work has continued with USBR funding.

Table 1. Sacramento River EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P09-D	**American Basin Fish Screen and Habitat Improvement Project** Phase III of American Basin Fish Screen and Habitat Improvement Project. Removal of a diversion dam, consolidation of diversions and the addition of state-of-the-art fish screens to Natomas Mutual Water Company's diversion on the Sacramento River, between Verona and the American River, and on the Cross Canal. Project phases I and II were funded through ERP-98-B29 and ERP-01-N60.	12/31/2009	$12,600,000	On going
ERP-98-B28	**The City of Sacramento Water Intake Fish Screen Replacement Projects: Sacramento River Water Treatment Plant and the E.A. Fairbairn Water Treatment Plant** Prepared final design for replacing fish screens at two water treatment plants, one on the Sacramento River and the other on the American, to reduce entrainment of anadromous fish.	6/30/2001	$1,964,500	Complete. The construction of these fish screens was funded by ERP-01-N51.
ERP-98-B29	**American Basin Fish Screen and Habitat Improvement Project** Phase I of American Basin Fish Screen and Habitat Improvement Project. Feasibility study and preliminary design and environmental compliance work for the American Basis Fish Screen and Habitat Improvement Project, which removed migration barriers and prevents straying and entrainment of anadromous fish. Project phases II and III were funded through ERP-01-N60 and ERP-02-P09-D.	6/30/2002	$450,000	Complete
ERP-98-N01	**Reclamation District 2035 Fish Screen Project feasibility Study** Prevents the entrainment of fish in Reclamation District (RD) 2035's diversion from the Sacramento River via installation of a fish screen.	9/30/2000	$100,000	Complete

Other Programs Contributing to ERP Vision

Attaining the vision for the Sacramento River EMZ/EMUs requires near-term funding and implementing actions to achieve the targets. This includes managing water project operations, purchasing title or easements of land from willing sellers, cooperatively developing and implementing a phased fish screening program, acquiring and placing gravel, and performing engineering studies to improve fish passage at diversions and dams. Significant areas of the Sacramento River between Red Bluff and Colusa actively meander. Management actions should aim to protect this functioning process where it is intact, in addition to restoring channel migration within the meander belt.

Several major restoration efforts are either being developed or implemented by state and federal agencies. They will greatly contribute to the success of effort to restore ecological health to the Sacramento River.

The U.S. Fish and Wildlife Service (USFWS) and the Bureau of Reclamation (Reclamation) are implementing the Central Valley Project Improvement Act (CVPIA), which provides for restoration of habitats and species and elimination of many stressors. Key elements of the CVPIA program include the Anadromous Fish Restoration Program (USFWS, 1997) and the Anadromous Fish Screening Program. Other elements are directed at spawning gravel replenishment, fish passage, water temperature control in the reach between Keswick Dam and RBDD, water acquisition, and other measures that will contribute to health of the Sacramento River and Sacramento-San Joaquin Delta EMZs.

The Sacramento River Conservation Area Forum (SRCAF) is a non-profit organization that evolved from 1986 State of California legislation (SB1086). The legislation called for a management plan to protect, restore and enhance the fisheries and riparian habitat along the Sacramento River from Keswick Dam down river to Verona. This effort is cooperative in nature and works to ensure that habitat restoration and management addresses not only the dynamics of riparian ecosystems, but also the realities of local agricultural and recreational issues associated with land use changes occurring along the river.

The SRCAF continues to promote and coordinate restoration related activities along the Sacramento River, develop and implement site-specific and sub-reach plans for areas within the Conservation Area, review and track projects and monitor ecosystem restoration progress within the Sacramento River Conservation Area (SRCA), and work to build a broader support and understanding of the goals of CALFED and the SB1086 Program.

Status of Area Today

As described in the previous section, ERP funded 77 projects that will benefit the Sacramento River EMZ/EMUs. The projects focused on stream meander, natural floodplain and flood processes, Central Valley stream temperatures, riparian and riverine aquatic habitat, freshwater fish habitat and essential fish habitat, and water diversions.

Planned Projects for Implementation

Keswick to Red Bluff EMU

None listed. The planned projects were constructed.

Red Bluff to Chico Landing EMU

The *Fish Passage Improvement Project at the Red Bluff Diversion Dam* (**ERP-98-B22**) was the first phase of a two phase project. This planning project examined alternatives for operating the Red Bluff Diversion Dam (RBDD) in a way that maximizes fish passage while minimizing the impacts to agricultural water supply by means of a new screened intake structure to the Tehama-Colusa Canal and Corning Canal. This project provided a project implementation plan, development of a biological monitoring plan and development of a preliminary concept report. The *Fish Passage Improvement at the Red Bluff Diversion Dam, Phase II Project* (**ERP-99-B07**) and the *Fish Passage Improvement at the Red Bluff Diversion Dam: Balance of Phase II Funding Project* (**ERP-01-N58**) continued the planning work started during *Fish Passage Improvement Project at the Red Bluff Diversion Dam* (**ERP-98-B22**). Together, *Fish Passage Improvement at the Red Bluff Diversion Dam, Phase II* (**ERP-99-B07**) and *Fish Passage Improvement at the Red Bluff Diversion Dam: Balance of Phase II Funding Project* (**ERP-01-N58**) accomplished the following activities: 1) preliminary design; 2) evaluation and screening of alternatives; 3) environmental documentation; 4) public involvement; and, 5) preliminary permitting. Additional funding would be needed to complete Phase III, final design of the intake structure; Phase IV construction of a new or improved facility outlined in Phase III; and, and Phase V, post construction monitoring of the new or improved facilities.

Chico Landing to Colusa EMU

The *Sub-Reach Planning for the Sacramento River: River Mile 144-164 Project* (**ERP-02-P27**) is leading planning efforts for the Colusa-Princeton Sub-reach of the Sacramento River. This is a comprehensive approach to restoration planning that includes a high level of stakeholder involvement to develop conceptual restoration plans and analyzes potential benefits to, and impacts of, restoration implementation on surrounding landowners and land uses. This plan is a subset of the Sacramento River Conservation Area goals. This project's main focus is planning associated with the protection and recovery of the river meander zone along a 20 mile reach of the Sacramento River.

The *Riparian Restoration Planning and Feasibility Study for the Riparian Sanctuary, Llano Seco Unit Project* (**ERP-02-P39**) and the *Riparian Sanctuary (Phase II) – Bringing Agricultural and Ecological Interests Together for Pumping Plant Protection and Riparian Restoration (Sacramento River Mile 178) Project* (**ERP-05D-S29**) were funded to identify feasible management options and develop a plan that will improve habitat and ecosystem processes on 950 acres of the Riparian Sanctuary at the Sacramento River National Wildlife Refuge, provide ecologically sound protections for the Princeton-Cordora-Glenn Irrigation District and Provident Irrigation District's pumping plant and fish screen facility, and increase scientific understanding of riparian restoration.

Colusa to Verona EMU

The *Meridian Farms Water Company - Positive Barrier Fish Screen Project* (**ERP-02-P15**) provided preliminary and final engineering design services for two new diversion and pumping facilities located at Meridian and Grimes.

Verona to Sacramento EMU

The *American Basin Fish Screen and Habitat Improvement Project (Phase I)* (**ERP-98-B29**)*, the American Basin Habitat Improvement Project (Phase II)* (**ERP-01-N60**), and the *American Basin Fish Screen and Habitat Improvement Project (Phase III)* (**ERP-02-P09-D**) supports the planning, feasibility, environmental permitting, removal of a diversion dam, consolidation of diversions, and the addition of state-of-the-art fish screens to Natomas Mutual Water Company's diversion on the Sacramento River, between Verona and the American River, and on the Natomas Cross Canal.

Impediments to Implementation

The availability of funding is the greatest impediment to implementation of the planned projects. In addition, an overall strategy needs to be developed regarding the need and criteria to select fish screens for installation.

References

CALFED Bay-Delta Program. 2000a. Ecosystem Restoration Program Plan - Volume II: Ecological Management Zone Visions. Final Programmatic EIS/EIR Technical Appendix. Sacramento, CA.

CALFED Bay-Delta Program. 2000b. Ecosystem Restoration Program Plan - Strategic Plan for Ecosystem Restoration. Final Programmatic EIS/EIR Technical Appendix. Sacramento, CA.

USFWS 1997. Revised draft anadromous fish restoration plan: a plan to increase natural production of anadromous fish in the Central Valley of California. U.S. Fish and Wildlife Service. May 30, 1997.

APPENDIX A

A.4. NORTH SACRAMENTO VALLEY ECOLOGICAL MANAGEMENT ZONE

Introduction

The North Sacramento Valley Ecological Management Zone (EMZ) encompasses the geographic area and tributary streams generally surrounding the City of Redding (Figure 1). The EMZ does not include the mainstem Sacramento River; which is instead addressed in the Sacramento River EMZ Chapter. Clear Creek, Cow Creek, Bear Creek, and Battle Creek are tributaries to the Sacramento River included in this EMZ, and evaluated in this report. They each represent an Ecological Management Unit (EMU) within the EMZ.

This EMZ provides habitat for a significant number of fish, wildlife, and plant species, including winter-, spring-, fall-, and late-fall-run Chinook salmon, steelhead trout, lamprey, native resident fish, Neotropical migratory birds, other riparian-dependent birds and mammals, and native anuran amphibians. The important ecological processes and functions that are shared by the individual ecological units of this EMZ include their respective streamflow patterns and capacity for natural sediment transport, stream meander, and gravel recruitment. Past and existing human activities, such as dam construction and gravel extraction from the active stream channel, have constrained opportunities to maintain or reactivate natural processes and functions to varying degrees.

The stressors present in this EMZ include water conveyance structures, water storage structures, water diversions, and invasive plant species. These stressors can impair ecological functions, impede the creation and maintenance of habitats, and may cause direct mortality to important species.

Clear Creek Ecological Management Unit

Clear Creek is a major tributary to the Sacramento River that drains approximately 238 square miles. It originates in the mountains east of Trinity Lake and flows into the Sacramento River near the City of Redding in Shasta County. Whiskeytown Reservoir stores natural flows from Clear Creek and water diverted from the Trinity River at Lewiston Dam through the Clear Creek Tunnel. Whiskeytown Dam, constructed in 1963, diverts more than 80% of Clear Creek's average natural flow and delivers it to the Spring Creek Powerhouse at Keswick Reservoir on the Sacramento River. The Clear Creek watershed has a natural flow pattern of high winter and low summer/fall flows, typical of many Sacramento Valley streams that originate from the foothills. The

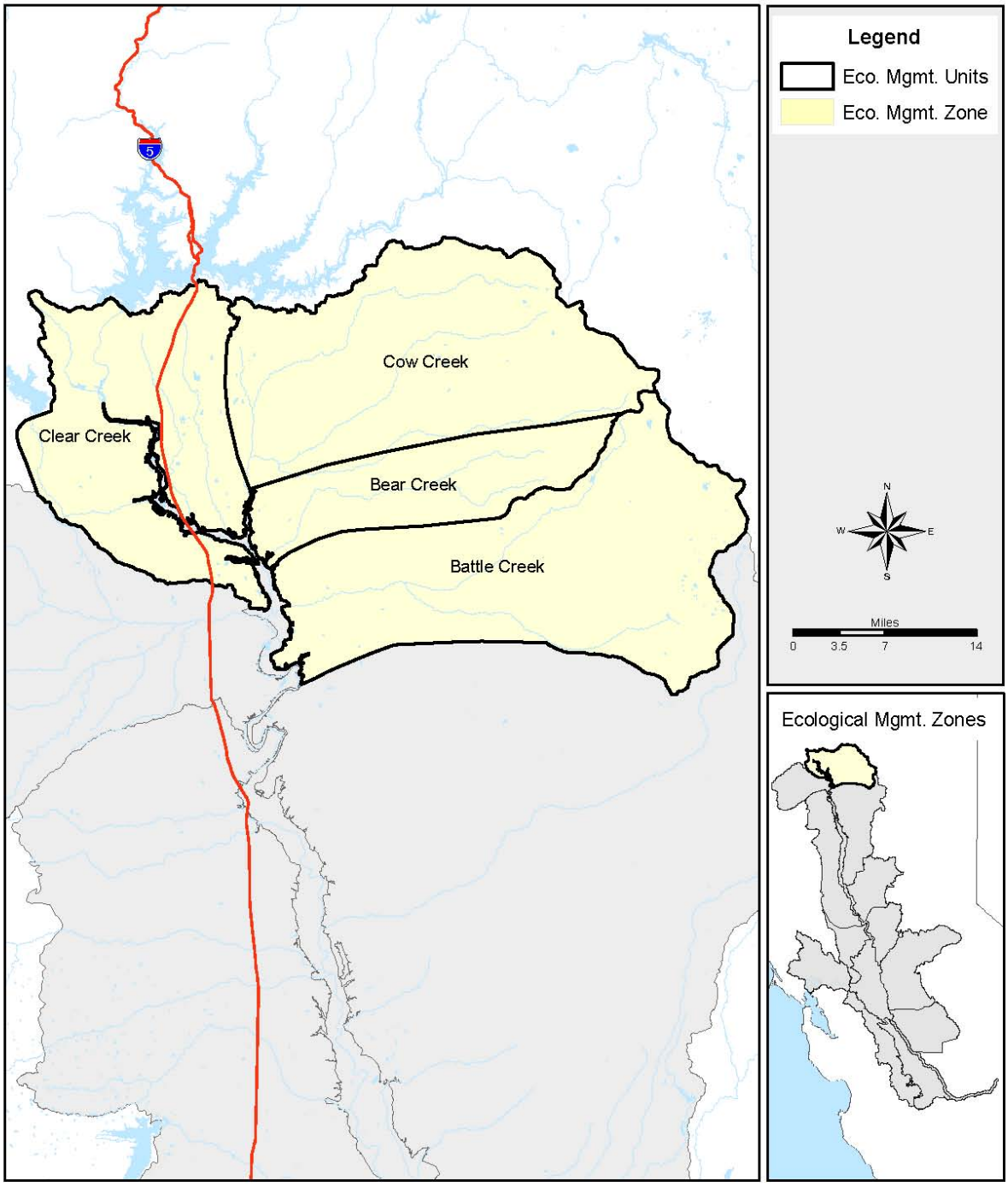

Figure 1. North Sacramento Valley Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. North Sacramento Valley EMZ Map

portion of Clear Creek below Whiskeytown Dam is managed for spring-, fall- and late-fall-run Chinook salmon and steelhead. The portion below the historic McCormick-Saeltzer Dam is most suitable for fall- and late-fall-run Chinook salmon spawning, but is unsuitable for oversummering spring-run Chinook, or for year-round rearing of steelhead. The McCormick-Saeltzer Dam historically impaired the upstream and downstream passage of juvenile and adult anadromous fish, prior to its removal in 2000.

Cow Creek Ecological Management Unit

Cow Creek flows through the southwestern foothills of the Cascade Range and enters the Sacramento River four miles east of the City of Anderson in Shasta County. The drainage area is approximately 425 square miles and the average discharge is 501,400 acre-feet per year. There are five major tributaries that flow into Cow Creek: Little (North) Cow, Oak Run, Clover, Old Cow, and South Cow creeks. Land use activities in the Cow Creek drainage include agriculture, timber harvest, livestock grazing, hydropower production, and development of several small communities in the watershed. Loss of habitat and water diversions are largely the result of activities associated with livestock production. Agricultural diversions are unscreened, ditches are unlined and poorly maintained, and grazing is destroying some of the riparian corridor and causing excessive erosion. Fall-run and late-fall-run Chinook salmon spawn in Cow Creek and all five tributaries. Adult steelhead trout have been observed in South Cow, Old Cow, and North Cow creeks. Surveys conducted in 1992 in Cow Creek and in four of the five tributaries concluded that Cow Creek is not suitable for spring-run Chinook salmon because of warm summer water temperatures and lack of large holding pools. However, steelhead could survive if provided access to the tributaries above the valley floor. North Cow, Clover, and Old Cow creeks have natural bedrock falls that are either complete or partial barriers to anadromous fish.

Bear Creek Ecological Management Unit

Bear Creek is a small eastside tributary that enters the Sacramento River five miles south of the City of Anderson in Shasta County. Bear Creek has a natural flow pattern of high winter and low summer-fall flows, typical of Sacramento Valley streams that originate from the foothills. During wet years, flows in winter average 1,100 to 2,000 cfs; during dry years, average monthly flows reach only 30 to 70 cfs. Small agricultural diversions contribute to lower flows in summer and fall. The limited runoff in this small stream makes it difficult to meet the limited agricultural water demands and instream flow needs of anadromous fish, especially in below-normal water years. During above-normal water years irrigation water demands are reduced, which reduces risk to juvenile salmon and steelhead during the spring diversion season. However, unscreened irrigation diversions operating during the juvenile emigration period for Chinook salmon and steelhead can significantly reduce survival rates. Bear Creek is able to support populations of fall-run Chinook salmon only when early fall rains create

suitable conditions for passage over shallow riffles and allow access to the limited spawning habitat. Because of low and warm streamflow conditions in spring, juvenile salmon and steelhead must emigrate early in the season to survive. Salmon spawning surveys conducted during years with sufficient flows to attract adult salmon indicate that Bear Creek can support 150-300 spawning salmon. Steelhead trout have been observed in Bear Creek, but no population estimates have been made.

Battle Creek Ecological Management Unit

Battle Creek is a tributary that enters the Sacramento River approximately five miles southeast of the City of Cottonwood in Shasta County. It drains a watershed of approximately 360 square miles. Battle Creek has a natural flow pattern of high winter and moderate summer-fall flows, and has the best connection between the Sacramento River and mountainous areas of any North Sacramento Valley EMU. Pacific Gas and Electric Company (PG&E) owns and operates the Battle Creek project, which consists of two small storage reservoirs, four unscreened hydropower diversions on the North Fork, and three unscreened hydropower diversions on the South Fork. The overall goal for the EMU is to restore important ecological functions and processes, as well as habitats. Restoration of these ecosystem elements will permit the restoration of anadromous fish populations in the Battle Creek watershed. Restoration will also require disease management measures for the Coleman National Fish Hatchery (CNFH) water supply. As the range of anadromous fish in the watershed is increased, additional efforts will be directed at fish screens, fish ladders, CNFH water supply management, and increased releases of water from hydroelectric diversions. Prior to development of the hydropower facilities, Battle Creek was one of the most important Chinook salmon spawning streams in the Sacramento Valley. Runs of fall-, winter-, and spring-run Chinook were present in the watershed. There is significant natural spawning of salmon and steelhead in Battle Creek between the CNFH weir and the mouth of Battle Creek, but the spawning populations are too large for available habitat. The blockage of the fall-run Chinook salmon migration at CNFH and the effect of low flows caused by PG&E's hydropower operations have combined to reduce salmon and steelhead populations above the CNFH to remnant status.

Applicable ERP Vision

The overall vision for the North Sacramento Valley EMZ focuses on restoring important fish, wildlife, and plant communities to a healthy condition. The development and implementation of comprehensive watershed management plans for the streams in this EMZ will restore important ecological processes to create and maintain habitats for fish, wildlife and plant communities. A primary vision for the EMZ involves restoring spring-run Chinook salmon and steelhead population levels to what they were in the late 1960s and early 1970s. This vision can be achieved by increasing protection for naturally produced Chinook salmon and steelhead as they rear and migrate downstream

from the natal areas to the mainstem Sacramento River. Protection methods include improving passage at water diversion structures, installing positive-barrier fish screens to protect juveniles, restoring and maintaining habitat below water storage sites, and providing sufficient flows for migration, holding, spawning and rearing.

Gravel extraction is a significant problem in many areas of this EMZ, and this activity should be relocated to areas away from active stream channels. Additional actions that would restore this EMZ include the reestablishment of floodplains in lower stream reaches to allow channel meander, sediment transport and deposition; improving water availability during salmonid migration; improving water quality; and creating a healthy riparian corridor. Maintenance and restoration of healthy riparian zones can be accomplished by providing shaded riverine aquatic habitat and woody debris, removing noxious, non-native weeds, and maintaining biologically productive gravel beds for fish spawning and invertebrate production.

Clear Creek Ecological Management Unit

The vision for the Clear Creek EMU is to restore flows from Whiskeytown Dam to allow successful upstream passage of Chinook salmon and steelhead to historical habitat, restore sediment transport and gravel recruitment in the stream channel, establish a clearly defined stream meander zone, and restore riparian and riverine aquatic plant communities. Clear Creek was selected to be a demonstration watershed for the CALFED Stage 1 (first seven years) Implementation Program. Because of this, CALFED supported ongoing efforts to implement a successful management and rehabilitation effort within the lower Clear Creek watershed. It is hoped that lessons learned in the Clear Creek watershed will be applied to similar watersheds. These lessons include how to improve overall watershed health; how to integrate local, state, federal and private efforts in a large-scale restoration program; how to design and implement actions to benefit spring-run Chinook salmon and steelhead; and how to best manage ecological processes such as sediment transport and stream meander in a highly modified stream system.

Cow Creek Ecological Management Unit

The vision for the Cow Creek EMU includes reducing adverse effects of timber harvest, erosion, and cattle grazing on the stream and riparian system, and maintaining or restoring streamflows during important periods of the year to allow migration, spawning, and rearing of fall-run Chinook salmon and steelhead trout. The development and implementation, at the local level, of a comprehensive watershed management plan would assist restoration efforts. Actions to improve Cow Creek include obtaining flow agreements, screening diversions to protect all life stages of anadromous fish, improving fish passage at agricultural diversion structures, and fencing selected riparian corridors in the watershed to exclude livestock and promote riparian regeneration.

Bear Creek Ecological Management Unit

The vision for the Bear Creek EMU emphasizes restoration and maintenance of important ecological processes such as stream flow and sediment supply. Improvements related to fish passage, immigration, holding, and spawning and rearing habitats will benefit steelhead trout. Restoration of Bear Creek will help restore ecological health of the Bay-Delta system, particularly for steelhead trout and fall- and late-fall run Chinook salmon. ERP recommends a cooperative program, with water users, for a mutually acceptable flow schedule that would provide protection for downstream migrating salmon and steelhead and recognize the needs of agriculture.

Battle Creek Ecological Management Unit

The vision for the Battle Creek EMU includes support for a local watershed conservancy and developing and implementing a comprehensive watershed management plan, increasing flows, improving water supply to Coleman National Fish Hatchery, removing diversion dams or installing new ladders, and installing positive-barrier fish screens to protect juvenile Chinook salmon and steelhead out-migrants. Improving water management operations and installing positive-barrier fish screens will provide many benefits for a variety of ecological processes. Restoration activities in Battle Creek will create much needed habitat for steelhead trout and spring-run Chinook salmon while maintaining the stream's existing importance to fall- and late-fall-run Chinook.

Stage 1 Expectations

The Stage 1 expectations for the North Sacramento Valley EMZ focused primarily on the Clear Creek and Battle Creek EMU's. One expectation for Clear Creek was to remove the McCormick-Saeltzer Dam to provide greater access to upstream habitat, restore sediment transport processes, and to reduce predator habitat. Another was to augment the supply of spawning-sized gravel in the Clear Creek channel, to fill instream mining pits, and isolate floodplain gravel mining pits from the active channel. Also, there was an expectation to provide sufficient scouring flow to periodically remove vegetation that had encroached within the active channel, and to mechanically remove vegetation if necessary. A watershed management plan was to be refined and implemented to reduce the transport of fine sediment to the creek channel and to protect and restore riparian habitat, in conjunction with local landowners and local, state, and federal agencies active in the watershed. Finally, the need to augment flows in Clear Creek and acquire water from willing sellers was to be evaluated.

The expectations for Battle Creek were to improve fish migration by removing diversion dams, upgrading fish passage facilities, and screening diversions. Efforts were to be made to improve instream flows in lower Battle Creek, in order to provide adequate fish

passage. In the longer term, a watershed management plan was to be developed and implemented in order to reduce the amount of fine sediments introduced into the creek channel, to protect and restore riparian habitat, to improve base flows, and to reduce water temperatures. Finally, efforts were to be made to improve the fish passage facilities at the Coleman National Fish Hatchery and to improve hatchery management and release practices to better protect the genetic integrity of wild anadromous fish populations.

Changes Attributable to ERP

North Sacramento Valley Ecological Management Zone

The *Expanding California Salmon Habitat to Alter Dams and Diversions* (**ERP-98-N02**) project inventoried dams and diversions in the Central Valley and developed a mechanism to purchase dams and diversions from willing sellers in order to improve fish passage. This project also assessed the opportunity for improving fish habitat by reoperating small hydroelectric facilities in California. Tasks included inventorying potential candidate facilities, developing a template to evaluate facility potential and costs, identifying cooperative strategies, and conducting community workshops. Overall, altering dams and diversions will contribute to the ERP target for reducing stressors caused by dams and other structures and for providing freshwater fish habitat and essential fish habitat.

The *Fish Screen Biological Performance Test* (**ERP-96-M23**) project was a pilot project to test the feasibility of an innovative fish screen design for smaller (<50 cfs) diversions in the Central Valley of California. Phase I of the project involved fabricating, testing, and hydraulically balancing the screen system. The fish screen system was tested at the Coleman National Fish Hatchery (CNFH). Tests using small Chinook salmon (45-50 FL) consistently showed internal eye injuries, except when flows were reduced and part of the screened water was refluxed through the toe of the screen. Changes in the toe of the screen by the manufacturer did not completely solve the problem, so it was concluded that a design change may be warranted to eliminate the eye injuries. Observations of the same type of fish screen functioning at a field-site in Oregon indicated that the conditions in the approach channel upstream of the weir crest are an important design element for injury-free operation. Phase II of the project involved re-performing biological testing using small Chinook salmon fry. A variety of hydraulic conditions were tested (high, medium, and low flow rates), and eye injuries varied from 0% to 12.5% depending on the hydraulic conditions. Phase III involved field testing by observing functioning fish screens at the Oregon field-site. Under the hydraulic conditions present, no injuries were detected. Overall, it was concluded that the design of the fish screens is a critical element in assuring proper hydraulic conditions for efficient and injury-free operation. Information obtained from this pilot project

contributed to the ERP target for reducing and/or eliminating stressors to anadromous and resident fish at dams and other structures.

Evaluations for the following projects can be found in the appropriate chapter:

- **ERP-01-N30** - *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development: Sacramento River EMZ*;
- **ERP-02-P17** - *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs: American River EMZ*;
- **ERP-02-P38** - *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed: American River Basin EMZ*;
- **ERP-04D-S08a, ERP-04D-S08b, ERP-04D-S08c** - *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program: Sacramento River EMZ*;
- **ERP-04D-S09** - *Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement: Keswick to Red Bluff Diversion Dam EMU*;
- **ERP-96-M16** - *Sacramento River and Major Tributaries Corridor Mapping Project: Sacramento River EMZ*;
- **ERP-97-C04a** - *Water Diversion Screening: Sacramento River EMZ*;
- **ERP-97-C03** - *Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning: Sacramento River EMZ*;
- **ERP-98-B15** - *Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking: American River EMZ*; and
- **ERP-99-N13** - *Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead: American River EMZ*.

Clear Creek Ecological Management Unit

The *Clear Creek Juvenile Salmonid Monitoring Project* (**ERP-01-N47**) provided essential information on the status, trends and habitat use of juvenile salmonids, and the *Clear Creek Anadromous Salmonid Monitoring Program* (**ERP-04-S16**) is an ongoing project that is providing essential information on the status and trends for all life stages of anadromous salmonids on Clear Creek. Information from these projects have been used in management decisions made by the Clear Creek Restoration Team, which is comprised of regulatory agencies, land management agencies, and local government, about restoration projects and future efforts. For example, monitoring in Phase 3A (which included installing root wads along a curve in the new channel) showed 3.1 times the average density of juvenile salmonids compared to all reaches. Backwater habitats created in Phase 3A (see **ERP-98-F15** below) had 1.5 times the average density of juvenile salmonids, and captured floodplain vegetation had 5.6 times

the average density. Because of this data, all of these habitat components were incorporated into future restoration phases (see **ERP-05D-S18** below- Phase 3B). These long-term monitoring projects are providing important feedback for adaptive management and evaluation. These projects also contribute toward ERP's goal of enhancing at-risk native salmonid species in the Central Valley, such as spring-run Chinook salmon and steelhead, by providing restoration projects with information on how to maximize their benefits to anadromous salmonids. Overall, anadromous fish monitoring is contributing to the ERP targets for streamflows, stream temperatures, coarse sediment supply, stream meander, natural floodplains and flood processes, freshwater fish habitats, essential fish habitats, and dams and other structures by providing needed data to assess how successful projects are at addressing these ERP targets.

The *Lower Clear Creek Floodway Restoration Project (Phase II)* (**ERP-98-F15**) was a full-scale implementation project. Several phases of design and construction were previously completed with Central Valley Project Improvement Act (CVPIA) and ERP grant funding. Phase I, funded by CVPIA, was completed in October 1998 and began with the removal of dredger tailing material from the Reading Bar dredger tailing borrow site to fill a large salmonid stranding pit at the Mining Reach south pond complex. Phase 2A, completed in 2000, continued extraction of borrow material at the Reading Bar and Mining Reach sites to fill 18.4 acres of off-channel north bank ponds, and re-create and revegetate floodplains. Extensive revegetation occurred at both the Reading Bar and Mining Reach sites. Phase 2B completed restoration of the floodplain along the south bank and a portion of the downstream north bank of the Mining Reach, filling 59.5 acres of ponds to eliminate the worst stranding sites. On-site borrow material was used, and floodplains were revegetated with native flora. Phase 3A, completed in 2002, was the first project phase that involved relocation of the channel itself. The channel was moved from a channel lined with claypan into an area with deeper alluvium. Limited structural measures were installed to prevent recapture of the original channel. Geomorphic monitoring following implementation has shown that the channel is now dynamic, is functioning as designed (with flows over 3,000 cfs overtopping the constructed floodplain), and has more in-channel anadromous fish habitat than was originally anticipated. Phase 3A also provided 12.9 acres of riparian revegetation on the newly constructed floodplains. To date, revegetation of constructed floodplains has increased habitat for riparian dependent avian fauna, including five MSCS "r" (contribute to recovery) and six "m" (maintain) species. This project contributed to the ERP targets for streamflows, stream meander, natural floodplains and flood processes, freshwater fish habitats, essential fish habitats, and dams and other structures.

Clear Creek Prescription (**ERP-99-N16**), a planning project, created an ecosystem-based watershed management prescription for the Clear Creek watershed to help achieve California Bay Delta Authority's vision of restoring important fishery, wildlife, and plant communities to a healthy condition, and serve as a model for other

watersheds in the state. The watershed coordinator facilitated community meetings, convened technical team meetings, and established an educational committee. A total of 1,095 students attended classes and/or participated in restoration projects. A Wildfire Defense Plan, a Shaded Fuel-break Plan, and a Roadside Hazard Reduction Strategy with Monitoring Plan were also developed. This project contributed to the ERP habitat target by improving habitat through the integration of actions described for ecological processes, habitats, and stressor reduction or elimination, as well as addressed outreach/educational goals of ERP.

The *Lower Clear Creek Monitoring Program* (**ERP-04-S05**) continues monitoring efforts in the realm of avian populations, geomorphic processes, and riparian habitat restoration response that were initiated during earlier phases of the *Lower Clear Creek Restoration Project* (**ERP-98-F15**). Several species addressed in the Multi-Species Conservation Strategy (MSCS) are found on Clear Creek, such as yellow warbler, song sparrow, and yellow-breasted chat. Monitoring the response of these species to restoration efforts is contributing to the base of knowledge on their requirements for future CALFED and otherwise-funded riparian restoration projects (P. Bratcher, personal communication). Geomorphological and riparian habitat monitoring are providing information on how to adaptively manage for and design future restoration projects, as well as assessing the need for gravel injection or flows that are needed to inundate the floodplain. These projects are contributing to the ERP targets addressing coarse sediment supply, stream meander, natural floodplains and flood processes, and riparian and shaded riverine aquatic habitats.

The *Lower Clear Creek Floodway Rehabilitation Project (Phase 3B)* (**ERP-05D-S18**) is an on-going full-scale implementation project. The reconstructed bankfull channel is designed to function geomorphically within newly constructed floodplain surfaces completed in Phases 2A and 2B of the Floodway Project (see previous paragraph), which are immediately adjacent to Phase 3B. Most importantly, the work will address a headcut that has continued to migrate and is now threatening the successful channel creation and riparian habitat created in previous project phases. This project contributes to the ERP targets for streamflows, stream meander, natural floodplains and flood processes, freshwater fish habitats, essential fish habitats, and dams and other structures. The target for stream meander will be nearly completed with the implementation of Phase 3B (**ERP-05D-S18**). Additionally, this project can provide model implementation of the Adaptive Management Process. This project can provide an opportunity to test the hypothesis that streamflow and sediment can be managed for ecosystem health and function on a highly regulated river. The careful evaluation of project data and the revisions made as a result of this evaluation can assist CALFED in its work with similar highly regulated Central Valley streams.

The *Genetic Comparison of Stocks Considered for Re-establishing Steelhead in Clear Creek* (**ERP-98-C12**) obtained fine-scale information on the genetic diversity of steelhead/rainbow trout from several locations to determine the preferred sources of a

founding stock for re-establishing a self-sustaining steelhead population in Clear Creek, following the removal of the McCormick-Saeltzer Dam. The project assessed three alternatives for re-establishment: allowing strays from the Upper Sacramento River to repopulate the lower Clear Creek watershed, stocking steelhead (juveniles or returning adults) from CNFH into the lower watershed, and trans-locating offspring of "native", resident rainbow trout from isolated populations in upper Clear Creek, above Whiskeytown Dam, to lower Clear Creek. While a final report could not be found in the database, it appears that strays have repopulated lower Clear Creek from the Sacramento River, based upon data from **ERP-01-N47** and other survey efforts (P. Bratcher, personal observation). Once McCormick-Saeltzer Dam was removed in 2000, steelhead were able to access the uppermost portions of lower Clear Creek (below Whiskeytown Dam) for spawning. This project contributed to the ERP species target of investigating the feasibility of using native rainbow trout currently isolated above dams to rebuild or recreate a steelhead run.

The *Sulphur Creek Coordinated Resource Management Planning Group* (**ERP-98-E15**) project supported the ongoing activities of the Sulphur Creek Coordinated Resource Management Planning Group (CRMP) by providing funding for a part-time employee and office supplies. Sulphur Creek is a small, urban tributary in the Redding area (within the Clear Creek EMU) which supports spawning and rearing of anadromous salmonids. The Sulphur Creek CRMP held public meetings, coordinated volunteers, and prepared grant proposals to implement Sulphur Creek restoration projects in the watershed. This project addressed the ERP target to maintain and improve habitat through integration of actions, as well as the educational and outreach goals of ERP.

Cow Creek Ecological Management Unit

The *Farmer and Rancher Assisted Ecosystem Restoration and Watershed Stewardship Project* (**ERP-05-S24**) has been funded by ERP, but the grant agreement had not been executed at the time of this writing. As outlined in the proposal, seven pre-qualified landowners, with holdings from 13 to 2,200 acres, located from the confluence of Cow Creek with the Sacramento River into the five main tributaries, are committed to implementing 22 Environmental Quality Incentives Program (EQIP) cost-share projects to support the ERP goals to assist in recovering endangered and other at-risk species and native biotic communities, rehabilitate ecological processes, protect and restore habitats, prevent establishment of and reduce impacts from non-native invasive species, and improve or maintain water and sediment quality. The projects include tailwater recovery, screening diversions, installing a water conveyance pipeline, irrigation management, riparian fencing, wetland enhancement, range planting, and brush management. Once implemented, the project will contribute to the ERP targets to improve freshwater fish habitats and essential fish habitats, and reduce stressors caused by dams and other diversions.

Bear Creek Ecological Management Unit

None listed.

Battle Creek Ecological Management Unit

The *Battle Creek Watershed Management Strategy* (**ERP-96-M25**) project provided funds for the establishment of the Battle Creek Watershed Conservancy (BCWC) and created a watershed management strategy for Battle Creek. The Conservancy collaborated between stakeholders through involvement from local landowners, local, state, and federal agencies, and other interested parties and groups. The watershed management strategy supplemented the existing "technical" watershed plan (see below – **ERP-96-M12**) by developing 13 strategies and related recommendations, providing the framework to guide future watershed restoration and educational activities in the Battle Creek watershed.

The *Battle Creek Chinook Salmon and Steelhead Restoration Plan* (**ERP-96-M12**) study developed technical information to complete an overall watershed plan for Battle Creek salmon and steelhead restoration. This watershed plan supplements the watershed management strategy developed in **ERP-96-M25** (see above). The technical information developed in this study included a management plan for opening up the fish barrier at the CNFH to address genetic and disease implications of rebuilding the remnant populations, a complete and updated series of habitat analyses for logical sequencing of restoration actions, and monitoring of water temperature, disease organisms, genetic characteristics, riparian habitat, and gravel conditions. This information will support two key long-term agreements critical to restoration/opening up the barrier maintained by the CNFH and increasing the flows below the PG&E hydropower diversions. The watershed plan includes critical information to guide the Battle Creek restoration effort, and was used as the technical basis for stakeholder negotiations that led to CALFED approving the funds for engineering and construction of the Battle Creek Restoration Project.

The *Battle Creek Watershed Stewardship* (**ERP-98-E06**) project supported the ongoing work of the BCWC by providing funds for direct ecosystem restoration, protection against future ecosystem degradation, improvement of degraded habitats, and public outreach. The project completed the implementation of the watershed strategy, development of plans for upper watershed restoration, implementation of a fuels management program, conservation easement planning, and removal of noxious weeds within the watershed. These tasks were determined based on identified needs within the watershed, requests from landowners, and suggestions from professionals working with the Conservancy through the Battle Creek Working Group. The tasks provide direct benefits to salmonids and other wildlife in the watershed. Overall, this project contributed to the ERP targets for riparian and shaded riverine aquatic habitats, freshwater fish habitats, and essential fish habitats.

The *Battle Creek Conservation Easements Acquisitions, Management, and Restoration Planning* (**ERP-01-N24**) project successfully acquired a conservation easement on Miller Ranch, protecting 1,511 acres and approximately three miles of frontage on the mainstem of Battle Creek. In a separate but related project, the Nature Conservancy, with cost-share funds, acquired Eagle Canyon Ranch, which protected 988 acres and approximately two miles of frontage on the North Fork of Battle Creek. Battle Creek is recognized as the only Sacramento River tributary capable of supporting all four runs of Chinook salmon (fall, late-fall, winter and spring), an important MSCS species. Funds from this project were used to conduct easement and biological monitoring activities on both the Miller and Eagle Ranches. The vegetation study collected fine scale data using both plot and line intercept methods. The study found that understory plant communities of both ranches were composed primarily of non-native herbaceous species, while shrub and tree species were primarily native. The collected data will be very valuable as a reference point for future monitoring. The easements protected critical riparian habitat and adjacent upland habitat in the Battle Creek Watershed. The project helped meet the ERP targets for riparian and shaded riverine aquatic habitats, freshwater fish habitats, and essential fish habitats.

The *Battle Creek Anadromous Salmonid Monitoring Program* (**ERP-01-N45**) is an ongoing project that has provided real-time information on salmonid monitoring for use in adaptive management of the Battle Creek Salmon and Steelhead Restoration Program. This project consists of adult fish counting and trapping at the Coleman barrier weir, adult, redd, and carcass (snorkel) surveys, and juvenile fish monitoring with two rotary screw traps. In the MOU for the *Battle Creek Salmon and Steelhead Restoration Project* (**ERP-99-B01**) (see below for description of the project), the participating parties agreed on five elements needed in biological and ecological monitoring. This project contains four of these elements: Post-Construction Evaluation and Assessment, Facilities Monitoring Plan, Operations and Maintenance Plan, and an Adaptive Management Plan (AMP). Monitoring may show that, given time, salmonids will be able to access target habitats, produce juvenile outmigrants, increase escapement, and meet AFRP/CALFED goals. If not, specific AMP responses include increasing minimum flows, removing natural barriers, initiating radiotelemetry studies, investigating unforeseen limiting factors, verifying the limiting life stage or IFIM models that underlie the restoration approach, developing improved temperature models, and/or extending video and electronic dam fish counts. Monitoring may also trigger other actions taken outside of the AMP, including changing operation of the CNFH barrier weir and/or supplementing winter Chinook or other fish populations in Battle Creek. This project addresses the ERP targets for streamflows, stream temperatures, freshwater fish habitats, essential fish habitats, and reducing stressors from water diversions and dams and other structures.

The *Anadromous Fish Habitat Monitoring for the Battle Creek Salmon & Steelhead Restoration* (**ERP-06D-S18**) is an ongoing project that continues and adds to the efforts of **ERP-01-N45** (see above) through counts of Chinook salmon and steelhead

returning to Battle Creek via the Coleman National Fish Hatchery(CNFH) barrier weir fish ladder, use of a rotary screw trap at CNFH to estimate juvenile production of Chinook salmon and steelhead, radio telemetry studies, instream studies upstream of CNFH, monitoring of streamflow conditions on the North and South forks of Battle Creek, installation of a weather station in the town of Manton to monitor climatic conditions, sediment monitoring, riparian habitat, and coldwater refuge studies.

The on-going *Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon Project* (**ERP-05D-S20**) will ultimately implement the first phase of a Central Valley-wide Constant Fractional Marking (CFM) program that uses coded-wire tagging/adipose fin clipping (CWT) to address central salmon management questions. The field work began in 2007. The relative contribution of hatchery and natural production to adult populations will be determined as represented in fisheries, spawner populations, and at Central Valley salmon hatcheries. The overall objectives of the Central Valley CFM program are to evaluate the contribution rates of hatchery fish to Central Valley Chinook salmon populations, evaluate the Central Valley propagation program's genetic and ecological effects on natural Chinook populations, estimate exploitation rates of hatchery and natural Central Valley Chinook salmon in ocean and inland fisheries, evaluate the success of restoration actions designed to increase natural production of Central Valley Chinook salmon, evaluate the relative impacts of water project operations on hatchery and naturally-produced Chinook salmon, and evaluate the recovery of listed stocks of Chinook salmon. This project will contribute to the ERP targets for fish and wildlife harvest and artificial fish propagation.

The *Engineering Investigation of Anadromous Fish Passage in Upper Battle Creek Project* (**ERP-97-M02**) is a planning and engineering investigation of fish passage for selected sites on North and South Fork Battle Creek. The project investigated the design of fish ladders to improve upstream migration for a greater range of flows and fish screens to minimize loss of downstream migrants. Improving fish passage will benefit winter-run and spring-run Chinook salmon (important MSCS species) and steelhead trout. The project recommended new fish ladders and fish screens at three diversions: Inskip Diversion, North Battle Creek Feeder Diversion, and Eagle Canyon Diversion. A new fish ladder and flat plate fish screen are proposed at the Inskip Diversion, a new pool and chute fish ladder and flat plate fish screen are proposed at the North Battle Creek Feeder Diversion, and a new vertical slot fish ladder and flat plate screen are proposed at the Eagle Canyon Diversion. These new fish facilities will be funded through the *Battle Creek Salmon and Steelhead Restoration Project* (see **ERP-99-B01** below and **ERP-06D-S12** in the "Planned Projects for Implementation" section). Installation of new fish passage structures will contribute to the ERP targets for streamflows, freshwater fish habitats, and essential fish habitats, and eliminate stressors associated with water diversions and dams and other structures.

A complementary project to **ERP-98-C14** was *Reconnaissance Investigation and Preliminary Design for Steelhead and Winter-run and Spring-run Chinook Passage Facilities* (**ERP-98-B16**). This project was a planning and design investigation of fish ladders and screens for improving fish passage on Battle Creek. The target species for this project are adult salmon and steelhead traveling upstream and juveniles traveling downstream. This investigation collected crucial field data followed by preliminary design work for fish ladders and fish screens at three sites, reconnaissance investigation work at two other sites, draft CEQA work for the five sites, and pre-reconnaissance work for some alternative fish screen sties. This, combined with other monitoring, ultimately fed into decisions about dam removal and other associated restoration projects on Battle Creek. This project contributed to the ERP target for freshwater fish habitats, essential fish habitats, and reducing stressors at dams and other structures.

ERP-99-B01, the *Battle Creek Salmon and Steelhead Restoration Project*, resulted in the draft and final Environmental Impact Statement/Environmental Impact Report for this project, as well as a Memorandum of Understanding between the National Marine Fisheries Service, U.S. Bureau of Reclamation, California Department of Fish and Game, and PG&E to define the respective parties' roles and responsibilities regarding actions that will be undertaken as part of the restoration project. See **ERP-06D-S12** in the "Planned Projects for Implementation" section for a description of the implementation phase of this project.

Improve Upstream Ladder and Barrier Weir at Coleman National Fish Hatchery at Battle Creek (**ERP-99-B08**) is an ongoing, full-scale implementation project. When the project is complete, the barrier weir fish ladder at the hatchery will be improved to meet the flow requirements of approximately 85 cfs. In addition, a modified barrier weir will be constructed. The fish ladder at the barrier weir is closed during July through early March to create a migration barrier. The barrier weir is designed and operated to accomplish broodstock collection for the hatchery, restrict access to the upper Battle Creek watershed to prevent hybridization of spring and fall Chinook, and restrict access to the upper Battle Creek watershed by fall- and late-fall Chinook to limit disease transmission into the hatchery's water supply. Undesired fish passage over the barrier has been documented; therefore, a modified barrier weir is necessary to block fish to achieve fisheries management objectives. This project will meet ERP targets for artificial fish propagation and meets the programmatic target for reducing stressors at dams and other structures.

The goal of the *Outreach and Technical Services to Support Landowner and Watershed Resident's Participation in the Battle Creek Salmon and Steelhead Restoration* (**ERP-03-M10**) project is to improve the effectiveness of both the BCWC's participation in agency and stakeholder deliberations and the Conservancy's outreach activities in the local community. The project will provide the technical resources required to provide a sound scientific basis for the Conservancy's expression of local concerns to the agencies, and for its outreach activities related to the *Battle Creek Salmon and*

Steelhead Restoration Project. Tasks include communicating technical and policy issues pertaining to salmon and steelhead restoration in Battle Creek to landowners and watershed residents, representing Battle Creek landowner interests in technical and policy discussions as it pertains to the development, implementation, and adaptive management of the restoration project, and developing site-specific habitat restoration and education projects within Battle Creek watershed. Participation by the Battle Creek Watershed Conservancy and its constituents will contribute towards addressing targets for freshwater fish habitats and essential fish habitats by developing concurrence and success in maintaining and improving fish habitat, and the target for reducing stressors at dams and other structures, (specifically target 3), which involves working with landowners, diverters, and other state or federal agencies managing Battle Creek to improve fish passage.

An ERP-funded monitoring project on Battle Creek was *Monitoring Adult and Juvenile Spring and Winter-Run Chinook Salmon and Steelhead in Battle Creek, California* (**ERP-98-C14**). This project monitored adult and juvenile spring- and winter-run Chinook salmon and steelhead in Battle Creek in order to obtain life history information to assess the suitability of the current habitat and provide an evaluation tool for restoration activities. The following twelve objectives were determined separately for spring-run Chinook salmon and steelhead: number of returning adults, timing of adult migration, age, size, and gender of returning adults, timing of spawning, location of spawning, timing of fry emergence, growth rate of juvenile salmonids, timing of juvenile emigration, size of emigrating salmonids, number of juveniles produced, potential limiting factors affecting survival at various life stages, and collecting tissue samples from adult and juvenile salmonids for genetic analysis. This information on runs that specifically used Battle Creek provided crucial information on restoration project issues including design, timing, and impacts.

Project Summary Table

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
North Sacramento Valley EMZ				
ERP-01-N30	**Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development** This project made soils information more accessible to individuals and groups engaged in ecosystem restoration projects in the Bay-Delta Region.	8/15/2004	$502,100	Complete. Final report titled "Digital Soil Survey Mapping and Digital Orthophoto-quad and Imagery Development". Please see the Sacramento River EMZ chapter for implementation success.
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs** The applicant synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region. The goals if this project are to identify the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, to develop recommendations for how such activities can best benefit breeding songbirds and to evaluate the songbird monitoring strategy.	7/31/2007	$356,876	Complete. Project complete per status report, but final report pending.
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed** The goal of this project is to assess the role of vegetation in shaping the watershed's hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Complete
ERP-04D-S08a	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)** This project will to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.	12/31/2008	$777,700	Complete
ERP-04D-S08b	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (DFG)** Same as above.	12/31/2008	$68,500	Complete
ERP-04D-S08c	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (USFWS)** Same as above.	3/31/2010	$496,210	Complete

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-04D-S09	**Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement** This project will obtain juvenile winter Chinook production indices and correlate these indices with estimated escapement from adult counts at the Red Bluff Diversion Dam and the winter-run carcass survey.	6/30/2009	$2,282,630	Complete
ERP-96-M16	**Sacramento River and Major Tributaries Corridor Mapping Project** This project will create a GIS package detailing riparian corridors along the Sacramento River and its major tributaries in portions of Glenn, Sutter, Colusa, Yuba, Yolo, and Sacramento Counties.	12/31/1999	$145,200	Complete. Please see Sacramento River EMZ chapter for implementation success.
ERP-96-M23	**Fish Screen Biological Performance Test** This project demonstrated the feasibility of the application of an innovative fish screen design to smaller (< 50 cfs) unscreened diversions in the Central Valley of California.	6/30/1998	$90,000	Complete. This pilot project tested the feasibility of an innovative fish screen design for smaller diversions in the Central Valley of California. Final report titled "Biological Performance Tests of East Fork Irrigation District's Sand Trap and Fish Screen Facility Phase I – 1999" (Copy of final report not in CHRPD).
ERP-97-C03	**Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning** This project developed a non-profit watershed group to implement the goals of the Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB1086) to improve riparian habitat along the Sacramento River.	12/31/2000	$200,000	Complete. Sacramento River Conservation Area Forum was formed.
ERP-97-C04a	**Water Diversion Screening** This project installed two demonstration fish screens at water diversions located on the Sacramento River and conducted outreach activities to encourage other private owners to participate in voluntary screening of their diversions.	2/28/2002	$374,850	Complete. Fourteen fish screens and one fishway were upgraded.
ERP-98-B15	**Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking** This project evaluated the feasibility of mass marking and/or tagging to increase the knowledge about juvenile salmon and steelhead distribution in inland and marine waters.	6/30/2002	$625,000	Complete. A contribution rate final report was completed in 2000 and a selective fishing final report was completed in 2001. Please see the American River EMZ chapter for implementation success.

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-N02	**Expanding California Salmon Habitat to Alter Dams and Diversions** This project inventoried dams and diversions in the Central Valley and developed a way to purchase dams and diversions to improve fish passage.	3/15/2000	$49,000	Complete. Project completed an inventory of dams and diversions in the Central Valley.
ERP-99-N13	**Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead** This project developed a plan to implement a Constant Fractional Marking (CFM) program that integrates traditional coded-wire tagging/fin marking and otolith thermal marking to address central Chinook salmon and steelhead management questions regarding the relative contribution of hatchery and natural production to adult populations.	11/30/2004	$92,657	Complete. See the American River EMZ chapter for implementation success.
Clear Creek Ecological Management Unit Projects				
ERP-01-N47	**Clear Creek Juvenile Salmonid Monitoring Project** This project provided funds for continued monitoring of juvenile salmonid conditions and outmigration in Clear Creek to provide information regarding the effectiveness of restoration activities funded through the CVPIA.	6/30/2007	$668,879	Complete. Project provided essential information on the status, trends, and habitat usage of juvenile salmonids. Final report not received as of 11/19/07.
ERP-04-S05	**Lower Clear Creek Monitoring Program** This project included: Avian Monitoring, Geomorphic Monitoring, and Riparian Habitat Monitoring.	1/31/2010	$1,308,449	Complete.
ERP-04-S16	**Clear Creek Anadromous Salmonid Monitoring Program** This project is a comprehensive salmonid monitoring program that will provide feedback for the adaptive management and evaluation of restoration actions of the Clear Creek Restoration Program and B2 Water Program.	12/31/2009	$1,974,068	Complete.
ERP-05D-S18	**Lower Clear Creek Floodway Rehabilitation Project (Phase 3B)** Project will reconstruct the bankfull channel, monitor project implementation, and stabilize a headcut.	1/31/2010	$3,482,451	Complete.

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-C12	**Genetic Comparison of Stocks Considered for Re-establishing Steelhead in Clear Creek** This project obtained fine-scale information on the genetic diversity of steelhead/rainbow trout from several locations to determine the preferred sources of a founding stock for re-establishing a self-sustaining steelhead population in Clear Creek following the removal of the McCormick-Saeltzer Dam.	9/30/2004	$45,493	Complete. Cannot determine if successful; No final report was found in the database.
ERP-98-E15	**Sulphur Creek Coordinated Resource Management Planning Group** This project provided funds to support the ongoing efforts of the Sulphur Creek Coordinated Resources Management Planning Group, which is a broad-based local stakeholder group that works to implement restoration activities in the watershed.	5/10/2001	$23,820	Complete. Sulphur Creek CRMP continues to be an active group in the watershed.
ERP-98-F15	**Lower Clear Creek Floodway Restoration Project (Phase II)** This project improved salmon spawning and rearing habitat by implementing the Lower Clear Creek Watershed Management Plan and restoring 2.9 miles of floodplain and riverine aquatic habitat.	6/30/2006	$3,559,596	Complete. Portions of Clear Creek were restored, improving salmonid spawning and rearing habitat.
ERP-99-N16	**Clear Creek Prescription** This project created an ecosystem-based watershed management prescription for the Clear Creek watershed to 1) help achieve CBDA's vision of restoring important fishery, wildlife, and plant communities to a healthy condition, and 2) serve as a model for other watersheds in the state.	3/31/2003	$256,260	Complete. This planning project was successfully implemented and created an ecosystem-based watershed management prescription for the Clear Creek watershed.
Cow Creek Ecological Management Unit Projects				
ERP-05-S24	**Farmer and Rancher Assisted Ecosystem Restoration and Watershed Stewardship Project** This project seeks to conduct multiple projects on-the-ground within the Cow Creek Watershed. It is anticipated that the project will improve water quality, riparian health and ecosystem restoration. The stated project objectives are to improve salmonid recovery in salmon-bearing streams and improve current range and wetland facilities. Public outreach activities are also proposed.	2/28/2010	$275,000	Contract executed on 11/2/07

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Battle Creek Ecological Management Unit Projects				
ERP-01-N24	**Battle Creek Conservation Easements Acquisitions, Management, and Restoration Planning** This project funded the acquisition of conservation easements on three properties in the Battle Creek watershed for the benefit of Chinook salmon and steelhead restoration efforts.	10/31/2004	$1,000,000	Complete. Project successfully acquired a conservation easement on Miller Ranch, protecting 1,511 acres and approximately three miles of frontage on the mainstem of Battle Creek.
ERP-01-N45	**Battle Creek Anadromous Salmonid Monitoring Program** This project is comprised of three Battle Creek salmonid monitoring projects to provide monitoring information for use in adaptive management of the Battle Creek Salmon and Steelhead Restoration Program: (1) adult fish counting and trapping at the Coleman barrier weir; (2) adult, redd, and carcass surveys, and (3) juvenile fish monitoring with using two rotary screw traps.	6/30/2007	$1,576,152	Complete. Project tasks were implemented; however there is no final report in the CHRPD. According to last progress report, the project provided real-time information on salmonid monitoring for use in adaptive management.
ERP-03-M10	**Outreach and Technical Services to Support Landowner and Watershed Resident's Participation in the Battle Creek Salmon and Steelhead Restoration Project** The project provides technical resources required providing a sound scientific basis for the Conservancy's expression of local concerns to the agencies and its outreach activities related to the Battle Creek Salmon and Steelhead Restoration Project.	7/1/2008	$300,000	Complete.
ERP-05D-S20	**Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon** The marking/tagging project provided information on: evaluating and revising Central Valley salmon hatchery operations, being able to track restoration of all races of Chinook salmon, tracking whether CALFED targets for population restoration of Chinook salmon are being reached , and evaluating effects of harvest.	09/30/2008	$6,775,998	Complete.

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-06D-S18	**Anadromous Fish Habitat Monitoring for the Battle Creek Salmon & Steelhead Restoration** This project will conduct counts of Chinook salmon and steelhead returning to Battle Creek via the Coleman National Fish Hatchery(CNFH) barrier weir fish ladder, use a rotary screw trap at CNFH to estimate juvenile production of Chinook salmon and steelhead, conduct radio telemetry studies, perform instream studies upstream of CNFH, monitor streamflow conditions on the North and South forks of Battle Creek, install a weather station in the town of Manton to monitor climatic conditions, conduct sediment monitoring, and study riparian habitat and coldwater refuge.	1/31/2010	$3,360,000	No status reports available in the database.
ERP-96-M12	**Battle Creek Chinook Salmon and Steelhead Restoration Plan** This project collected data to create a watershed plan that will comprise a part of the overall watershed strategy used for implementing the Battle Creek Salmon and Steelhead Restoration Project.	10/1/1999	$306,000	Complete. This study developed technical information to complete an overall watershed plan for Battle Creek.
ERP-96-M25	**Battle Creek Watershed Management Strategy** This project provided funds to form a watershed conservancy and created a "community plan" for the Battle Creek watershed that supplemented the existing "technical plan" and provided a two-tiered document for restoration activities in the watershed.	10/15/1999	$50,000	Complete. Project successfully implemented by establishing the Battle Creek Watershed Conservancy (BCWC), which continues to be an active group in the watershed. Project also created a watershed management strategy for Battle Creek. Report titled “Battle Creek Watershed Community Strategy”.
ERP-97-M02	**Engineering Investigation of Anadromous Fish Passage in Upper Battle Creek Project** This project consisted of the preliminary design phase for construction of fish screens and ladders to improve passage of anadromous fish along the North and South Forks of Battle Creek.	6/30/2002	$395,000	Complete. This project successfully investigated the design of fish ladders on the North and South forks of Battle Creek.
ERP-98-B16	**Reconnaissance Investigation and Preliminary Design for Steelhead and Winter-run and Spring-run Chinook Passage Facilities** This project funded the planning and preliminary design phase for the improvement of anadromous fish passage on Battle Creek through analysis of five sites for construction of fish screens and ladders.	6/30/2001	$395,000	Complete. This project successfully collected important field data and resulted in preliminary design work for fish ladders and fish screens at three sites on Battle Creek.

Table 1. North Sacramento Valley Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-C14	**Monitoring Adult and Juvenile Spring and Winter Chinook Salmon and Steelhead in Battle Creek, California** This project monitored salmon and steelhead in Battle Creek to obtain life history information to assess the current health of the habitat and provide an evaluation tool for restoration activities.	8/31/2002	$150,000	Complete. Project monitored adult and juvenile spring- and winter-run Chinook salmon and steelhead in Battle Creek in order to obtain life history information.
ERP-98-E06	**Battle Creek Watershed Stewardship** This project provided funds to facilitate the activities of the Battle Creek Watershed Conservancy in development and implementation of watershed restoration activities in the Battle Creek watershed.	9/15/2002	$145,000	Complete. Project supported the ongoing work of the BCWC by providing funds for direct ecosystem restoration, protection against future ecosystem degradation, improvement of degraded habitats and public outreach.
ERP-99-B01	**Battle Creek Salmon and Steelhead Restoration Project** This project will restore 42 miles of habitat for anadromous fish by decommissioning several PG&E diversion dams, providing fish ladders and screens for those that remain, and increasing instream flows for fish.	Unknown	$28,000,000	Complete. Project resulted in the draft and final EIS/EIR for the Restoration Project as well as a Memorandum of Understanding between the National Marine Fisheries Service, U.S. Bureau of Reclamation, California Department of Fish and Game, and Pacific Gas and Electric Company.
ERP-99-B08	**Improve Upstream Ladder and Barrier Weir at Coleman National Fish Hatchery at Battle Creek** This project will improve the fish ladder at the Coleman National Fish Hatchery barrier weir and modify the barrier weir to repair existing damage to assist management in restoring fish populations on Battle Creek.	12/31/2009	$1,663,400	Complete.

Other Programs Contributing to ERP Vision

The *Battle Creek Watershed Stewardship, Phase II* (**CVPIA-01-F05**) project funded the BCWC to conduct an assessment of the watershed conditions in the upper Battle Creek watershed, as well as the lands lying upslope and downstream of the Battle Creek Salmon and Steelhead Restoration Project reaches (see below for evaluation of that project). The assessment identified significant sediment sources, other environmentally sensitive areas, and established priorities and necessary measures for treatment, where needed. In addition, the project implemented a watershed information system to assist the Restoration Project's monitoring, assessment, and adaptive management.

The discussion for the *Using Molecular Techniques to Preserve Genetic Integrity of Endangered Salmon in a Supplementation Program* (**CVPIA-01-F08**) project can be found in the Sacramento River EMZ chapter.

The *McCormick-Saeltzer Dam Fish Passage Project*, *Clear Creek, Shasta County* (**ERP-97-M05**) was to be an ERP-funded full-scale implementation project, however the original awarded funds were never used and the project was cancelled. The Bureau of Reclamation used other funding to remove the dam in 2000, which completely addressed the ERP target for reducing stressors caused by dams and other structures. The target for reducing or eliminating stressors caused by water diversions was addressed by negotiating a water right on Clear Creek to be provided elsewhere within the Central Valley Project service area in Shasta County. Removing the McCormick-Saeltzer Dam also addressed the programmatic action for dams and other structures.

The U.S. Fish and Wildlife Services' (USFWS) Anadromous Fisheries Restoration Program (AFRP) also implemented several projects that have benefited the North Sacramento Valley EMZ. They are as follows:

- *Genetic Analysis of Hatchery and Natural-Origin Winter-Run Chinook Salmon* – this project was funded for four years (1997-2000);
- *Winter-run carcass survey on the upper mainstem (Sacramento River)* – this project was funded for four years (1997-2000); and;
- Evaluation of intermittent east and west-side tributaries to the upper mainstem Sacramento River as rearing habitat for juvenile Chinook salmon.

These projects contributed valuable information regarding the status of winter-run, spring-run and fall-run Chinook salmon and steelhead trout in tributaries to and within the Sacramento River between Keswick Dam and Red Bluff Diversion Dam.

Status of the Area Today

North Sacramento Valley Ecological Management Zone

As shown in Table 1 above, 14 projects have been funded that would benefit the entire North Sacramento Valley EMZ (see Table 1 above). Those projects are as follows:

- **ERP-01-N30 -** *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development*;
- **ERP-02-P17 -** *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs;*

- **ERP-02-P38 -** *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed;*
- **ERP-04D-S08a -** *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC);*
- **ERP-04D-S08b -** *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (DFG);*
- **ERP-04D-S08c -** *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (USFWS);*
- **ERP-04D-S09 -** *Estimating the Abundance of Sacramento River Juvenile Winter Chinook Salmon with Comparisons to Adult Escapement;*
- **ERP-96-M16 -** *Sacramento River and Major Tributaries Corridor Mapping Project;*
- **ERP-96-M23 -** *Fish Screen Biological Performance Test;*
- **ERP-97-C03 -** *Upper Sacramento River Fisheries and Riparian Habitat Management Program (SB 1086) Implementation: Watershed Management Planning;*
- **ERP-97-C04a -** *Water Diversion Screening;*
- **ERP-98-B15 -** *Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking;*
- **ERP-98-N02 -** *Expanding California Salmon Habitat to Alter Dams and Diversions;* and
- **ERP-99-N13 -** *Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead.*

Overall, the projects within the North Sacramento Valley EMZ addressed and/or will address the ERP targets of stream flow, coarse sediment supply, riparian and riverine aquatic habitats, essential fish habitats, water diversions, dams and other structures, fish and wildlife harvest, and artificial fish propagation.

Clear Creek Ecological Management Unit

ERP funded eight projects that will benefit the Clear Creek EMU (see Table 1 above). They are as follows:

- **ERP-01-N47** – *Clear Creek Juvenile Salmonid Monitoring Project;*
- **ERP-04-S05** – *Lower Clear Creek Monitoring Program*;
- **ERP-04-S16** – *Clear Creek Anadromous Salmonid Monitoring Program*;
- **ERP-05D-S18** – *Lower Clear Creek Floodway Rehabilitation Project (Phase 3B)*;
- **ERP-98-C12** – *Genetic Comparison of Stocks Considered for Re-establishing Steelhead in Clear Creek*;
- **ERP-98-E15 -** *Sulphur Creek Coordinated Resource Management Planning Group;*
- **ERP-98-F15** – *Lower Clear Creek Floodway Restoration Project (Phase II);* and

- **ERP-99-N16** – *Clear Creek Prescription*.

Overall, all monitoring and implementation projects on Clear Creek addressed and/or will address the ERP targets of coarse sediment supply, stream meander, natural floodplains and flood processes, riparian and shaded riverine aquatic habitats, freshwater fish habitats, and essential fish habitats, as well as dams and other structures.

In addition to the targets and actions addressed by the various ERP funded projects on Clear Creek, it is worthy to note that several additional targets and actions have been implemented on Clear Creek. These targets and actions have been implemented with funding from other sources, or by management decisions made by the responsible agencies involved with the management of Clear Creek watershed. The following targets are very similar, if not identical, to actions identified for Clear Creek in the CVPIA:

- Central Valley stream flows, target 2: These flow targets have been implemented on Clear Creek since the mid-1990's. There has been a substantial response by fall-run Chinook due to this increase in stream flows.
- Central Valley stream temperatures, target 1: Since the removal of the McCormick-Saeltzer Dam, spring-run Chinook and Central Valley steelhead have become established in the upper eight miles of lower Clear Creek. A temperature gage located near Igo is used to manage water temperatures for these species to comply with Endangered Species Act requirements.
- Coarse sediment supply, target 2: Clear Creek has received gravel, typically in excess of the target of 25 to 50 tons, per year for nearly a decade. Funding has come from a variety of sources, but none of the funding in perpetuity.
- Dams and other structures, target 6, Programmatic Action: As previously stated, the McCormick-Saeltzer Dam was removed in 2000. As part of this action, the water rights remaining on Clear Creek were addressed (water diversions, target 2) by transferring the owners' water right from Clear Creek to other Central Valley Project (CVP) water within Shasta County.

Cow Creek Ecological Management Unit

Only one project has been funded that will directly benefit the Cow Creek EMU, the *Farmer and Rancher Assisted Ecosystem Restoration and Watershed Stewardship Project* (**ERP-05-S24**). However, several projects have been funded that may indirectly benefit the Cow Creek watershed. They are as follows:

- **ERP-02-P17** – *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs*;

- **ERP-04D-S08a** – *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program*; and,
- **ERP-02-P38** – *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed*.

Additional projects were implemented by various entities to benefit the Cow Creek watershed. They are as follows:

- The U.S. Fish and Wildlife Services' (USFWS) Anadromous Fisheries Restoration Program (AFRP) initiated water quality studies on Cow Creek to collect baseline data on flow, temperature, and substrate distribution and quality, and to identify and map migration barriers and unscreened agricultural diversions.
- The Western Shasta Resource Conservation District (WSRCD) has received funding to carry out the following projects within the Cow Creek watershed:
    - A water quality study to identify sources of fecal coliform contamination in two hot spots in the Cow Creek watershed, and to understand the problems and potential solutions to fatal high water temperatures at lower elevations throughout the watershed for anadromous fish;
    - Construction of two fish screens on existing irrigation diversions;
    - Planning, design, and construction of part of the Backbone Ridge fuelbreak to protect residents and landowners;
    - Completion of a watershed management plan;
    - Hiring of a watershed coordinator to assist the Cow Creek Watershed Management Group and the many other activities and projects taking place in the watershed; and,
    - Implementation of a variety of additional projects such as a construction of a tailwater collection pond, retrofit of a fish screen, completion of an irrigation efficiency and instream flow augmentation feasibility study, and ongoing public outreach and education.

Bear Creek Ecological Management Unit

While no projects within the Bear Creek watershed have been directly funded by ERP, two monitoring projects have been funded that may indirectly affect Bear Creek. They are as follows:

- **ERP-04D-S08a** – *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program*; and,
- **ERP-02-P38** – *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed*.

Battle Creek Ecological Management Unit

ERP funded 13 projects that will benefit the Battle Creek EMU (see Table 1 above). They are as follows:

- **ERP-01-N24** – *Battle Creek Conservancy Easements, Acquisitions, Management and Restoration Planning*;
- **ERP-01-N45** – *Battle Creek Anadromous Salmonid Monitoring Program*;
- **ERP-03-M10** – *Outreach and Technical Services to Support Landowner and Watershed Resident's Participation in the Battle Creek Salmon and Steelhead Restoration Project*;
- **ERP-05D-S20** – *Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Chinook Salmon*;
- **ERP-06D-S18** - *Anadromous Fish Habitat Monitoring for the Battle Creek Salmon & Steelhead Restoration*
- **ERP-96-M25** – *Battle Creek Watershed Management Strategy*;
- **ERP-96-M12** – *Battle Creek Salmon and Steelhead Restoration Plan*;
- **ERP-97-M02** – *Engineering Investigation of Anadromous Fish Passage in Upper Battle Creek Project*;
- **ERP-98-B16** – *Reconnaissance Investigation and Preliminary Design for Steelhead and Winter-run and Spring-run Chinook Passage Facilities*;
- **ERP-98-C14** – *Monitoring Adult and Juvenile Spring- and Winter-run Chinook Salmon in Battle Creek, California*.
- **ERP-98-E06** – *Battle Creek Watershed Stewardship*;
- **ERP-99-B01** – *Battle Creek Salmon and Steelhead Restoration Project*; and
- **ERP-99-B08** – *Improve Upstream Ladder and Barrier Weir at Coleman National Fish Hatchery at Battle Creek*.

Overall, the 13 projects that were funded in the Battle Creek watershed addressed the ERP targets of Central Valley stream flows (Programmatic target and target 3), stream temperatures, freshwater fish habitats, and essential fish habitats, reducing and eliminating stressors — water diversions (target 1), dams and other structures (Programmatic and target 3 and 5), fish and wildlife harvest, and artificial fish propagation. Monitoring projects on Battle Creek provided critical management information for CALFED Goal 1 – At Risk Species and CVPIA priority species: winter-, spring-, fall-, and late-fall-run Chinook salmon and steelhead trout. In addition, the Battle Creek Watershed Conservancy continues to be a very active group in the watershed that acts as liaison between residents of the watershed and the regulatory agencies representing the *Battle Creek Salmon and Steelhead Restoration Project*.

The U.S. Fish and Wildlife Services' (USFWS) Anadromous Fisheries Restoration Program (AFRP) implemented several projects that benefited the Battle Creek EMU. The projects are as follows:

- An analysis of alternative hatchery management strategies to integrate operations with the restoration of natural populations of Chinook salmon and steelhead in Battle Creek;
- Investigate solutions to the unscreened Coleman National Fish Hatchery water delivery system;
- Acquire a conservation easement on the Eagle Canyon Ranch (Pelton property) at the confluence of Digger Creek and the North Fork of Battle Creek; and,
- Sacramento River and Battle Creek: Environmental Education Program for Battle Creek Area Residents.

Planned Projects for Implementation

Clear Creek Ecological Management Unit

One planning project was funded by ERP for the Clear Creek EMU:

- *Clear Creek Prescription* (**ERP-99-N16**)

This project created an ecosystem-based watershed management prescription for the Clear Creek watershed that served as a model for other watersheds in the state. While this project was funded as a planning project, it actually implemented several restoration projects and developed a Wildfire Defense Plan, a Shaded Fuelbreak Plan, and a Roadside Hazard Reduction Strategy with a Monitoring Plan. The project involved the local community and stakeholders in a collaborative, non-regulatory forum for developing projects to address water quality and quantity issues, restoring fish habitat, and protecting natural processes. A watershed coordinator facilitated meetings and established an educational committee. A science curriculum consultant recruited teachers for field experiences; over 1,000 students attended field trips and approximately 200 students participated in restoration projects. In addition, three fuelbreaks were treated.

Clear Creek Ecological Management Unit

None listed.

Bear Creek Ecological Management Unit

None listed.

Battle Creek Ecological Management Unit

Four planning projects were funded for the Battle Creek EMU; they are as follows:

- *Battle Creek Watershed Strategy* (**ERP-96-M25**);
- *Battle Creek Watershed Stewardship, Phase II* (**CVPIA-01-F05**);
- *Engineering Investigation of Anadromous Fish Passage in Upper Battle Creek Project* (**ERP-97-M02**); and,
- *Outreach and Technical Services to Support Landowner and Watershed Resident's Participating in the Battle Creek Salmon and Steelhead Restoration Project* (**ERP-03-M10**).

All four planning projects contributed valuable information that addressed the need for improved anadromous fish passage on Battle Creek. This valuable information was used to guide the decision to fund the *Battle Creek Salmon and Steelhead Restoration Project* (See above for a description of project **ERP-99-B01** and below for **ERP-06D-S12**).

The overall goal of the *Battle Creek Salmon and Steelhead Restoration Project* (**ERP-06D-S12**) is to reestablish approximately 42 miles of important Chinook salmon and steelhead habitat on Battle Creek, an additional six miles of habitat on its tributaries, and improve water quality for the CNFH. The restoration project will be completed primarily through the modification of the Battle Creek Hydroelectric Project facilities and operations, including instream flow releases. Habitat restoration will enable safe passage for naturally produced salmonids and will facilitate their growth and recovery in the Sacramento River and its tributaries. These salmonids include Central Valley spring-run Chinook salmon, which are state and federally listed as threatened; Sacramento River winter-run Chinook salmon, which are state and federally listed as endangered; and Central Valley steelhead, which are federally listed as threatened.

At the time of this writing, funding for **ERP-06D-S12**, Phase I of the *Battle Creek Salmon and Steelhead Restoration Project*, has been appropriated through June 2010 and is available for liquidation through June 2012. The grant agreement to implement this project is in final draft form and is expected to be executed early in 2008; construction is expected to begin in the fall of 2008. During Phase 1 of the Restoration Project, fish passage improvements on the North Fork of Battle Creek will be achieved by installing fish screens and ladders at the North Battle Creek Feeder and Eagle Canyon Diversion Dams, installing the Eagle Canyon Canal pipeline, removing the Wildcat Diversion Dam and appurtenant conveyance systems, and modifying the Asbury Dam to prevent steelhead from getting upstream of the dam and potentially infecting Darrah Springs Hatchery with IHN. Phase I improvements on the lower South Fork of Battle Creek include installing a tailrace connector from Inskip Powerhouse to Coleman Canal and a new Inskip Powerhouse bypass (near Coleman Dam). Phase I will reestablish access to approximately 31 of the total 42 miles of habitat for anadromous fish populations and improve water quality for the CNFH in the Battle Creek watershed. This project will reach the ERP targets for streamflows, freshwater fish habitats, and essential fish habitats, and eliminate stressors associated with water diversions and dams and other structures.

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APPENDIX A

A.5. COTTONWOOD CREEK ECOLOGICAL MANAGEMENT ZONE

Introduction

Cottonwood Creek drains an area of 938 square miles on the west side of the Central Valley and enters the Sacramento River a short distance downstream of the Redding-Anderson area (Figure 1). Cottonwood Creek is the largest undammed tributary on the west side of the Sacramento Valley and functions as an important regional wildlife corridor and habitat for Neotropical migratory birds. More importantly, Cottonwood Creek is a primary source of coarse sediments and spawning gravel for the Sacramento River, supplying 85% of the gravel introduced naturally into the Sacramento River between Redding and Red Bluff.

The Cottonwood Creek Ecological Management Zone (EMZ) includes two Ecological Management Units (EMUs):

- Upper Cottonwood Creek EMU
- Lower Cottonwood Creek EMU

Upper Cottonwood Creek Ecological Management Unit

The Upper Cottonwood Creek EMU provides the stream flow and coarse sediments needed to maintain the overall ecological health of lower Cottonwood Creek and the Sacramento River. Important stream reaches in the Upper Cottonwood Creek EMU include the South and North Forks of Cottonwood Creek, Beegum Creek, and the mainstem reach of Cottonwood Creek above the confluence with the South Fork (also known as the Middle Fork). Spring-run Chinook salmon enter Cottonwood Creek and migrate to the headwaters of the South and Middle Forks during March, April, and May. During spring of drier years, low flows and high water temperatures may impede or prevent the upstream migration of adult spring-run salmon to summer holding areas. Steelhead trout enter Cottonwood Creek during late fall and early winter and spawn during winter and spring. The creek also supports resident rainbow trout and brown trout in the upper tributaries. This unit can sustain important migration, holding, spawning, rearing, and emigration habitats for fish species if stream flows are maintained and could offer increased carrying capacity if watersheds are rehabilitated. Fall-run and late fall-run Chinook also use the watershed for spawning and rearing.

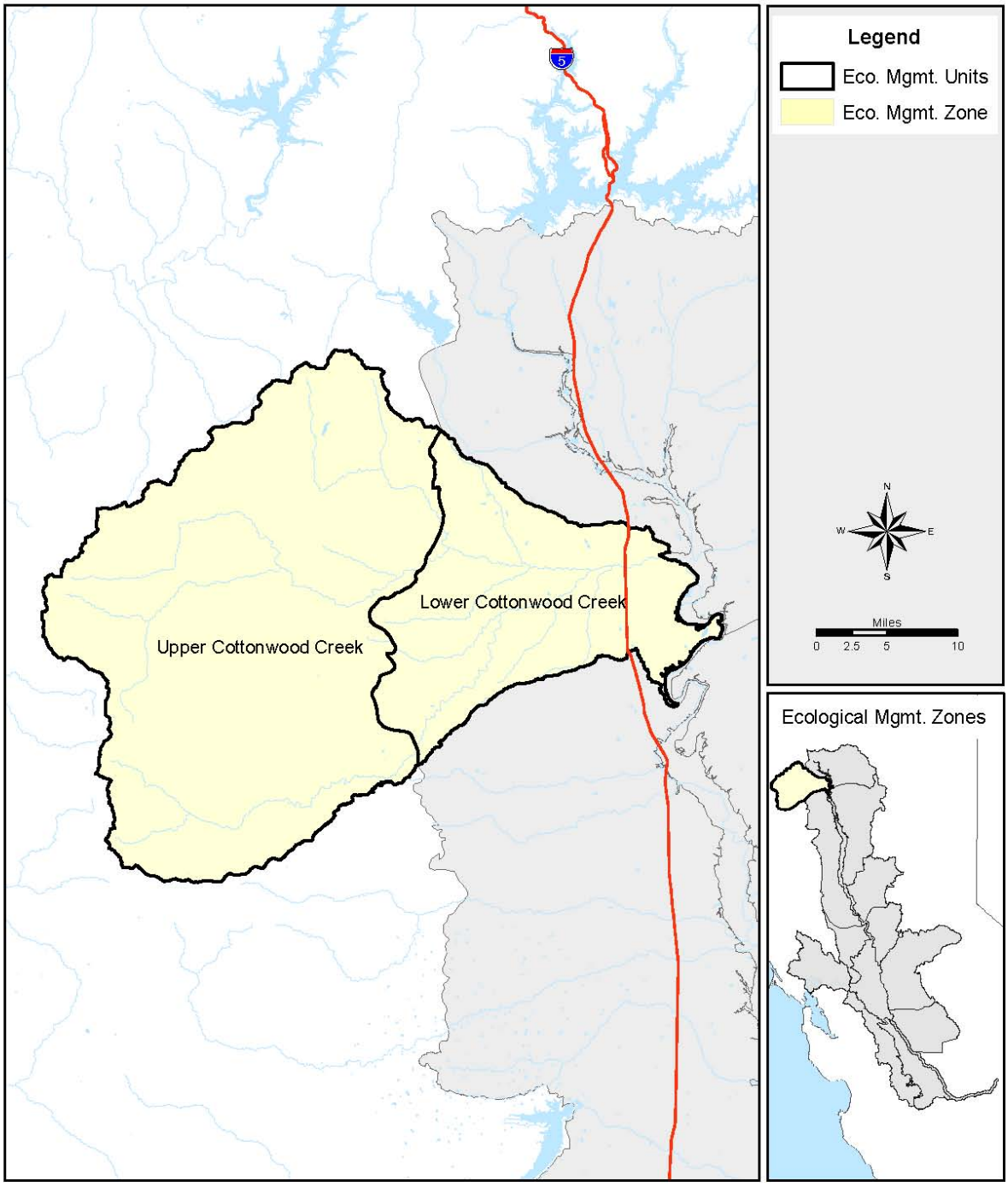

Figure 1. Cottonwood Creek Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Cottonwood Creek EMZ Map

Lower Cottonwood Creek Ecological Management Unit

The Lower Cottonwood Creek EMU primarily consists of low foothills and a large alluvial floodplain comprising the mainstem Cottonwood Creek from the North and Middle Fork Cottonwood Creek confluence down to the Sacramento River, and from the South Fork where Highway 36 crosses the creek down to the confluence with the Sacramento River. This area can provide important spawning areas for fall- and late-fall-run Chinook salmon. However, salmon spawning areas in the lower reaches of Cottonwood Creek have been degraded. Some areas are entirely covered with sand and silt, and others are compacted with sediments or have become armored as a result of flood flows. Gravel transport through lower Cottonwood Creek is a significant ecological function, and sufficient stream flows are needed to provide sediment transport and gravel cleansing. Gravel has been mined in the lower reaches of Cottonwood Creek for many years. Gravel extraction in excess of annual replenishment rates can have many adverse effects on the form and function of stream channels, and also reduces the recruitment of spawning gravel to the Sacramento River. Managing instream gravel extraction and implementing long-term efforts to reactivate gravel recruitment, restore floodplain and flood processes, and maintain plant communities along the creek will benefit the salmon in Cottonwood Creek and the Sacramento River.

Applicable ERP Vision

The vision for the Cottonwood Creek EMZ is to restore natural streamflow patterns, coarse sediment supply, natural floodplain and flood processes, and riparian forest and riverine aquatic habitats (CALFED 2000b). In addition, the proposed restoration actions are designed to reduce or eliminate to the extent necessary stressors that impair ecological processes, including gravel mining operations, structures that inhibit Chinook salmon and steelhead trout migrations, and land use activities (e.g. water diversions, logging, and grazing).

A restored Cottonwood Creek will provide incremental benefits to the overall objective of restoring and maintaining important aquatic species, such as Chinook salmon and steelhead trout, in Cottonwood Creek and in the Sacramento River. With restoration, Cottonwood Creek EMZ will support sustainable populations of fall-, late-fall-, and spring-run Chinook salmon and steelhead trout after natural sediment supply and gravel recruitment, cleansing, and transport processes are reactivated; gravel spawning and riparian habitats are restored; and the adverse effects of upper watershed diversions, logging, and grazing are reduced.

Stage 1 Expectations

The Stage 1 expectations for the Cottonwood Creek EMZ and associated EMUs were to relocate gravel mining operations from the active stream channel and adjacent floodplains to higher terraces (CALFED 2000c). An additional expectation was to develop and implement a watershed management plan to reduce the amount of fine sediments introduced into the creek and to protect and restore riparian habitat.

Changes Attributable to ERP

The *Cottonwood Creek Channel Restoration Planning/Geomorphic Analysis* (**ERP-97-N07**) project yielded geomorphic analysis of approximately 20 miles of lower Cottonwood Creek. This hydrologic and geomorphic data will aid in the design of future projects that achieve ERP targets for floodplain interaction and channel meander to develop and maintain instream and riparian habitat. In addition, the geomorphic analysis documented long-term changes in the lower alluvial reaches attributable to aggregate extraction in excess of annual replenishment rates. Implementing Graham Matthews and Associates' recommendation to end in-channel gravel extraction (Graham Matthews and Associates 2003) would contribute to coarse sediment supply targets as well as the Stage 1, Action 1 to relocate gravel mining operations from the active channel and nearby floodplain to higher terraces (CALFED 2000c).

The Cottonwood Creek Watershed Group was formed April 20, 1998 to help improve the Cottonwood Creek watershed (*Cottonwood Creek Watershed Group Formation* (**ERP-98-E05**). This grant also funded the creation of base maps showing watershed boundaries, streams, roads, and landowners, as well as the acquisition of aerial photos. The *Cottonwood Creek Watershed Monitoring and Assessment* (**ERP-00-E03**) project continued the management of the Cottonwood Creek Watershed Group to oversee the completion of a watershed assessment. CH_2M Hill prepared the assessment and a follow-up watershed strategy. These documents provided the baseline information and comprehensive review of previous studies needed to develop and implement a local watershed management plan. The Cottonwood Creek Management Plan was later funded by a grant from the CALFED Watershed Program and is nearly complete. Completing the watershed group formation and subsequent watershed management plan satisfied the Stage 1, Action 2 identified in the ERP Strategic Plan to develop and implement a watershed management plan (CALFED 2000c).

For many years, students from Evergreen Middle School have benefited from the environmental education curriculum and service learning projects sponsored by the Cottonwood Creek Watershed Group (CCWG). The purpose of the *Kids for Our Creeks* (**ERP-02-P06**) project was to provide this education to the other seven K-8 schools in the watershed, as well as charter schools and children being home-schooled. The CCWG was able to hire several qualified Watershed Educational Coordinators during the

term of this grant. One noteworthy product of this grant is the development of a watershed-related curriculum for each grade level from Kindergarten through 8th grade. Restoration projects completed during this grant included tree and native grass planting at Evergreen Middle School, tree planting after the Platina fire, and Environmental Cleanup Day on Cottonwood Creek. These plantings contributed to ERP targets to maintain and restore riparian habitat.

Project Summary Table

Four projects have been funded that benefit the Cottonwood Creek EMZ.

Table 1. Cottonwood Creek Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-00-E03	**Cottonwood Creek Watershed Monitoring and Assessment** This project assessed conditions in the watershed to give a baseline for future projects.	12/31/2003	$350,000	Complete. Allowed Cottonwood Creek Watershed Group to oversee preparation of assessment and watershed strategy.
ERP-02-P06	**Kids for Our Creeks** This environmental education project established partnerships with the local K-8 schools and established watershed education programs through the use of an education coordinator.	6/30/2007	$164,579	Complete. Project developed a watershed-related curriculum for each grade level from Kindergarten through 8th grade.
ERP-97-N07	**Cottonwood Creek Channel Restoration Planning/Geomorphic Analysis** This project involved geomorphic and hydrologic analyses and re-surveys of historic data to document geomorphic trends along lower Cottonwood Creek.	11/1/2002	$61,000	Complete. Final report titled, "Hydrology, geomorphology, and historic channel changes of lower Cottonwood Creek, Shasta and Tehama counties, California" completed in November 2003.
ERP-98-E05	**Cottonwood Creek Watershed Group Formation** This project funded the formation of a community-based organization to develop and implement watershed stewardship strategies for the Cottonwood Creek watershed.	12/31/2001	$161,000	Complete. Final report titled, "Cottonwood Creek Report" dated January 18, 2000.

Other Programs Contributing to ERP Vision

The Cottonwood Creek Watershed Group (CCWG) is an organized association of landowners, residential home owners, business owners, and other private parties. The group's goal is to work together to maintain, conserve, and restore a healthy and productive Cottonwood Creek Watershed. The CCWG has either applied for funding or received grants to undertake the following projects:

- Noxious weed removal, specifically *Arundo donax* and *Tamarix sp.* (a critical need)
- Geomorphic analysis and sediment budget for South Fork Cottonwood Creek and main stem
- Limiting factors analysis for fish
- Installation and monitoring of a video weir funded by U.S. Fish & Wildlife Service
- Groundwater and surface water quality monitoring funded by management plan grant
- Bank stabilization and riparian restoration project on Chuck Lema property funded by Partners for Fish and Wildlife
- Fuels management plan, shaded fuel breaks, and water storage tanks funded by U.S. Forest Service
- Watershed-wide riparian inventory, including California red-legged frog surveys, funded by Natural Resource Conservation Service
- Currently developing an oak retention ordinance with Tehama County Planning Department
- Formed a coalition for north state landowners in response to the Ag Waiver program
- Programmatic Safe Harbor Agreement held by watershed group for California red-legged frog approved this year

Various other efforts have been conducted within the Cottonwood Creek watershed. A comprehensive soil mapping effort is being conducted on U.S. Forest Service (USFS) lands that will provide additional information on soil and geomorphic relationships in the future. Surface-water-quality was monitored by the U.S. Army Corps of Engineers (USACE) along Cottonwood Creek. Under contract with USACE, the U.S. Geological Survey (USGS) also monitored streamflow, water temperature, total sediment load, and turbidity at particular sites within the Cottonwood Creek watershed. The California Department of Water Resources (DWR) also conducted its own surface- and ground-water-quality monitoring within the watershed.

Status of Area Today

The projects implemented to date have helped describe the current condition of the watershed and further identified and prioritized stressors. A Watershed Management

Plan has been developed that uses the information gathered for watershed management purposes. The Cottonwood Watershed Group recognizes that invasive species removal is a critical need for the watershed.

Planned Projects for Implementation

Review processes, such as those provided by the Sacramento River Conservation Area Forum, help to ensure that riparian habitat considerations are addressed within the 100-year floodplain of the River. Additional work needs to occur, however, including addressing the riparian resources of Cottonwood Creek (which is an ERP milestone), and addressing non-native weed control.

The Stage 1 expectations for the Cottonwood Creek EMZ to relocate gravel mining operations from the active stream channel and adjacent floodplains to higher terraces (CALFED 2000c) did not take place. The assessment performed by Graham Matthews and Associates (GMA) in *Cottonwood Creek Channel Restoration Planning/Geomorphic Analysis* found that instream gravel mining has dramatically accelerated streambank erosion in the lower reaches of Cottonwood Creek. There are many landowners along Cottonwood Creek and South Fork Cottonwood Creek who would benefit from bank stabilization measures proposed by GMA. Implementing channel and riparian restoration projects would contribute to several ERP restoration targets including establishing a continuous riparian habitat zone, maintaining and improving freshwater fish habitat, and restoring channel meander characteristics for Cottonwood Creek. In addition, the Cottonwood Creek Watershed Group has been instrumental in consolidating known information about the watershed; providing a forum through which landowners can obtain assistance on their land management needs, while also potentially improving natural resource conditions; and obtaining grants for projects that address ERP goals and objectives. Helping to maintain the watershed group will aid greatly in accomplishing future restoration in the watershed.

Impediments to Implementation

Discrepancies and contradictions exist among published reports regarding sediment transport rates in Cottonwood Creek. Once these discrepancies are resolved, a comprehensive and cohesive set of studies can be developed.

The actions recommended in the Anadromous Fish Restoration Plan (AFRP) were established to meet population targets. However, the initiation of these actions may preclude regulatory efforts in the basin regarding fisheries.

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APPENDIX A

A.6. COLUSA BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The Colusa Basin Ecological Management Zone (EMZ) is an extensive hydrologic and geographic area west of the Sacramento River between Cottonwood Creek to the north and Cache Creek to the south. The Colusa Basin EMZ is one of the primary waterfowl and wetland migratory bird migration and wintering areas of the Pacific Flyway. The Zone contains three National Wildlife Refuges and some critical privately owned wetlands in the Sacramento Valley. The Colusa Basin Drainage area contains vital waterfowl and wetland habitats and contributes to the filtering of agricultural return flow. The wetlands along the drain provide important habitat for endangered and threatened species. The Colusa National Wildlife Refuge has some of the highest concentrations of giant garter snake in the Central Valley.

The Colusa Basin Ecological Management Zone includes the following Ecological Management Units (EMU) (Figure 1):

- Stony Creek Ecological Management Unit
- Elder Creek Ecological Management Unit
- Thomes Creek Ecological Management Unit
- Colusa Basin Ecological Management Unit

Protecting and improving important ecological processes and functions will help to maintain important attributes of the Colusa Basin Ecological Management Zone, and preserve its ability to serve as a source of sediment and nutrients to the Sacramento River Ecological Management Zone. Important processes needed to provide a healthy ecosystem in the Colusa Basin Ecological Management Zone and contribute to the health of the Sacramento River are the streamflow patterns of the basin and natural sediment supply. The three largest tributary streams in this zone (Stony, Elder, and Thomes creeks) all discharge into the Sacramento River. The Colusa Basin maintains some of its historic capacity to retain and detain floodwater. It captures the seasonal inflow from small westside tributaries that flow into it. The soils underlying the Stony, Elder, and Thomes Creek watersheds are important sediment sources to the Sacramento River.

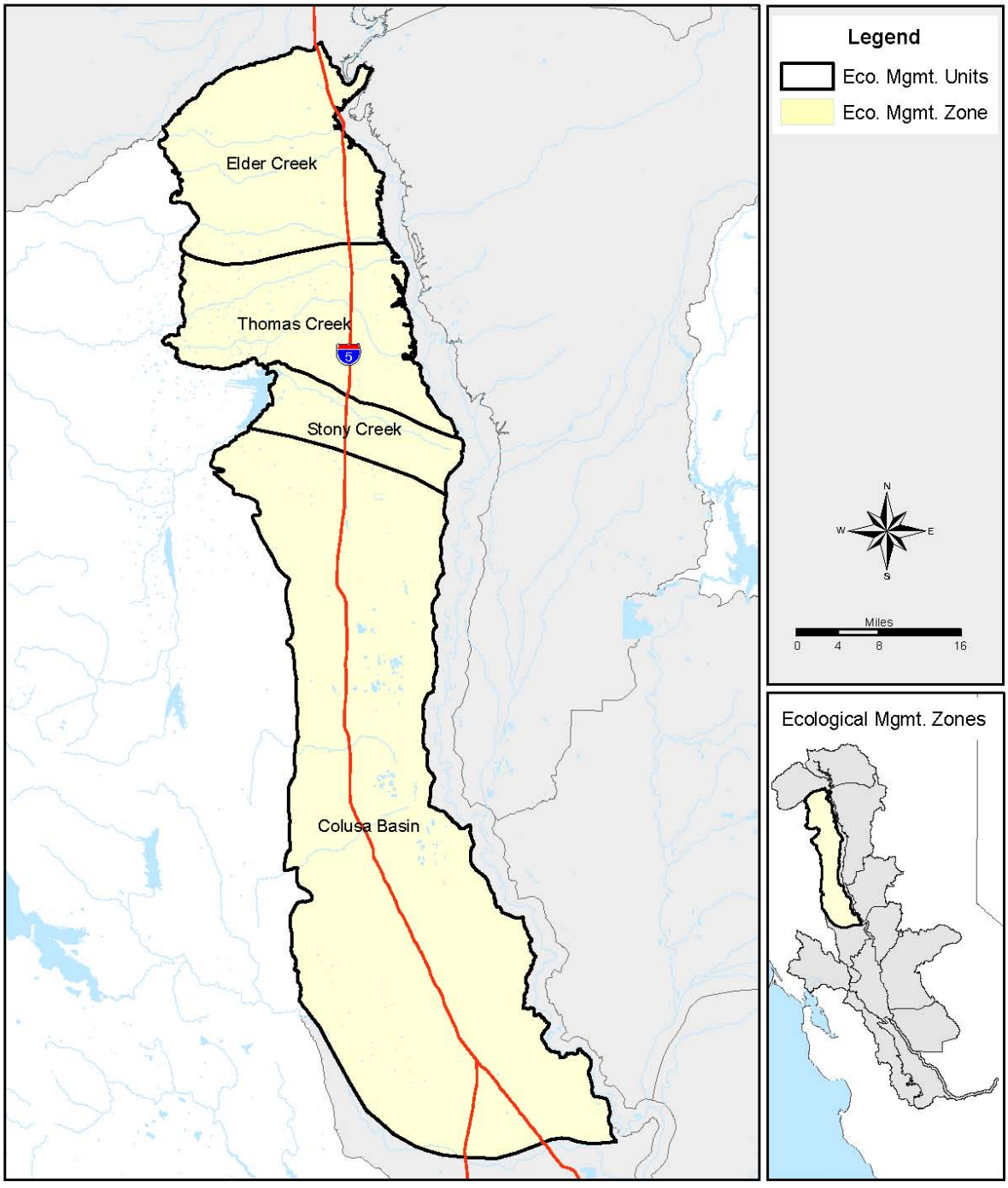

Figure 1. Colusa Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Colusa Basin EMZ Map

Applicable ERP Vision

The Vision for the EMZ focuses on restoring ecological processes and functions related to sediment transport and restoring seasonally flooded aquatic habitats that provide important wintering areas for waterfowl and shorebird guilds, and in providing wetland habitats that will contribute to the recovery of the giant garter snake. The vision also included a large cooperative program with landowners to improve the wildlife benefits related to agricultural practices in the area. In addition, it emphasizes maintenance or improvements to the ecological processes and improvements to fish habitats.

Stony Creek Ecological Management Unit

The vision for the Stony Creek EMU is to maintain and improve valuable aquatic and terrestrial habitat types by restoring upstream areas to improve system integrity and increase habitat complexity.

Elder Creek Ecological Management Unit

The vision for the Elder Creek EMU is to restore degraded habitat, the sediment balance, and a more natural stream channel and riparian habitat in the lower section.

Thomes Creek Ecological Management Unit

The vision for the Thomes Creek EMU is establishing a clearly defined stream channel consistent with flood control needs, effectively enhancing sediment transport in the lower stream reach, and improving sediment delivery to the Sacramento River.

Colusa Basin Ecological Management Unit

The vision for the Colusa Basin is to remedy ecological problems related to the Colusa Basin Drain and the mainstem Sacramento River, and to maintain and improve the area's value in providing seasonally flooded wetland habitat.

Stage 1 Expectations

The Stage 1 expectation for the Colusa Basin Ecological Management Zone was to restore seasonal wetlands and encourage wildlife-friendly agricultural practices in support of the Central Valley Habitat Joint Venture.

Changes Attributable to ERP

The Colusa County Resource Conservation District held 6 public and steering committee meetings to introduce the *Sand and Salt Creek Watershed Project* (**ERP-98-B05**). The District felt the success of the project was strongly tied to these public meetings as landowner participation grew to 16 participants as a result (Colusa County Resource Conservation District, 2002). Based on monitoring data, resource management plans and site maps were developed for all sites. The plans were implemented with site development, project construction and planting treatments. Also, a grade stabilization structure was constructed in a designated channel within the project area to control head-cutting and retard erosion upstream. This project contributed to targets for water quality including 1) reduce the adverse effects of herbicides, pesticides, fumigants, and other agents toxic to fish, 2) establish desirable sediment deposition in the Colusa Basin, and 3) maintain and improve freshwater and essential fish habitat by reducing stressors.

The Colusa Basin Watershed has a considerable impact on water quality in the Sacramento River and Sacramento River Delta. Non-point source pollution from agricultural and winter runoff within the watershed is transported via the Colusa Basin Drain into the Sacramento River. Inputs such as sediment and agricultural waste contribute to the ongoing non-point source pollution issue within the watershed. *The Colusa Basin Watershed Project* (**ERP-99-N14**) served as a watershed management project to assist private landowners in addressing non-point source pollution, flood control issues, exotic invasive weed abatement, and reactivating important ecological processes and functions of riparian corridors in the Colusa Basin Drain watershed.

The *Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming* (**ERP-05-S32**) will evaluate potential effects of fallowing of agricultural habitat on giant garter snake, monitor response of the species to habitat restoration, and identify critical habitat components in restoration design in support of ERP's vision to reduce the conflict between protection for this species and other beneficial uses of land and water in the Delta Region.

Project Summary Table

As shown in Table 1, 11 projects have been funded that would benefit the Colusa Basin EMZ. The projects are focused on at-risk species, environmental water quality, and local watershed stewardship. These projects are described in more detail in the following section.

Table 1. Colusa Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-95-M06	**Biologically Integrated Orchard System Almond Expansion Project** This is an information and technology transfer pollution prevention program for eliminating the use of diazinon and reducing other pesticides used in California almond production	12/30/1998	$660,000	Complete.
ERP-98-B05	**Sand and Salt Creek Watershed Project** Supported Sand and Salt Creek Watershed Project, which assists local landowners in reducing non-point source pollutions on primarily agricultural lands through the selection of 16 cooperating sites for implementation of Resources Management System plans for the benefit of priority fish species. RMS plans focuses on management practices aimed at reducing surface runoff, diazinon residues, and silt and sedimentation into the Colusa Basin Drain and the Sacramento River.	11/26/2002	$599,000	Complete. Selected 16 demonstration sites, developed and implemented resource management plans, monitored sites and collected baseline data, conducted public workshops and tours.
ERP-99-B27	**Watershed Educational Training (WET) Program.** This project will increase public awareness of watershed issues through implementation of the Colusa County Resource Conservation District's (CCRCD) Watershed Educational Training (WET) project, linking community watershed health with the ecological objectives and goals identified by the CBDA. The project will supply the knowledge that enables the public to make sound environmental decisions that come with appreciation for our natural resources.	3/9/2003	$12,887	Complete. The WET project utilizes interactive watershed models to demonstrate the causes and effects of non-point source pollution in the watershed.
ERP-99-N14	**Colusa Basin Watershed Project** This project served as a watershed management project to assist private landowners in addressing non-point source pollution, flood control issues, exotic invasive weed abatement, and reactivating important ecological processes and functions of riparian corridors in the Colusa Basin Drain watershed.	11/6/2005	$492,500	Complete. This project consisted of six selected sites which implemented riparian enhancement and restoration practices to existing degraded riparian corridors and associated wetlands to reduce the amount of surface runoff, chemical residues, and sediments flowing into the Colusa Basin Drain.

Table 1. Colusa Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-01-N30	**Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development** This project made soils information more accessible to individuals and groups engaged in ecosystem restoration projects in the Bay-Delta Region.	8/15/2004	$430,390	Complete. Final report titled "Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development". This project falls within the Elder Creek, Thomes Creek, and Stony Creek EMU's, among others. It was evaluated as part of the Sacramento River EMZ.
ERP-01-N04	**Arundo Donax: Survey and Eradication** This objective of this project is to identify and eradicate areas infested by Arundo donax and Tamarix on Red Bank Creek and Reed's Creek.	12/31/2006	$539,836	Complete. Final Report titled "Survey and Eradication of Arundo donax and Tamarix parviflora; Tehama County". This project falls within the Elder Creek EMU among others. It was evaluated as part of the Sacramento River EMZ.
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Program** The applicant synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region. They identified the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, developed recommendations for how such activities can best benefit breeding songbirds and evaluated the songbird monitoring strategy.	7/31/2007	$356,876	Ongoing. This project falls within the Thomes Creek and Stony Creek EMU's, among others. It was evaluated as part of the Sacramento River and American River Basin EMZs.
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed** The broad goal of this project is to assess the role of vegetation in shaping the watershed's hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Ongoing. This project falls within the Elder Creek, Thomes Creek, and Stony Creek EMU's, among others. It was evaluated as part of the American River Basin.

Table 1. Colusa Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-04D-S08a	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)** This project will to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons. Separate contracts have been written for PSMFC and USFWS involvement (ERP-04D-S08-a and ERP-04D-S08-c). The overall goal for all three components is to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter,spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.The DFG contracted directly for the major equipment purchases to be made.	12/31/2008	$777,700	Ongoing. This project falls within the Elder Creek, Thomes Creek, and Stony Creek EMU's, among others. It was evaluated as part of the Sacramento River EMZ.
ERP-04D-S08b	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (CDFG)** This project will to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.	12/31/2008	$68,500	Ongoing. It was evaluated as part of the Sacramento River EMZ.
ERP-04D-S08c	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (USFWS)** This project will to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall- run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.	3/31/2010	$496,210	Ongoing. It was evaluated as part of the Sacramento River EMZ.
ERP-05-S32	**Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming** This project will evaluate the potential effects of rice field fallowing on giant garter snakes to meet information needed to establish valid regulatory guidelines for the CALFED EWA program. In addition, assess giant garter snake habitat use in selected habitat restoration projects using the techniques USGS developed at Colusa National Wildlife Refuge so that these habitats can be adaptively managed in their agricultural setting.	6/30/2010	$1,187,367	Ongoing.

Status of Area Today

As described in the previous section, 11 projects have been funded by the ERP that would benefit the Colusa Basin EMZ. The majority of these projects have been focused on research and monitoring (5 projects). The research and monitoring projects have provided valuable information that should guide future implementation of phased projects during stage 2.

Planned Projects for Implementation

Protecting and improving important ecological processes and functions will help to maintain important attributes of the Colusa Basin EMZ and will preserve its ability to serve as a source of sediment and nutrients to the Sacramento River EMZ. 11 projects have been funded that would benefit the Colusa Basin EMZ. The projects are focused on at-risk species, environmental water quality, and local watershed stewardship. Five of the project have been research and monitoring projects, providing valuable information that should guide future implementation of phased projects during Stage 2.

Efforts related to watershed planning, and programs to reduce contaminant runoff should continue to be implemented; as these types of programs will not only benefit fish and wildlife resources in the zone but also in downstream areas.

Funding for continued implementation of watershed planning, reducing sediment input to waterways, invasive species control, and efforts to reduce pesticide runoff will continue to be a significant impediment to implementing and achieving ecological health in the Colusa Basin EMZ.

Impediments to Implementation

Funding for continued implementation of watershed planning, reducing sediment input to waterways, invasive species control, and efforts to reduce pesticide runoff will continue to be a significant impediment to implementing and achieving ecological health in the Colusa Basin EMZ.

References

CALFED Bay-Delta Program. 2000. Ecosystem Restoration Program Plan - Volume II: Ecological Management Zone Visions. Final Programmatic EIS/EIRTechnical Appendix. Sacramento, CA.

CALFED Bay-Delta Program. 2000. Ecosystem Restoration Program Plan - Strategic Plan for Ecosystem Restoration. Final Programmatic EIS/EIRTechnical Appendix. Sacramento, CA.

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APPENDIX A

A.7. BUTTE BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The Butte Basin Ecological Management Zone (EMZ) encompasses a significant portion of the Sacramento Valley, east of the Sacramento River and north of the Colusa Basin Ecological Management Zone, and includes the following seven Ecological Management Units (EMU) (Figure 1):

- Paynes Creek EMU
- Antelope Creek EMU
- Mill Creek EMU
- Deer Creek EMU
- Big Chico Creek EMU
- Butte Creek EMU
- Butte Sink EMU

The Butte Basin Ecological Management Zone provides habitat for a wide variety of fish, wildlife, and plant communities and habitats. Generally, the wildlife populations are healthy. Spring-run Chinook and steelhead, however, need to achieve higher sustainable annual population levels before they are considered healthy and no longer a problem in the Delta. The greatest need is to maintain processes closely linked to the natural streamflow regime. Continued efforts toward increasing flows and reducing physical barriers to fish migration will improve the overall ecological health of the watersheds in the basin while contributing to species restoration.

Paynes Creek Ecological Management Unit

Paynes Creek enters the Sacramento River five miles north of Red Bluff. There are no significant dams on the stream; however, as many as 16 diversions seasonally divert water. Diversions are confined to the period between late spring and early fall. Significant losses of juveniles can occur in spring if the irrigation season begins when juvenile salmon are attempting to emigrate from the stream into the Sacramento River. Approximately 15 diversions in Paynes Creek need to be screened to protect juvenile fish.

Paynes Creek has a natural flow pattern of high winter and low summer-fall flows, typical of many Sacramento Valley streams that originate in the foothills rather than the crests of the Sierra Nevada or Cascade ranges. Low summer and fall flows are further reduced by diversions. The stream is often dry during summer and fall. Fall-run Chinook salmon and steelhead trout use Paynes Creek when streamflow is sufficient to

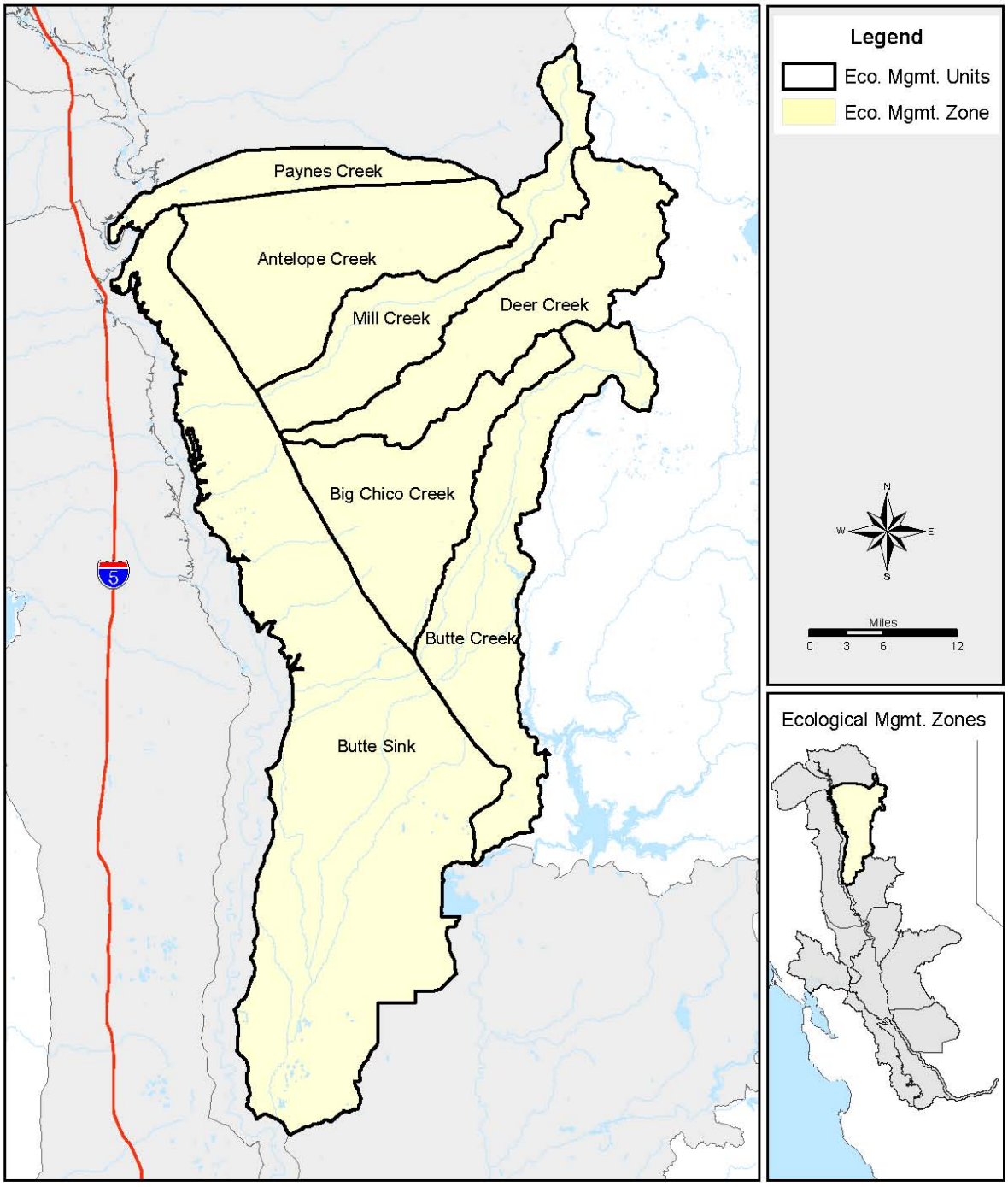

Figure 1. Butte Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Butte Basin EMZ Map

allow upstream passage. The size of the salmon run in Paynes Creek is closely linked to rainfall. Therefore, actions to restore and improve conditions for Chinook salmon and steelhead are more likely to succeed during periods of normal to above normal rainfall.

In addition to low flow, inadequate spawning gravel has been identified as a significant factor limiting salmon production. The California Department of Fish and Game (DFG) built five spawning riffles with 1,000 tons of spawning gravel in 1988. Improvement to the sediment supply, including gravel for fish spawning, needs further evaluation. Also riparian and riverine aquatic habitat needs to be improved by providing adequate streamflow and by protecting shorelines from livestock. Vegetation planting may be required in certain areas to hasten and sustain a riparian corridor along the stream.

Antelope Creek Ecological Management Unit

Antelope Creek flows southwest from the Cascade Range foothills and enters the Sacramento River nine miles southeast of Red Bluff. It is relatively unaltered above the valley floor, but the seasonal lack of flow to the Sacramento River reduces the creek's potential to produce anadromous fish. DFG has been monitoring the spring-run Chinook population in Antelope Creek using snorkel observation techniques. The 2006 count of 102 is the second highest number observed since snorkel counts began in 1989. During this period, counts have ranged from 0 to 154 salmon. DFG has limited historical records of spring-run Chinook salmon occurrences in Antelope Creek, dating back to the 1950's. The status of steelhead in Antelope Creek is unknown.

From spring through fall, the natural flow pattern is altered by diversions in the lower creek. There are two water diversions at the canyon mouth on Antelope Creek. The Edwards Ranch uses water from both diversion points under riparian and pre-1914 water rights. The Los Molinos Mutual Water Company (LMMWC) shares one diversion with a water right of 70 cfs. To reestablish and increase salmon and steelhead in Antelope Creek, priority must be given to providing and maintaining adequate passage flows from October 1 through June 30 below the Edwards and LMMWC diversion dam. Diversions on Antelope Creek have been screened to protect juvenile salmon and steelhead during their downstream passage. Passage through the lower watershed (Butler Slough) is also an issue requiring further investigation due to multiple channels providing water to diversions, the wetland-like nature of the lower watershed, and a lack of bypass channels to return anadromous fry to the main channel. In the upper watershed, DFG is currently looking at alternatives to improve fish passage at the Paynes Place road crossing within the Tehama Wildlife Area which is managed by DFG. Since the majority of spring-run Chinook habitat and cold water refugia is upstream of this crossing, providing a long-term solution for fish passage will be critical in maintaining access to viable spring-run habitat in Antelope Creek.

The riparian and riverine aquatic habit along the Antelope Creek corridor needs several improvements. Some areas have been denuded and will require significant

revegetation. Instream flows should be maintained throughout the irrigation diversion season to provide aquatic habitat and riparian vegetation benefits. In the lower stream section below the canyon mouth, Antelope Creek is subject to braiding and channel bifurcation, which also impair upstream fish passage.

Mill Creek Ecological Management Unit

Mill Creek is a major tributary of the upper Sacramento River, flowing from the southern slopes of Mt. Lassen and entering the Sacramento River 1 mile north of the town of Tehama. The 65-mile-long creek is confined within a steep-sided, relatively inaccessible canyon in the upper watershed. Mill Creek spring-run Chinook salmon are unique because they spawn at altitudes above 5,000 feet, the highest altitudes known for salmon spawning in California. Two dams on the lower 8 miles of the stream divert most of the natural flow for irrigation purposes, usually from May until September. An additional dam, Clough Dam, was removed and replaced with a siphon. All of the water diversions have screens maintained by DFG and are in good operating condition.

The ecological health of the Mill Creek ecological unit is rated above average due to unimpeded stream flow and the undisturbed quality throughout the holding and spawning habitat of spring-run Chinook salmon and steelhead. Flows remain relatively high through spring, even in dry years, because of snowmelt and springs on Mt. Lassen. Mill Creek differs from other eastside streams because of its high silt load and turbidity during the spring snowmelt period. Recent water quality monitoring for Mill Creek indicates that lands within Lassen Volcanic National Park contribute the major source of silt from the steep barren slopes adjacent to the headwaters. The majority of the silt sources in Mill Creek are the result of natural geologic processes that have existed for thousands of years and are not an impediment to the survival of the endemic anadromous fish populations.

Restoration activities are presently being implemented in accordance with the priorities stated in the Mill Creek Watershed Management Strategy (MCC 1997). The Strategy Report addresses potential stressors including the potential adverse impacts from timber harvesting and additional recreational activities. However, the majority of the upper and middle watershed is protected from detrimental activity due to its Wilderness designation, PACFISH regulations, and private conservation easements. Potential restoration work is concentrated in the lower watershed area on the valley floor that has been impacted by human activities. The major restoration efforts include replanting native riparian vegetation, implementing irrigation efficiency measures, and securing additional instream flows.

Deer Creek Ecological Management Unit

Deer Creek is also a major tributary to the upper Sacramento River. The Deer Creek watershed drains approximately 200 square miles and the creek enters the Sacramento

River 1.5 miles north of Woodson Bridge State Park. The lower ten miles of the creek flow through the valley, where most of the flow is diverted. Since 1990, the local irrigation districts, with assistance from DFG and the California Department of Water Resources (DWR), have voluntarily provided fish passage flows at critical times. All of the three diversion structures have fish ladders and screens but are currently negatively affecting at least some portion of each of the runs that use the stream.

Of all the Sacramento Valley streams, Deer Creek has the greatest potential for restoring spring-run Chinook salmon (CALFED Bay-Delta Program, 2000a). Habitat in the upper watershed is relatively intact, with numerous holding areas and an abundance of spawning gravel. Some spawning areas in lower Deer Creek are lightly armored and could limit production of fall-run Chinook salmon. Except for the lack of streamflows on the valley floor below the agricultural diversions, fish habitat throughout the drainage is generally of good quality.

Restoration efforts in the last 10 years on Deer Creek have involved the ongoing participation and support of local landowners through the Deer Creek Watershed Conservancy. One accomplishment of the Deer Creek Watershed Conservancy has been the successful development of a cooperative watershed management plan including a watershed management strategy (Deer Creek Watershed Conservancy, 1998). Inadequate flow for upstream passage is the most significant problem on Deer Creek (CALFED Bay-Delta Program, 2000a).

Big Chico Creek Ecological Management Unit

Big Chico Creek enters the Sacramento River five miles west of the City of Chico. The stream is the focal point of the local Chico community and flows through Bidwell Park, downtown Chico, and the Chico State University campus. Lindo Channel functions as a flood relief channel for Big Chico Creek and both support mature riparian habitat. Marginal spawning and rearing habitat in Big Chico Creek and Lindo Channel below the Five Mile Recreation Area is used by fall-run Chinook salmon. Big Chico Creek and Lindo Channel provide wildlife habitat, anadromous fisheries production and rearing habitat, urban storm drainage, flood control, and recreation.

Important resources in Big Chico Creek include spring-run and fall-run Chinook salmon and steelhead trout and resident native fishes. DFG has conducted annual snorkel surveys in Big Chico Creek since 1989. The 2006 estimate of 299 spring-run Chinook was one of the highest figures in the last ten years. There are no significant impoundments on the stream, and the only major water diversion, the M & T Pumping Station, has been relocated to the mainstem Sacramento River. Inadequate flow for upstream fish passage is the most significant problem on Big Chico Creek (CALFED Bay-Delta Program, 2000a). Recent assessments indicate a potential to rebuild the spring-run Chinook population, a small steelhead population, and a highly variable spawning population of fall-run Chinook salmon.

Restoration efforts on Big Chico Creek will involve the participation and support of local landowners through the Big Chico Creek Watershed Alliance. One role of this stakeholder group has been to sponsor the development of a Watershed Management Strategy that will assist in the effort to preserve and restore spring-run Chinook salmon and steelhead trout. Salmon and steelhead passage problems at Iron Canyon, One-Mile Pool, and Five-Mile Diversion could be improved by repairing weirs and fishways. Water management operations, such as the flow split at Five Mile Diversion Dam, that can improve flows for passage should be evaluated. Gravel recruitment is limited; existing gravel sources should be protected and supplemental gravel placed into the creek channel as needed.

Butte Creek Ecological Management Unit

Butte Creek originates in the Jonesville Basin in Lassen National Forest, on the western slope of the Sierra Nevada. The creek enters the Sacramento Valley southeast of Chico and meanders in a southwesterly direction to the initial point of entry into the Sacramento River at Butte Slough. A second point of entry into the Sacramento River (at lower flows) is through the Sutter Bypass and Sacramento Slough. Lower Butte Creek flows parallel to the Sacramento River for almost 50 miles to the Butte Slough outfall. The Butte Slough and Sutter Bypass reaches of Butte Creek serve as flood relief and convey all Sacramento River flows above approximately 25,000 cubic feet per second.

Stream flow on Butte Creek is similar to that on Deer Creek, with water from snowmelt and springs to maintain summer and fall flow even in drier years. Fall-run and spring-run Chinook salmon and steelhead trout exist in Butte Creek. Furthermore, Butte Creek is one of only three tributaries to the Sacramento River that continues to support a population of spring-run Chinook salmon. The anadromous reach of Butte Creek is approximately 90 miles, extending from impassable natural barriers 15 miles northeast of Chico to the bottom of the Sutter Bypass near Verona. Butte Creek's Chinook salmon and steelhead populations can be affected by inadequate flows, unscreened diversions, inadequate passage over diversion dams, unblocked agricultural return drains that attract and strand adult fish, poor water quality, and poaching.

Butte Creek water management is extremely complex. Diversion dams on Butte Creek above Butte Slough supply water for power generation, irrigation, hunting clubs, and domestic use. Wildlife refuges and hunting clubs dependent on Butte Creek water provide some of the most valuable wildlife and waterfowl habitat in the Sacramento Valley. Evaluating and determining water rights, water use, and instream flow needs will be a long-term effort requiring the involvement of irrigation districts, private landowners, and agency personnel. Also, the Butte Creek Watershed Conservancy is an important organization in developing, evaluating, and implementing measures to improve the ecological health of Butte Creek.

Butte Sink Ecological Management Unit

The Central Valley is one of the most important waterfowl wintering areas in the Pacific Flyway. In recognition of the value of waterfowl throughout North America, the Central Valley Habitat Joint Venture was formed to protect and restore wetlands in the Central Valley. The Butte Sink is one of the important elements of this venture. There are 11,363 acres of publicly owned and managed waterfowl habitat in the area, including the Butte Sink National Wildlife Refuge (733 acres), Gray Lodge Wildlife Area (8,375 acres), and the Upper Butte Sink unit of Gray Lodge (3,750 acres).

The Gray Lodge Wildlife Area is natural habitat in a complex of wetlands and associated uplands whereas the Upper Butte Sink Unit and Butte Sink National Wildlife Refuge are mostly agricultural land that will be restored to natural habitat. Hunting clubs maintain more than 30,000 acres of habitat in a normal year. Of this total, about 18,000 acres are natural wetlands and 12,000 acres are harvested rice fields flooded for hunting. Currently, 5,350 acres of private duck clubs are permanently protected by USFWS Conservation Easements in the Butte Basin. The National Audubon Society owns and manages another 500 acres of wetlands at the Paul L. Wattis Audubon Sanctuary west of Butte Creek (CVHJV 1990).

The area is also seasonally important for salmon and steelhead passage between the Sacramento River and holding, spawning, and rearing areas of the creeks. The sink is predominately wetlands interspersed with riparian vegetation all of which is subject to frequent natural seasonal flooding, which is a major reason for its importance to fish and wildlife, particularly waterfowl.

Applicable ERP Vision

The vision for the Butte Basin Ecological Management Zone focuses on restoring physical processes and habitats, and reducing stressors to meet spring-run Chinook salmon and steelhead population levels of the late 1960s and early 1970s. In addition, improvements in the riparian corridors will provide improved habitat for waterfowl and other wildlife. The Ecosystem Restoration Program proposes targets and actions that will increase protection for naturally produced Chinook salmon and steelhead as they rear and migrate to the mainstem Sacramento River. Important actions to improve survival include maintaining and restoring a healthy riparian zone, which includes ample shaded riverine aquatic habitat, woody debris, and biologically productive gravel beds for fish spawning and invertebrate production. The vision also anticipates screening many small water diversions and providing sufficient flows during important periods of adult migration and juvenile emigration.

Paynes Creek Ecological Management Unit

The vision for the Paynes Creek Ecological Unit is to improve steelhead trout and fall-run Chinook salmon populations by improving streamflows and gravel spawning habitat. Paynes Creek can make minor but important contributions to the upper Sacramento River runs of these fish if adequate holding, spawning, rearing, and migration habitat are provided. Adequate streamflows are important for maintaining and restoring the connectivity of upstream spawning and nursery areas with the mainstem Sacramento River. Sufficient flows must be provided to cleanse and distribute new spawning gravels. The riparian corridor needs significant improvement in several areas; some have been denuded and will require significant revegetation.

Antelope Creek Ecological Management Unit

The vision for the Antelope Creek Ecological Unit is to increase its ability to make small contributions to Chinook salmon and steelhead populations by improving fall and spring flows, increasing spawning gravels and restoring riparian corridors. The health of Antelope Creek will be maintained so that it can provide seasonal inflow, sediments, and nutrients to the Sacramento River. Antelope Creek will provide important migratory corridors for aquatic and terrestrial species. Antelope Creek could be important in some years for salmon and steelhead with adequate flows and improved spawning and rearing habitat.

Mill Creek Ecological Management Unit

Mill Creek is an important ecological unit in the Butte Basin Ecological Management Zone. It provides valuable habitat for anadromous and native resident fish. The vision for the Mill Creek Ecological Management Unit is to increase spring- and fall-run Chinook salmon and steelhead by maintaining adequate streamflows, restoring riparian corridors, and maintaining upper watershed health. It is important to note that Mill Creek's undisturbed condition offers holding and spawning habitat which is essentially unchanged from historic times. Restoration of the creek's anadromous fish populations may depend on the success of downstream restoration actions.

Deer Creek Ecological Management Unit

The Deer Creek Ecological Management Unit is one of the more important ecological units in the Butte Basin Ecological Management Zone. It provides for highly valued populations of spring-run Chinook salmon and steelhead, as well as populations of other Chinook salmon and resident native fish. The vision for Deer Creek is to increase Chinook salmon and steelhead runs by maintaining adequate streamflows, spawning gravels, fish passage, protecting and restoring riparian corridors, and maintaining upper watershed health. This is being accomplished by a locally sponsored comprehensive

watershed management and restoration program which is supported by-many state and federal agencies.

Big Chico Creek Ecological Management Unit

The vision for the Big Chico Creek Ecological Management Unit is to increase runs of Chinook salmon and steelhead by providing adequate streamflows, providing unobstructed fish passage, protecting and restoring riparian corridors, and maintaining upper watershed health. This is being accomplished by implementing locally sponsored comprehensive watershed management and restoration programs.

Butte Creek Ecological Management Unit

The vision for the Butte Creek Ecological Management Unit is restoring spring-run Chinook salmon and steelhead populations by improving fish passage, increasing and improving streamflow, consolidating and screening diversions, and protecting and restoring the riparian corridor. These improvements will help to restore and maintain habitats needed to support a large population of spring-run Chinook salmon and modest populations of fall-run Chinook salmon and steelhead. Screening will allow continued water diversion for agricultural purposes and for the seasonal flooding of private wetlands and adjacent wildlife refuges. Restoring habitat in Butte Creek would allow the spring-run and fall-run Chinook to achieve increased annual spawning populations.

Butte Sink Ecological Management Unit

The vision for the Butte Sink Ecological Management Unit includes restoring stream channels, streamflow, and riparian and riverine aquatic habitats, as well as adjacent wetland habitat. The Ecosystem Restoration Program Plan also envisions restoring or maintaining stream channels, streamflows, and riparian and riverine aquatic habitats to improve rearing and migrating conditions for salmon and steelhead and to improve habitats for resident native fishes, such as the Sacramento splittail.

Stage 1 Expectations

Stage 1 expectations for the Butte Basin Ecological Management Zone included improving fish passage at diversion dams, improving instream flows by purchasing water from willing sellers, and developing and implementing watershed management plans.

Changes Attributable to ERP

Altogether 26 projects were funded that benefit the Butte Basin EMZ. A more in-depth discussion is provided for some of these projects under the specified EMU's below. For more details on the complete list of projects see Table 1.

Ecological Management Zone-wide Projects

The U.S. Forest Service implemented two projects, *Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)* (**ERP-97-B01**) and *Lassen National Forest Watershed Stewardship within the Anadromous Watersheds of Butte, Deer and Mill Creeks* (**ERP-01-N26**), within the Lassen National Forest (LNF) to identify and stabilize potential sediment sources from roads in the Deer, Mill, and Antelope Creek watersheds. LNF implemented erosion control measures on Forest Service roads, updated the National Forest road system database, and prepared a road management plan for Mill, Deer and Antelope creeks. The second grant allowed LNF to continue this work by replacing culverts and resurfacing roads as well as closing, decommissioning, and relocating roads in both the Deer and Mill Creek watersheds. In-channel monitoring was completed for Deer Creek, Mill Creek, Rattlesnake Creek, and the north and south forks of Calf Creek. Watershed stewardship education was established at Chester elementary and high schools. Interpretive signs were installed and a campground patrol program was instituted at Deer Creek campgrounds in order to deter poaching of spring-run Chinook during holding and spawning periods.

In the Butte Creek watershed, a Colby Meadows Condition Assessment and a meadow restoration demonstration project were completed. *Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)* (**ERP-97-B01**) and *Lassen National Forest Watershed Stewardship Within the Anadromous Watersheds of Butte, Deer and Mill Creeks* (**ERP-01-N26**) are among the few projects that are focused on headwaters restoration and upper watershed management within the CALFED boundary (P. Bratcher, personal communication). Maintenance and restoration of the upper watershed conditions contribute towards the ERP goals of water quality, the needs of listed species such as steelhead and spring-run Chinook, and working cooperatively on watershed management.

The *Real Time Flow Monitoring Project* (**ERP-04D-S07**) funds the continued operation and maintenance of 13 flow monitoring stations that assess, acquire, and manage minimum base instream flows for Mill, Deer, Big Chico and Butte creeks. Each of the four tributaries support at-risk species including spring-run Chinook salmon and steelhead and each has significantly impaired flows that have been detrimental to the survival of these at-risk species (Department of Water Resources, 2004).

Furthermore, analysis of flows and diversions shows that the exercise of legal water rights, appropriative, adjudicated, and riparian, often exceeds instream flows critical for spring-run salmon and steelhead migration. The monitoring data generated by these flow gauges is being used by agencies and water managers to establish minimum base flows dedicated for instream use, thereby addressing Butte Basin Central Valley streamflow targets and significantly contributing to the recovery of spring-run Chinook salmon and steelhead in Mill, Deer, Big Chico, and Butte creeks. Antelope Creek was originally included in this project proposal but was dropped due to problems with access. Information generated by these monitoring stations could be extrapolated to determine flows for Paynes and Antelope creeks as well.

Mill Creek Ecological Management Unit

The Nature Conservancy (TNC) has conducted two projects whose goals are to protect a continuous corridor of riparian, aquatic, and upland habitat along key tributary streams of the Sacramento River. With the *Deer and Mill Creeks Acquisition and Enhancement Project* (**ERP-98-F20**), TNC acquired easements totaling 549 acres on Deer Creek and 12 acres on Mill Creek. Both Deer and Mill creeks support populations of spring-run Chinook salmon and steelhead. Deer Creek, in particular, has the greatest potential for restoring spring-run Chinook salmon due to its above average ecological health and contingent of water users that are willing to provide fish passage flows at critical times (CALFED Bay-Delta Program, 2000a). Further acquisitions and restoration work continued with *Mill and Deer Creeks Protection and Stewardship* (**ERP-02-P26**). This project protected riparian and blue oak woodland habitats on the east side of the upper Sacramento River Valley in Tehama County. Conservation easements have been demonstrated to be an effective method of maintaining existing wildlife-compatible land uses, especially limited cattle grazing, and discouraging intensive development within a landscape (The Nature Conservancy, 2001). In this ongoing project, The Nature Conservancy is acquiring conservation easements, installing protective fencing around sensitive habitats and conducting ecological monitoring to ensure easement compliance. These areas represent some of the best examples of contiguous blue oak woodland in the state, as well as relatively pristine Central Valley riparian habitat (P. Bratcher, personal communication). Both of these projects contribute to restoring and maintaining riparian habitat along the lower ten miles of Mill and Deer creeks.

The *Lower Mill Creek Riparian Restoration, Phase I and II* (**ERP-97-N08** and **ERP-98-F04**) projects continue a restoration project initiated in 1996 by the Mill Creek Conservancy, The Nature Conservancy, and The Los Molinos School District, supported by funding from the CVPIA and its Anadromous Fish Restoration Program (AFRP). In 1998, the Nature Conservancy used CALFED funds to purchase 9.48 acres near the confluence of the Sacramento River and Mill Creek. *Lower Mill Creek Riparian Restoration* (**ERP-97-N08**) provided funds to acquire the property and initiate the riparian restoration. *Lower Mill Creek Riparian Restoration (Phase II)* (**ERP-98-F04**) products included lower Mill Creek maps in conjunction with CH_2M Hill, completed a

monitoring report of the "Runyon" site, and funds for the Mill Creek Conservancy to hold public meetings and report on the progress of several re-vegetation sites. These activities contributed to: 1) the protection and enhancement of shaded riverine habitat for native fisheries; 2) the reduction of fragmentation of the riparian corridor for Neotropical migratory birds; and 3) the control of exotic vegetation.

On January 1, 1997, a portion of Clough Dam on Mill Creek washed away. The *Anadromous Fish Passage at Clough Dam on Mill Creek Project* (**ERP-98-B21**) provided funds to remove the remainder of Clough Dam, except for a small portion the Clough Family requested be left for historical significance. A larger fish screen was installed upstream at the Los Molinos Mutual Water Company diversion ditch and an underground siphon to convey irrigation water was installed at the former dam site. This project addressed the ERP target to reduce or eliminate stressors such as dams and other structures on Mill Creek.

Deer Creek Ecological Management Unit

Recognized as one of the last remaining natal streams for spring-run Chinook salmon and steelhead trout, USFWS, CALFED, and DFG have all identified Deer Creek as a priority watershed (Deer Creek Watershed Conservancy, 1997). The preparation of a Watershed Condition Analysis Report and a Watershed Management Strategy were previously funded by the State Water Resources Control Board and the U.S. Fish and Wildlife Service. These documents identified limiting factors and strategies to address concerns associated with spring-run and fall-run Chinook salmon and steelhead habitat and production. As a result of the *Deer Creek Watershed Management / Implementation Program* (**ERP-97-E02**), a Highway 32 Contingency Spill Plan and a Fire Management Plan were produced in order to provide support for future technical design and engineering, watershed monitoring and education. Outreach and education were also implemented in the local Vina and Chester areas. The development of individual ranch management plans was funded by the CALFED Watershed Program. This planning project contributed to ERP targets to develop comprehensive watershed management programs that protect water quality, base flows, and riparian vegetation.

The *Lower Deer Creek Restoration and Flood Management Feasibility Study and Conceptual Design* (**ERP-02D-P53**) is a planning project that uses a collaborative approach between resource agencies, irrigation districts, landholders, and watershed groups to develop a flood management plan for lower Deer Creek. Instream habitat quality has declined since levee construction in 1949 (Deer Creek Watershed Conservancy, 2002). The objective of this project is to develop a conceptual design for a flood control alternative for lower Deer Creek that uses managed floodplain inundation as a restoration tool. To date, subcontractors have compiled peak flow data and completed the pre-feasibility monitoring plan, the hydrology and geomorphology existing conditions report, and the draft conceptual model for the January 1997 flood.

In 1997, the *M&T/Parrott Pumping Station and Fish Screen Project* (**ERP-95-M05**) provided funds to move the Parrott-Phelan Pumping Station from its historic location in Big Chico Creek to a new point of diversion in the Sacramento River. With support from CALFED and the Central Valley Improvement Act, the new pumping facility was reconstructed with state-of-the-art fish screens for over $5 million (Ducks Unlimited, 2002b). This joint effort accomplished three ERP objectives by: 1) removing an impediment to salmon production on Big Chico Creek; 2) reducing the number of diversions on Butte Creek; and 3) providing, in perpetuity, up to 40 cfs of instream flows for spring-run Chinook salmon in Butte Creek. Since the construction of the fish screens and pumping facility in the Sacramento River, river dynamics have created substantial sediment depositions causing a significant gravel bar and eddy in front of the pumping plant fish screens and intake, as well as the City of Chico's Wastewater Treatment Plant outfall situated 300 ft downstream from the pumping facility. This encroaching gravel bar creates a barrier to maintaining a sweeping flow critical to fish screen operation and fish survival, and places both facilities in continual danger of being severed from the Sacramento River by river meander during seasonally increased river flows (MWH Americas, 2004). In November 2001, a partnership between the City of Chico, U.S. Fish and Wildlife Service (USFWS), DFG, California Department of Parks and Recreation, and M&T/Llano Seco Ranches worked together to set back the gravel bar in order to protect the existing facilities from damage or loss. The *M&T/Llano Seco Fish Screen Facility Project* (**ERP-02-P08-D**) is ongoing and will provide continued support to maintain this gravel bar and protect the facility until a long-term solution can be implemented. The interim solution being discussed is to remove the gravel bar and stabilize the right bank of the river with toe-rock. The toe-rock will temporarily prevent the river from meandering and will be removed in five years when a long-term solution can be implemented (K. Moroney, personal communication).

Also, see discussion above on *Deer and Mill Creeks Acquisition and Enhancement Project* (**ERP-98-F20**).

Big Chico Creek Ecological Management Unit

The *Big Chico Creek Watershed: Phase I and II* (**ERP-97-E01**) project provided funds to the Big Chico Creek Watershed Alliance to document the existing conditions of the watershed and also to conduct a survey of stakeholders about the most important issues occurring in Big Chico Creek. The Watershed Management Strategy was created in Phase II using the results from the stakeholders' inventory and the Existing Conditions Report. Phase III, to be funded at a later date, consists of developing the specific projects and programs detailed in the management strategy to help protect aquatic and riparian habitat for out-migrating salmonid juveniles and rearing habitat for non-natal salmonids, splittail, and other species of concern in the watershed. The Watershed Management Strategy could also identify stressors, biotic decline and recommendations to protect watershed resources. Creating plans to improve

ecosystem health will meet both local needs and those important for the Bay-Delta restoration.

Also, see discussion below on *Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation* (**ERP-01-N49**) and *Butte Creek Spring-run Chinook Salmon Life History Investigation* (through **ERP-04-S10**).

Butte Creek Ecological Management Unit

The *Butte Creek Watershed Educational Workshops and Field Tours Series* (**ERP-98-B35**) provided funds for staff of the Butte Creek Watershed Project to conduct workshops and field tours to educate the public on issues within the Butte Creek watershed, opening a new venue for dialogue regarding the future of the Butte Creek watershed. Workshops and field tours covered topics such as timber harvest and cattle grazing practices, the Butte Creek watershed fishery (emphasizing anadromous salmonids), wildland road erosion, fluvial geomorphic processes, riparian habitat, history of the Butte Creek watershed and hydroelectric power generation in the Butte Creek watershed.

The *Butte Creek Watershed Coordinator Assistant, Education Project, Road Survey Project, Geomorphology Analysis, and Restoration Implementation* (**ERP-98-F01**) project had four separate components. A watershed coordinator assistant was hired to maintain the operations of the Butte Creek Watershed Conservancy. The education project conducted two training sessions for teachers to help them incorporate watershed awareness into their classroom curriculum including an Adopt-A-Watershed workshop and a Natural History float down the Sacramento River. Various restoration projects were also initiated as part of the education project: elementary students removed tree-of-heaven (*Ailanthus altissima*) and planted over 100 student-propagated native riparian plants along Little Chico Creek; elementary and junior high students planted riparian trees on the Butte Creek Keeney Preserve; junior high students also propagated native riparian plants and planted them in the Keeney Preserve; and high school students removed non-native species and planted native plants on Big Chico Creek. Overall, the restoration projects improved riparian habitat, thus contributing to the ERP target for riparian and riverine aquatic habitat restoration. The third component of this funded project was an evaluation of forest roads within the upper Butte Creek watershed to assess the impacts of road networks on hillslope hydrology and accelerated sediment transport. The survey assessed approximately 50 miles of road in three sub-watersheds (Scotts John, Bull and Varey creeks) of upper Butte Creek. The results indicated that Bull Creek, Scotts John Creek, and Varey Creek contribute approximately 13,725, 1,892 and 328 cubic yards of road-related sediment, respectively. While these results may help land managers to understand some of the potential problem areas for road-related erosion, the study only established trends resulting from a sampling of three individual sub-watersheds. The fourth component of the project involved conducting a fluvial geomorphology study of Upper Butte Creek.

The objectives of the study were to address the specific land and water management practices that affect the critical holding and spawning habitat for spring-run Chinook salmon, steelhead trout and other associated riparian species. The study also proposed to address the geologic status, riparian corridor conditions, the fluvial geomorphology and urban and recreational development in critical areas.

The *Lower Butte Creek Project (Phase II: Preliminary Engineering and Environmental Analysis for Butte Sink Structural Modifications and Flow-Through System)* (**ERP-99-B02**) was a planning project aimed at ultimately improving fish passage through the Butte Sink and its associated water control structures. The project accomplished the following tasks: 1) preliminary designs of structural modifications for up to four sites in the Butte Sink; 2) environmental review at proposed construction sites; 3) final engineering design for upgrade to the flow-through, flood-up system for the Butte Sink; 4) review of fisheries impacts with respect to the recommendations prepared by the engineers for a flow-through system structural modification upgrades for the Butte Sink; and 5) facilitation of a cooperative operations agreement which details how the flow-through system will be operated during various flow regimes. At the time of this writing, funding for implementation has not been secured. If implemented, the project would improve the long-term stability of natural production of anadromous fish populations, particularly spring-run Chinook salmon and steelhead. *The Lower Butte Creek Project: Phase III Facilitation/Coordination and Construction of Three Fish Passage Modifications to Sutter Bypass West Side Water Control Structures* (**ERP-01-N54**) continues this work. Ducks Unlimited is working with water diverters and drainage districts to develop a Drainage Water Management Plan for the Giusti Weir drainage area. This plan will assist area diverters with meeting instream flows for the West Side Sutter Bypass channel during normal, dry, and critically dry years. Also, at Weir #1, steel uprights that currently trap debris and complicate maintenance will be removed. This project contributes to ERP targets to increase flow in Butte Creek, reduce stressors at diversions, and improve upstream fish passage. It is evaluated further in the Feather River/Sutter Basin Ecological Management Zone chapter.

Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation (**ERP-01-N49**) is an ongoing research project that is defining life history characteristics of spring-run Chinook salmon in Butte and Big Chico Creeks in order to better assess the collective effectiveness of the entire Butte Creek restoration effort. Butte Creek is one of several streams that form the basis for population trends for the threatened spring-run Chinook salmon in the Central Valley of California. Big Chico Creek currently exhibits only a remnant non-sustaining population of spring-run Chinook salmon and is not used as a population trend indicator at this time. This project started in 1995 and will continue until 2010, *Butte Creek Spring-run Chinook Salmon Life History Investigation* (through **ERP-04-S10**). This project has and continues to: 1) develop adult spring-run Chinook salmon and fall-run Chinook salmon escapement estimates for Butte Creek and spring-run Chinook salmon escapement estimates for Big Chico Creek; 2) monitor outmigration timing and relative abundance of age-0+ juvenile

spring-run Chinook salmon within Butte and Big Chico creeks, including the Sutter Bypass; 3) document outmigration of yearling spring-run Chinook salmon; and 4) document relative growth and residence time of juvenile spring-run Chinook salmon in the Butte Creek system, including the Sutter Bypass, through coded-wire tagging of juvenile salmon collected at the Parrott-Phelan Diversion Dam and released approximately two miles downstream at the Baldwin Construction Yard. Other research projects are also assisting in tracking coded wire tagged Butte Creek spring-run Chinook salmon juveniles as they emigrate downstream through the mainstem Sacramento River and Delta. Tagged salmon have been, and will continue to be recovered in the ocean fishery to determine how and where Butte Creek spring-run Chinook salmon contribute to the ocean harvest. Additionally, recovery of returning tagged adults to Butte Creek is providing information on survival, age structure, and straying.

Project Summary Table

Table 1. Butte Basin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Mill Creek EMU Projects				
ERP-02-P26	**Mill and Deer Creeks Protection and Stewardship** This project will help address water quality and quantity, salmon habitat, and existing wildlife-friendly agriculture on Mill Creek and Deer Creek through conservation easements and active land stewardship.	12/31/2008	$4,700,000	Ongoing. Acquired conservation easements in lower 10 miles of Deer and Mill creeks. Conducted monitoring on easements in the Lassen Foothills.
ERP-97-N08	**Lower Mill Creek Riparian Restoration** This project restored and enhanced native riparian vegetation on parcels along Mill Creek, a high-priority tributary of the upper Sacramento River, for the benefit of anadromous fish.	6/20/2004	$69,000	Complete.
ERP-98-B21	**Anadromous Fish Passage at Clough Dam on Mill Creek** This project was the final design and construction of fish passage facilities at or near Clough Dam on Mill Creek for the benefit of salmon and steelhead.	6/30/2003	$1,013,906	Complete. Removed a portion of Clough Dam, installed an underground siphon at the former dam site, and installed a larger fish screen at the upper diversion.
ERP-98-F04	**Lower Mill Creek Riparian Restoration (Phase II)** This project funded Phase II of the Mill Creek Riparian Restoration Project, restored and enhanced native riparian vegetation on one or more parcels along lower Mill Creek.	Unknown.	$30,000	Complete. Produced maps of lower Mill Creek. Mill Creek Conservancy held series of public meetings at revegetation sites.

Table 1. Butte Basin EMZ Project Summary				
ERP Project Number	**Project Name and Description**	**End Date**	**Total Funding**	**Project Status**
ERP-98-F20	**Deer and Mill Creeks Acquisition and Enhancement.** This project proposed to acquire and restore almost 2,500 acres of critical riparian and floodplain habitat along the lower and middle reaches of Deer and Mill Creeks in the upper Sacramento River watershed.	12/31/2003	$1,000,000	Complete. Acquired conservation easements on approximately 561 acres along Deer and Mill creeks.
Deer Creek EMU Projects				
ERP-01-N04	***Arundo donax*: Survey and Eradication** This project located and eradicated areas infested by Arundo donax and Tamarix sp. on Red Bank Creek and Reed's Creek and will continue eradication efforts on Deer Creek.	12/31/2006	$539,836	Ongoing.
ERP-02D-P53	**Lower Deer Creek Restoration and Flood Management; Feasibility Study and Conceptual Design** This project will investigate the feasibility of allowing flood flows in Deer Creek to access the natural floodplain in a controlled manner to improve habitat and flood control.	10/31/2008	$1,519,200	Ongoing. Completed riparian vegetation maps, instream habitat assessment, floodplain mapping and analysis, and flow model for the 1997 flood.
ERP-02-P08-D	**M & T/Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project** This project will protect the existing M&T/Llano Seco fish-screen facility and its beneficiaries while investigating and identifying a technically and economically feasible long-term solution to adapt the fish-friendly pumping facility to the lateral migration of the Sacramento River.	6/30/2008	$4,390,087	Ongoing. Continuation of ERP-95-M05.
ERP-02-P26	**Mill and Deer Creeks Protection and Stewardship** This project will help address water quality and quantity, salmon habitat, and existing wildlife-friendly agriculture on Mill Creek and Deer Creek through conservation easements and active land stewardship.	12/31/2008	$4,700,000	Ongoing. Acquired conservation easements in lower 10 miles of Deer and Mill creeks. Conducted monitoring on easements in the Lassen Foothills.
ERP-95-M05	**M&T/Parrott Pumping Station and Fish Screen Project** The project will evaluate the feasibility of setting back levees on Deer Creek and investigate the feasibility of allowing flood flows to access the natural floodplain to improve habitat and flood control.	12/31/1997	$1,610,000	Complete. Continued with ERP-02-P08-D.
ERP-97-E02	**Deer Creek Watershed Management and Implementation Program** This project provided funds to support on-going watershed monitoring and education programs in the Deer Creek watershed as directed by the Deer Creek Watershed Management Strategy.	12/31/1999	$196,554	Complete. Completed a High-way 32 contingency spill plan and fire management plan. Conducted a water quality monitoring. Implemented local outreach and education.

Table 1. Butte Basin EMZ Project Summary				
ERP Project Number	**Project Name and Description**	**End Date**	**Total Funding**	**Project Status**
ERP-98-F20	**Deer and Mill Creeks Acquisition and Enhancement.** This project proposed to acquire and restore almost 2,500 acres of critical riparian and floodplain habitat along the lower and middle reaches of Deer and Mill Creeks in the upper Sacramento River watershed.	12/31/2003	$1,000,000	Complete. Acquired conservation easements on approximately 561 acres along Deer and Mill creeks.
Big Chico Creek EMU Projects				
ERP-01-N49	**Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation** This project will provide information on the basic life history of spring-run Chinook salmon and steelhead trout populations in Butte and Big Chico Creeks to help evaluate the effectiveness of many fish restoration projects intended to improve anadromous fish populations in the two watersheds.	6/30/2006	$507,132	Ongoing.
ERP-02D-P68	**Arundo Eradication and Coordination, Phase II** This project controls the invasive riparian plant *Arundo donax* to allow native riparian plant species to naturally propagate. It is being removed from the banks of Big Chico Creek, Lindo Channel, Gray Lodge State Wildlife Area and creeks in the American River Basin EMZ.	3/15/2009	$2,033,859	Ongoing. Continuation of ERP-01-N04.
ERP-97-E01	**Big Chico Creek Watershed: Phase I** This project provided funds for the Big Chico Creek Watershed Alliance to document the watershed's existing conditions and create a Watershed Management Strategy.	12/31/1999	$422,830	Complete.
Butte Creek EMU Projects				
ERP-01-N49	**Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation** This project will provide information on the basic life history of spring-run Chinook salmon and steelhead trout populations in Butte and Big Chico Creeks to help evaluate the effectiveness of many fish restoration projects intended to improve anadromous fish populations in the two watersheds.	6/30/2006	$507,132	Ongoing.

Table 1. Butte Basin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-01-N54	**Lower Butte Creek Project: Phase III Facilitation/Coordination and Construction of Three Fish Passage Modifications to Sutter Bypass West Side Water Control Structures** The goal of this project is to increase self-sustaining populations of spring-run and winter-run Chinook salmon, steelhead, and splittail by significantly improving accessibility to the natal holding and spawning areas in Butte Creek through improvement and installation of fish ladders and screens at three locations along the creek.	12/31/2008	$3,047,227	Ongoing.
ERP-04-S10	**Butte Creek Spring-run Chinook Salmon Life History Investigation** This project will continue to develop and refine spring-run Chinook salmon adult escapement estimates.	6/30/2010	$513,144	Ongoing.
ERP-98-B35	**The Butte Creek Watershed Educational Workshops and Field Tours Series** This project provided funds to support the efforts of the Butte Creek Watershed Project to create education workshops and outreach materials focused on watershed issues. This project included numerous workshops/field tours to be held over the course of eighteen months.	12/31/2002	$32,276	Complete.
ERP-98-F01	**Butte Creek Watershed Coordinator Assistant, Education Project, Road Survey Project, Geomorphology Analysis, and Restoration Implementation** This project combined the tasks from four proposals submitted during the 1997 PSP year: 1) provided funds for an assistant watershed coordinator; 2) developed the Butte Creek Watershed Education Project; 3) funded the Butte Creek Watershed Road Survey; and 4) provided for a geomorphic analysis of Lower Butte Creek.	12/30/2001	$302,745	Complete. There is no final report for the fluvial geomorphic study in the database.
ERP-98-N02	**Expanding California Salmon Habitat through Non-governmental and Non-regulatory Mechanisms to Alter Dams and Diversions.** This project inventoried dams and diversions in the Central Valley and developed a mechanism to purchase dams and diversions from willing sellers to improve fish passage.	3/15/2000	$49,000	Complete.
ERP-99-B02	**Lower Butte Creek Project (Phase II: Preliminary Engineering and Environmental Analysis for Butte Sink Structural Modifications and Flow-Through System)** This project provided funds for Phase II of the Lower Butte Creek Project, designed to improve fish passage through the Butte Sink and its associated water control structures for the benefit of anadromous fish populations, particularly spring-run Chinook salmon and steelhead.	6/30/2002	$900,000	Complete.

Table 1. Butte Basin EMZ Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Butte Sink EMU Projects				
ERP-05-S32	**Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming**This project will evaluate the potential effects of rice field fallowing on giant garter snakes in order to establish regulatory guidelines for the CALFED EWA program. Giant garter snake habitat use will be assessed using the techniques USGS developed at Colusa National Wildlife Refuge so that habitats can be adaptively managed in the agricultural setting.	6/30/2010	$1,187,367	Ongoing.
EMZ-Wide Projects				
ERP-01-N26	**Lassen National Forest Watershed Stewardship within the Anadromous Watersheds of Butte, Deer and Mill Creeks** This project continued the work of ERP-97-B01 and restored areas of Butte, Deer, and Mill Creek watersheds through implementation of various restoration activities incl. initiating road restoration at 50 sites.	11/15/2004	$849,845	Complete. Installed interpretive signs at campgrounds, began campground patrols at spring-run Chinook spawning areas, and completed a meadow demonstration project.
ERP-01-N30	**Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development**This project made soils information more accessible to individuals and groups engaged in ecosystem restoration projects in the Bay-Delta Region.	8/15/2004	$430,390	Complete.
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Program.** The goals if this project were to identify the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, to develop recommendations for how such activities can best benefit breeding songbirds and to evaluate the songbird monitoring strategy.	7/31/2007	$356,876	Ongoing.
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed**This project will assess the role of vegetation in shaping watershed hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Ongoing.

Table 1. Butte Basin EMZ Project Summary				
ERP Project Number	**Project Name and Description**	**End Date**	**Total Funding**	**Project Status**
ERP-04D-S07	**Real Time Flow Monitoring** This project will operate and maintain 13 flow monitoring stations with temperature sensors on Mill, Deer, Big Chico and Butte creeks.	9/30/2008	$330,000	Ongoing.
ERP-04D-S08a	**Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)**This project will to monitor the annual abundance, migration timing, spawning distribution, and several life history characteristics of hatchery and natural winter, spring, late fall and fall-run Chinook salmon during the 2006, 2007, and 2008 spawning seasons.	12/31/2008	$777,700	Ongoing.
ERP-97-B01	**Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)** This project stabilized potential sediment sources within the Deer, Mill, and Antelope Creek watersheds on Lassen National Forest lands for the benefit of anadromous fish species.	3/31/2001	$371,000	Complete. This work was continued with ERP-01-N26.

Other Programs Contributing to ERP Vision

The *Mill Creek Fish Passage Study – Hydroacoustic Escapement Monitoring* (**CVPIA-05-V14**) was a CVPIA/AFRP project administered by the U.S. Fish and Wildlife Service. Hydroacoustic technology was used to detect spring-run Chinook passage on their upstream migration in Mill Creek. This was a pilot project to assess the potential use of this technology as a complement to other fish studies on Mill Creek and other comparable streams. The method proved effective for estimating escapement on Mill Creek. Ultimately, the data could be used to determine water flow needs and potentially establish bypass flows with irrigation districts. The amount funded was for one year of study; it will be funded again in the spring and summer of 2008. This project contributes to the ERP target to increase streamflow in Mill Creek.

Antelope and Deer Creeks Fish Passage Improvement (**CVPIA-05-V15**) is an AFRP funded project initially proposed to implement fish passage improvement projects on both Antelope Creek and Deer Creek. The Deer Creek component was subsequently dropped and could be funded at a later date. Antelope Creek supports populations of spring-run, fall-run, and late fall-run Chinook salmon and steelhead. The Edwards Ranch maintains two diversions that are screened to protect juvenile salmon and steelhead during their downstream passage (CALFED Bay-Delta Program, 2000a). However, the Edwards Dam fish ladder is a barrier to fall-run Chinook and potentially to

spring-run Chinook also (P. Bratcher, personal communication). In fall 2007, the fish ladder will be replaced and the dam will be resurfaced and modified to encourage fish entry into the ladder. This project will reduce or eliminate the stress to anadromous fish caused by dams and other structures while contributing to targets to improve Chinook salmon and steelhead survival in Antelope Creek.

Status of the Area Today

Paynes Creek Ecological Management Unit

At this time Paynes Creek is not yet under the stewardship of a watershed group that would organize stakeholders and promote restoration activities. The Tehama County Resource Conservation District, however, has taken an active role in promoting watershed awareness and currently has two reports in progress, the Tehama East Watershed Assessment and the Tehama East Fire Management Plan. Both of these plans cover Paynes and Antelope creeks, and an assortment of other eastside Sacramento River tributaries in Tehama County between Battle Creek and Mill Creek. The projects listed below are ongoing in various ecological management units including the Paynes Creek Ecological Management Unit; they are program-wide in their geographic location as well as their benefits:

- *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development* (**ERP-01-N30**)
- *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Program* (**ERP-02-P17**)
- *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**)
- *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)* (**ERP-04D-S08a**)

Antelope Creek Ecological Management Unit

The following projects occur in multiple EMU's including the Antelope Creek Ecological Management Unit:

- *Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)* (**ERP-97-B01**)
- *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development* (**ERP-01-N30**)
- *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**)

- *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)* (**ERP-04D-S08a**)

In fall 2007 DFG staff will gather field data in order to design a bypass channel on the Edwards diversion as part of the *Antelope Creek Fish Passage Improvement Project* (**CVPIA-05-V15**). Then in 2008 DFG will install the bypass at the diversion to return fry to the Antelope Creek stream channel. An opportunity to increase flows for spring-run Chinook passage could come in the form of a water exchange program where diverters cooperate to reduce surface water diversion in exchange for water from groundwater wells later in the irrigation season, easements, or acquisitions.

Mill Creek Ecological Management Unit

The following projects occur in multiple EMU's including the Mill Creek Ecological Management Unit:

- *Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)* (**ERP-97-B01**)
- *Deer and Mill Creeks Acquisition and Enhancement* (**ERP-98-F20**)
- *Lassen National Forest Watershed Stewardship within the Anadromous Watersheds of Butte, Deer and Mill Creeks* (**ERP-01-N26**)
- *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development* (**ERP-01-N30**)
- *Mill and Deer Creeks Protection and Stewardship* (**ERP-02-P26**)
- *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**)
- *Real Time Flow Monitoring* (**ERP-04D-S07**)
- *Upper Sacramento River Basin Chinook Salmon Escapement Monitoring Program (PFMC)* (**ERP-04D-S08a**)

The following projects are being implemented exclusively in the Mill Creek EMU:

- *Lower Mill Creek Riparian Restoration* (**ERP-97-N08**)
- *Lower Mill Creek Riparian Restoration (Phase II)* (**ERP-98-F04**)
- *Anadromous Fish Passage at Clough Dam on Mill Creek* (**ERP-98-B21**)

Deer Creek Ecological Management Unit

The following projects occur in multiple EMU's including the Deer Creek Ecological Management Unit:

- *Watershed Improvement: Stabilization of Potential Sediment Sources within the Deer, Mill, Antelope Creek Watersheds on Lassen National Forest Lands (Phase 1 of 2 Phases)* (**ERP-97-B01**)
- *Deer and Mill Creeks Acquisition and Enhancement* (**ERP-98-F20**)
- *Arundo Donax: Survey and Eradication* (**ERP-01-N04**)
- *Lassen National Forest Watershed Stewardship within the Anadromous Watersheds of Butte, Deer and Mill Creeks* (**ERP-01-N26**)
- *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development* (**ERP-01-N30**)
- *Mill and Deer Creeks Protection and Stewardship* (**ERP-02-P26**)
- *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**)
- *Real Time Flow Monitoring* (**ERP-04D-S07**)

The following projects are being implemented exclusively in the Deer Creek EMU:

- *Deer Creek Watershed Management/Implementation Program* (**ERP-97-E02**)
- *Lower Deer Creek Restoration and Flood Management; Feasibility Study and Conceptual Design* (**ERP-02D-P53**)

The lower watershed needs adequate consistent flows for fish passage. The first phase of a water exchange program has been funded by the Four Pumps Program. The Deer Creek Flow Enhancement Program is an agreement between the Deer Creek Irrigation District and the Department of Fish and Game, and it augments fish passage flows while maintaining existing water rights. This program will provide the Deer Creek Irrigation District with supplemental water in the form of groundwater. Diverters will cooperate to reduce surface water diversion in exchange for water from ground water wells later in the irrigation season. Also, the watershed management strategy developed in the *Deer Creek Watershed Management/Implementation Program* (**ERP-97-E02**) has been updated by the current watershed coordinator and contains recommendations that need to be prioritized and implemented. The Deer Creek Watershed Conservancy and the U.S. Forest Service at Lassen National Forest jointly received funds from the CALFED Watershed Program to continue water quality monitoring and education and outreach.

Big Chico Creek Ecological Management Unit

The following seven projects were funded by ERP to benefit the Big Chico Creek Ecological Management Unit. They were evaluated in the Butte Basin EMZ Projects section above.

- *M&T/Parrott Pumping Station and Fish Screen Project* (**ERP-95-M05**)
- *Big Chico Creek Watershed: Phase I* (**ERP-97-E01**)

- *Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development* (**ERP-01-N30**)
- *Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation* (**ERP-01-N49**)
- *M & T/Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project* (**ERP-02-P08-D**)
- *Arundo Eradication and Coordination, Phase II* (**ERP-02D-P68**)
- *Real Time Flow Monitoring* (**ERP-04D-S07**)

Butte Creek Ecological Management Unit

The following seven projects were funded by ERP to benefit the Butte Creek Ecological Management Unit. They were evaluated in the Butte Basin EMZ Projects section above.

- *The Butte Creek Watershed Educational Workshops and Field Tours Series* (**ERP-98-B35**)
- *Butte Creek Watershed Coordinator Assistant, Education Project, Road Survey Project, Geomorphology Analysis, and Restoration Implementation* (**ERP-98-F01**)
- *Expanding California Salmon Habitat through Non-governmental and Non-regulatory Mechanisms to Alter Dams and Diversions* (**ERP-98-N02**)
- *Lower Butte Creek Project (Phase II: Preliminary Engineering and Environmental Analysis for Butte Sink Structural Modifications and Flow-Through System)* (**ERP-99-B02**)
- *Lassen National Forest Watershed Stewardship within the Anadromous Watersheds of Butte, Deer and Mill Creeks* (**ERP-01-N26**)
- *Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation* (**ERP-01-N49**)
- *Real Time Flow Monitoring* (**ERP-04D-S07**)

Many of the proposed projects that would benefit anadromous fish in Butte Creek are complete or in progress (P. Ward, personal communication). Since about 1992, major restoration actions implemented by state and federal resource management agencies, water interests and local stakeholders, have significantly contributed to an increase in the spring-run salmon population and reduced the potential for extinction (Ward, 2005).

In addition to projects funded by ERP, ongoing projects in the Butte Creek Watershed include the *Butte Sink White Mallard Dam and Associated Diversions Evaluation* project funded by AFRP. Construction to replace the White Mallard Dam is underway and slated to be complete by mid-October, 2007. The *Lower Butte Creek-Sutter Bypass Pumping Plants Fish Screening Project* will reduce losses of adult and juvenile anadromous fish from the lower Butte Creek system by screening three large DWR pumping plants located in the Sutter Bypass.

There are approximately 40 unscreened diversions on the east side of the Sutter Bypass. The *Sutter Bypass East Side Diversions and Weirs Assessment* is being administered by Ducks Unlimited and conducted by Jones and Stokes. Jones and Stokes is constructing a model of the salmonid population and assessing the need for screens at each location. DWR will also be replacing two structures: 1) the Willow Slough fish ladder will be replaced in May 2008 in order to handle debris and a wider range of flows, and 2) Weir #2 will be under construction for two years as DWR rebuilds the flashboard dam and fish ladder.

At the Sutter National Wildlife Refuge, the southern-most refuge in the Sacramento National Wildlife Refuge Complex, the USFWS is making fish-friendly improvements to diversions. The USFWS is also working to reclaim habitat by controlling knot grass, *Paspalum distichum*, and Bermuda grass, *Cynodon dactylon*. Due to the high water table on the refuge these species are pervasive and difficult to control (M. Peters, personal communication). Ducks Unlimited is obtaining funding to replace approximately 40 water control structures that regulate the water level in ponds. Also the pond bottoms will be reconfigured to improve marsh management. Ducks Unlimited is also working with the Sacramento National Wildlife Refuge Complex and Sutter Extension Water District to supply 60 cfs of additional water to the Sutter Bypass and handle it in a fish friendly way (O. Zirkle, personal communication).

In 2001, the CALFED Watershed Program funded the preparation of the Butte Creek Watershed Floodplain Management Plan (FMP) and the final report was completed in May 2005. Flood flows from Little Chico Creek are also diverted into Butte Creek, so the Butte Creek Watershed FMP was developed to establish a strategy to reduce flooding and flood-related hazards associated with both Butte Creek and Little Chico Creek. Since its adoption, the Butte Creek Watershed FMP has been incorporated into the county-wide floodplain management plan and also used to develop a Butte County Local Hazard Mitigation Plan, required by the Federal Emergency Management Agency in order to qualify for hazard mitigation funding (S. Edell, personal communication).

Butte Sink Ecological Management Unit

The following seven projects were funded by ERP to benefit the Butte Sink Ecological Management Unit. They were evaluated in the Butte Basin EMZ Projects section above or in other ecological management zone chapters where noted.

- *The Butte Creek Watershed Educational Workshops and Field Tours Series* (**ERP-98-B35**)
- *Butte Creek Watershed Coordinator Assistant, Education Project, Road Survey Project, Geomorphology Analysis, and Restoration Implementation* (**ERP-98-F01**)

- *Lower Butte Creek Project (Phase II: Preliminary Engineering and Environmental Analysis for Butte Sink Structural Modifications and Flow-Through System)* (**ERP-99-B02**)
- *Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation* (**ERP-01-N49**)
- *Arundo Eradication and Coordination, Phase II* (**ERP-02D-P68**)
- *Arundo donax Eradication and Coordination Program: Monitoring and Evaluation* (**ERP-04-S14**)
- *Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming* (**ERP-05-S32**)

Purchasing conservation easements continues to be one of the prime ways to protect fish and wildlife and their habitat. Within the 18,000-acre Butte Sink Wildlife Management Area (WMA) conservation easements have been purchased on 10,311 acres, requiring landowners to maintain wetlands on their property in perpetuity. The Butte Sink WMA also includes the 733-acre Butte Sink National Wildlife Refuge. The fee title was purchased in 1980 by the USFWS in order to protect wetlands for wintering waterfowl. Acquiring and protecting these lands contributes to many ERP objectives including providing habitat and management for endangered, threatened, or sensitive species of concern, providing habitat for Neotropical migratory land birds, and preserving natural diversity and abundance of flora and fauna. This refuge also provides feeding and resting habitat for wintering waterfowl and alleviates crop depredation. As a result, the Butte Sink WMA has the highest concentration of waterfowl per acre in the world.

Planned Projects for Implementation

Deer Creek Ecological Management Unit

Planning projects to be implemented include the *Lower Deer Creek Restoration and Flood Management; Feasibility Study and Conceptual Design* (**ERP-02D-P53**) project. This project provided funds to study managed floodplain inundation and develop a conceptual design and now needs funding to implement the flood management design. This project ties directly to ERP strategic goals, milestones, Sacramento Region priorities and the Stage I Implementation Plan.

Big Chico Creek Ecological Management Unit

Planning projects to be implemented include *M & T/Llano Seco Fish Screen Facility Short-Term/Long-Term Protection Project* (**ERP-02-P08-D**). After the Parrott-Phelan Pumping Station was relocated from the Big Chico Creek to a new point of diversion in the Sacramento River, a large gravel bar formed that continually threatens both the

pumping station and fish screen operations. ERP funding is being used to maintain the gravel bar at its 1995 size, and also to investigate technically and economically feasible solutions to allow the facility to operate while maintaining the river meander. Once these protective measures are determined, funding will be sought to implement these solutions.

Butte Sink Ecological Management Unit

Planning projects to be implemented include the *Lower Butte Creek Project (Phase II: Preliminary Engineering and Environmental Analysis for Butte Sink Structural Modifications and Flow-Through System)* (**ERP-99-B02**) that is being implemented through *Lower Butte Creek Project: Phase III Facilitation/Coordination and Construction of Three Fish Passage Modifications to Sutter Bypass West Side Water Control Structures* (**ERP-01-N54**). This project will develop a Drainage Water Management Plan for the Giusti Weir drainage area that will help develop water conservation plans for critically dry years and identify alternate sources of water. A hydrology study will be conducted at the Giusti Weir to identify sources and amounts of drainage water. Conceptual plans will then be developed to reroute drainage water from upstream sources through the Giusti Weir and discharge into the Sutter Bypass. This additional instream flow will contribute to ERP targets to increase flow in Butte Creek.

Impediments to Implementation

In addition to issues around securing funding, another impediment to making further gains comes primarily from conflicts or concern posed by adjacent landowners with different land use goals. Tension between agricultural landowners and restorationists along the Sacramento River is due to the conversion of farmland into riparian forest and valley oak savanna. There is a perception of an increased exposure to negative biological and physical impacts on farming and the local environment such as more frequent flooding and additional wildlife issues created by restoration efforts (Singh 2007). Some local agricultural landowners have created political opposition to increasing the riparian habitat corridor within the Sacramento River Conservation Area.

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APPENDIX A

A.8. FEATHER RIVER AND SUTTER BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The Feather River/Sutter Basin Ecological Management Zone (EMZ) is located on the east side of the Sacramento River north of the American River Basin Ecological Management Zone (Figure 1), and includes the following Ecological Management Units (EMUs):

- Feather River Ecological Management Unit
- Yuba River Ecological Management Unit
- Bear River and Honcut Creek Ecological Management Unit
- Sutter Basin Ecological Management Unit

Chinook salmon, white sturgeon, green sturgeon, steelhead and lamprey are important anadromous fish species, and striped bass and American shad are harvested species that all depend on healthy conditions in the Feather River/Sutter Basin EMZ. The Feather River is important for spawning and rearing fall-run and spring-run Chinook salmon, steelhead, white and green sturgeon, striped bass, and American shad. The Yuba River is important for fall-run Chinook salmon, steelhead, and American shad, and potentially for spring-run Chinook salmon. Bear River and Honcut Creek support small runs of fall-run Chinook salmon. Sutter Bypass is an important migration route for spring-run and fall-run Chinook salmon from Butte Creek. In most years, almost all populations of upper Sacramento River migratory fish are potentially affected by the Sutter Bypass. The Sutter Bypass is also an important spawning and rearing area for splittail, which migrate from downstream habitats each winter to spawn in flooded portions of the lower rivers, such as the Sutter Bypass.

Important ecological processes that would maintain or increase Feather River/Sutter Basin EMZ health include streamflow, coarse sediment supply, stream meander, floodplain processes, and water temperature.

Important habitats include riparian wetlands, shaded riverine aquatic (SRA), freshwater fish habitat, and essential fish habitat. Seasonally flooded wetlands are common through the lower basin and are extremely important habitat areas for waterfowl, shorebird, and wading bird guilds. Important species include all runs of Chinook salmon, steelhead trout, sturgeon, American shad, resident native fish guilds, waterfowl guilds, shorebird and wading bird guilds, and riparian wildlife guilds. Stressors, including flood control mechanisms, urbanization (floodplain encroachment), dams,

legal and illegal fish harvest, insufficient flow in the lower portions of most streams, high water temperature during salmon spawning and egg incubation, poor water quality, stranding in flood bypasses and flood plains, hatchery stocking of salmon and steelhead, and unscreened or poorly screened water diversions, have affected the health of anadromous fish populations.

Feather River Ecological Management Unit

The Feather River, with a drainage area of 3,607 square miles, is the largest Sacramento River tributary downstream of Shasta Dam. Watersheds of the various forks drain high-elevation ranges of the Cascade Range and Sierra Nevada. Numerous storage reservoirs are located on the river, including Lake Almanor, and Butt Valley Reservoir on the North Fork, Lake Davis, Frenchman Lake, and Bucks Lake on the Middle Fork, and Little Grass Valley Reservoir on the South Fork. Oroville Reservoir and Thermalito Afterbay are on the mainstem below the confluence of the forks, and major water diversions take place at both reservoirs. The lower Feather River downstream of Oroville picks up the flow of major tributaries, including Honcut Creek, the Yuba River, and the Bear River.

Yuba River Ecological Management Unit

The Yuba River watershed drains 1,339 square miles of the western Sierra Nevada slope and includes portions of Sierra, Placer, Yuba, and Nevada Counties. The Yuba River is tributary to the Feather River which, in turn, feeds into the Sacramento River.

Three dams on the river have altered river flows and fish passage. Englebright Dam was built by the U.S. Army Corps of Engineers (USCOE) in 1941 to collect placer mining debris that contributed to flooding in the Central Valley. Englebright Reservoir contributes storage capacity, hydropower, and cool, bottom-released water to the lower Yuba River. Most Englebright Reservoir water, the lowermost storage reservoir on the river and the upstream anadromous fish limit, is released through the Narrows 1 and 2 Englebright Dam powerhouses to generate hydroelectric power. The 0.2 mile of river between the dam and the two powerhouses has no flowing water unless the reservoir is spilling. The 0.7 mile of river from the Narrows 1 and 2 powerhouses to the Deer Creek mouth has steep rock walls; long, deep pools; and short stretches of rapids. Below this area, the river cuts through 1.3 miles of sheer rock gorge called the Narrows, forming a single large, deep, boulder-strewn pool.

The river canyon opens into a wide floodplain several miles beyond the downstream end of the Narrows, where large quantities of hydraulic mining debris remain from past gold-mining operations. This 18.5-mile section is typified as open-valley plain. Daguerre Point Dam, 12.5 miles downstream from Englebright Dam, is the major lower-river diversion point. The open plain continues 7.8 miles below Daguerre Point Dam to beyond the downstream Yuba Goldfields terminus. This section is primarily alternating

pools, runs, and riffles, with gravel and cobble substrate, and contains most of the suitable lower Yuba River Chinook salmon spawning habitat.

The remaining section of the lower Yuba River extends approximately 3.5 miles to its confluence with the Feather River. This river section is bordered by levees and is subject to Feather River backwater influence.

Bear River and Honcut Creek Ecological Management Unit

The Bear River is the second largest tributary to the Feather River, with a watershed area of 300 square miles. It enters the Feather River at river mile (RM) 12, immediately upstream from the town of Nicolaus. Honcut Creek flows into the Feather River from a small foothill watershed approximately 15 miles below Thermalito. In highest rainfall years, winter flows average 3,400 to 5,600 cfs. In normal years, winter inflows are 600 to 800 cfs. In the driest years, watershed inflows average only 20 to 65 cfs in winter months and zero cfs in all other months.

Sutter Basin Ecological Management Unit

The Sutter Bypass section of the Sutter Basin provides important waterfowl habitat and serves as a migratory route for salmon and steelhead in the upper Sacramento River and its tributaries, particularly Butte Creek. Salmon and steelhead migrating to Butte Creek use Butte Slough, which originates at the Butte Slough Outfall Gates and ends at the north end of the Sutter Bypass. The reach within the Sutter Bypass is generally referred to as the East and West Barrows and the connection with the Sacramento River is the Sacramento Slough. In wet years, when Sacramento River overflows into the bypass, both upstream-migrating adults and downstream-migrating juvenile salmon and steelhead use Butte Slough, the East and West Barrows, and Sacramento Slough. Native resident fish, including splittail, also use the bypass as spawning and rearing habitat. In wet years, some salmon, steelhead, and native resident fish may become stranded in isolated pockets and then die when floodwaters recede from the bypass and respective overflow weirs (Tisdale, Colusa, and Moulton).

The bypass has remnant riparian woodlands and wetlands and is part of the Sutter National Wildlife Refuge. Sutter National Wildlife Refuge is the only publicly owned waterfowl habitat in the Sutter basin. It consists of 2,590 acres of seasonally and permanently flooded marsh and scattered uplands. Private duck clubs provide 1,500 acres of habitat of which about 500 acres are natural wetland. Most of the private duck clubs and nearly all of the natural wetlands in this area are located in the Sutter Bypass (CVHJV 1990). The northern end of the bypass is connected to the extensive marshlands of Butte Sink. Large areas of the bypass are used to grow irrigated crops, such as rice.

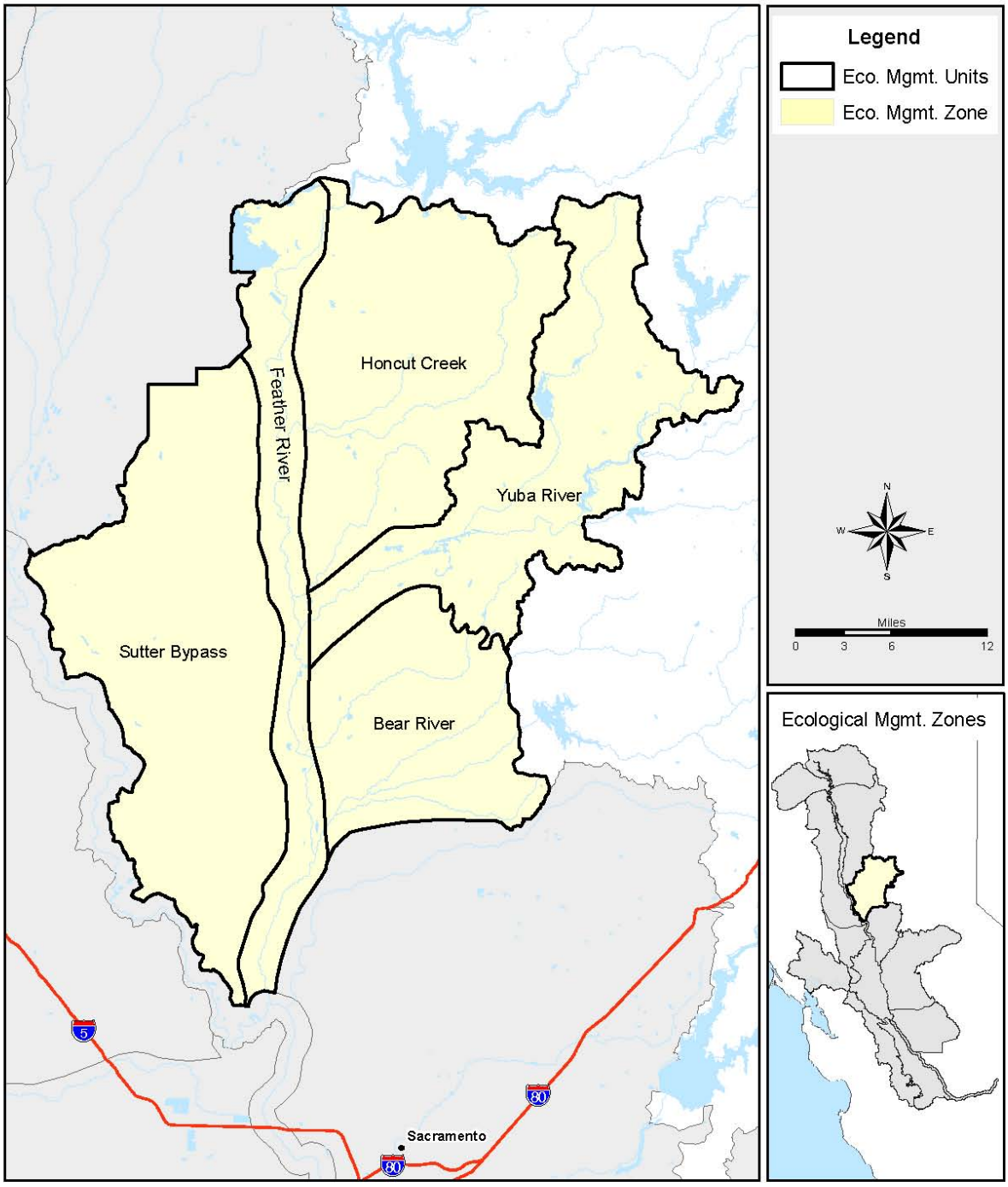

Figure 1. Feather River & Sutter Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Feather River/Sutter Basin EMZ Map

Applicable ERP Vision

The vision for the Feather River/Sutter Basin EMZ includes the restoration and enhancement of important fishery, wildlife, and plant communities. Attaining this vision requires reducing stressors and restoring or reactivating important ecological processes and habitats that create and maintain fish, wildlife, and plant communities throughout the EMZ (CALFED 2000).

The vision for this EMZ focuses on maintaining and improving floodplain and flood processes, streamflow, coarse sediment recruitment and transport, and seasonally flooded aquatic habitats that provide important wintering areas for waterfowl and shorebird guilds (CALFED 2000). Actions to reduce stressors include the installation of screens on diversions, upgrading or installing fish passage facilities at diversion dams or other obstacles to fish migration, providing suitable water temperatures for summer rearing, reducing the extent of stranding loss of juvenile fish, and limiting the adverse effects of introducing hatchery fish on endemic aquatic species.

Feather River Ecological Management Unit

The vision for the Feather River Ecological Management Unit is to improve natural spawning populations of spring-run and fall-run Chinook salmon and steelhead (CALFED 2000). This involves improving spring (March) flows below Oroville in dry and normal water-years, improving spring through fall base flows, providing suitable water temperatures for summer rearing, and improving spawning and rearing habitat in the lower river below Oroville. The vision also includes implementation of adaptive management components of monitoring and research to collect the scientific information required to best judge the merits of additional flows and the timing for additional flows that would provide the highest benefit for aquatic species and habitat maintenance.

The vision for the Feather River includes reactivating or maintaining important ecological processes that create and sustain habitats for anadromous fish (CALFED 2000). The Feather River must not only contribute substantially to the growth of many fish populations, but provide better support for naturally spawning steelhead, fall-run and spring-run Chinook salmon, American shad, white sturgeon and green sturgeon, lamprey, and striped bass. The most important processes include floodplain and flood processes and a natural streamflow pattern in the river, to which most of the anadromous and resident native fishes are adapted.

Yuba River Ecological Management Unit

The vision for the Yuba River is to improve spring streamflows for spawning runs of spring-run Chinook salmon (potentially), steelhead, sturgeon, and American shad (CALFED 2000). These flows will also benefit downstream migration of juvenile fall-run

Chinook salmon, steelhead, lampreys and sturgeon. Improving streamflows will also benefit stream-channel and riparian habitat; native resident species, including splittail, that spawn farther downstream in the Feather River; and other species that reside further downstream in the Bay-Delta estuary. The vision also includes the evaluation of gravel recruitment and sediment transport processes, stream-channel configuration, and riparian habitats in the lower Yuba River floodplain to improve anadromous and resident fish production and survival.

Bear River and Honcut Creek Ecological Management Unit

The vision for the Bear River and Honcut Creek Ecological Management Units is to improve conditions for fall-run Chinook salmon and steelhead by maintaining and improving stream-channel, riparian, and floodplain habitat; ensuring adequate spawning gravels; and, where possible, improving late-fall flows for adult salmon spawning migrations and late-winter flows to support young salmon emigrating from the river (CALFED 2000). Also, improving gravel recruitment and riparian habitat would provide adequate habitat for salmon and steelhead in years when they use these streams. In addition to improving floodplain habitats, upper watershed health should also be improved by reducing forest fuels and implementing other practices to protect streamflows, stream channels, riparian habitat, and minimizing sediment input to the streams.

Sutter Basin Ecological Management Unit

The vision for the Sutter Bypass Ecological Management Unit is to restore adequate streamflows, as well as stream channel, riparian, and wetland habitats in the floodplain, and also to ensure passage of adult salmon migrating upstream through the Sutter Bypass and accessibility to floodplain spawning and rearing areas for splittail (CALFED 2000). In addition to improving conditions for migrating salmon and steelhead in the Sutter Bypass and eliminating stranding, actions taken to benefit salmon and steelhead will improve waterfowl and wildlife habitat in the bypass. Fish passage and unscreened diversion problems should be resolved where possible.

Stage 1 Expectations

Stage 1 expectation for the Feather River and Sutter Basin Ecological Management Zone and the associated Ecological Management Units are not specifically called out in the Ecosystem Restoration Program Plan. However, expectations for the first seven years are encompassed in the visions listed above.

Changes Attributable to ERP

Feather River/Sutter Basin EMZ-wide Projects

As shown in Table 1, seven projects (three planning and four research/monitoring projects) have been funded by ERP that contribute to the overall knowledge base of the entire EMZ as well as adjacent EMZs.

A suite of research and monitoring projects were undertaken on a program-wide level which contributed to the vision for artificial fish propagation in the Feather River/Sutter Basin EMZ. Together, these projects, *Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking* (**ERP-98-B15**), *Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead* (**ERP-99-N13**), *Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries* (**ERP-99-N13b**), have resulted in the development of recommendations regarding 1) the coded wire tagging program in the Central Valley, 2) specific marking, tagging and implementation recommendations associated with a comprehensive marking and tagging program, 3) selective fishing options in the marine or freshwater environments if they are implemented in the future, and 4) constant fractional marking levels and some of the other manipulable factors (Newman et al. 2004). In addition, an ongoing project, *Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon* (**ERP-05D-S20**), will provide the basis for evaluating and revising Central Valley salmon hatchery operations. This project will allow restoration efforts of all races of Chinook salmon to be tracked, track whether CALFED targets for population restoration of Chinook salmon are being reached, and help evaluate the effects of harvest.

The *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs* (**ERP-02-P17**) is an ongoing research effort designed to evaluate the results of past and current riparian bird system research and monitoring across the entire CALFED region. Information learned from this study will contribute to the successful implementation of ERP riparian and riverine aquatic habitat targets for the Feather River/Sutter Basin EMZ.

The Sacramento River and Major Tributaries Corridor Mapping Project (**ERP-96-M16**) was completed in July 2001. The objective of this research project was to map riparian vegetation along the Sacramento River and tributary streams within the Sacramento Valley. The tributaries mapped within the Feather River/Sutter Basin EMZ include the Feather River from Verona to Butte County line and Yuba River, Feather River from Butte County line to Oroville, Yuba River to Highway 20 Bridge, and Bear River from the Feather River to Camp Far West Reservoir. This project contributed valuable research

information for the ERP target to improve riparian and riverine aquatic habitat which would provide adequate habitat for salmon and steelhead in the Feather River Sutter Basin EMZ. Improved riparian habitat will also benefit riparian associated wildlife, such as those in the Neotropical migratory bird guild.

Mine Remediation Assessment and Field Investigations of the Middle Yuba River and other Watersheds (**ERP-02-C03D**) The California Department of Conservation, Office of Mine Reclamation, Abandoned Mine Lands Unit (AMLU) performed site assessments of abandoned mine sites throughout the Bay-Delta watershed. Methods including site visits, historical records review, database compilation, and GIS analysis's, led to a program-wide inventory report on abandoned mines, In addition, AMLU produced a legal guidance document on liability issues of abandoned mine remediation; led the Statewide Abandoned Mine Lands Forum; and developed and led an interagency workgroup to make recommendations on criteria for pilot mine remediation projects.

Feather River Ecological Management Unit

As shown in Table 1, two program-wide projects have been funded by ERP that work toward meeting ERP targets in the Feather River EMU.

The *Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watersheds* (**ERP-98-C15**) and *Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed (Phase II)* (**ERP-00-B06**) was completed in 2002. This research addressed key areas of scientific uncertainty about green sturgeon to minimize harm to this species and its population(s) in the lower Sacramento-San Joaquin watershed. This multi-phase project determined baseline information regarding green sturgeons' biological requirements and the feasibility of this species' artificial culture for further research and potential mitigation considerations. This research project resulted in a 2002 report titled, "Determination of Green Sturgeon Spawning Habitats and their Environmental Conditions". The report summarizes the investigation of sturgeon spawning in the Feather River system. The primary result of the project was to investigate the habitat preferences and physical environmental conditions of green sturgeon spawning. A secondary result of the project was to provide genetic material to UC Davis investigators from green sturgeon known to have spawned in the Bay-Delta watershed. The project provided valuable research toward meeting the ERP species target to achieve recovery of green sturgeon in the Feather River EMU.

Yuba River Ecological Management Unit

As shown in Table 1, two implementation, four planning and 14 research/monitoring, totaling 20 projects, have been funded by ERP that work toward meeting ERP targets in the Yuba River Ecological Management Unit (EMU).

The *Browns Valley Irrigation District Fish Screen Project* (**ERP-96-M17**) consisted of

planning, design, and construction of a positive barrier fish screen on Browns Valley Irrigation District's diversion located on the Yuba River approximately three quarters of a mile upstream of Daguerre Point Dam, through four unscreened pumps. The pumps have a maximum diversion capacity of 65 cfs. DFG and USFWS determined that the existing diversion pumps caused entrainment for naturally produced juvenile steelhead trout and Chinook salmon. The existing rock gabion, which was not effective as a fish screen, was replaced with a wedge-wire fish screen (Montgomery Watson 1999). The successful implementation of this project contributed toward the ERP water diversions target to improve the survival of juvenile anadromous fish in the Yuba River by replacing fish screens.

Life History and Stock Composition of Steelhead Trout (**ERP-98-N03**) characterized the life history patterns and stock composition of steelhead in the Yuba River to support ecosystem restoration and species recovery programs such as the Ecosystem Restoration Program Plan (ERPP), the federal Endangered Species Act (ESA), the Anadromous Fish Restoration Program (AFRP), and California's Anadromous Fisheries Program Act of 1988. The primary benefit of this study was to provide basic information on the life history and stock composition of steelhead trout in the lower Yuba River for use in identifying and evaluating the effectiveness of proposed restoration and management actions directed at the species. The primary objectives of the study are to 1) use scale characteristics to assess the population and life-history characteristics of Yuba River steelhead; 2) estimate the contributions of hatchery and wild steelhead to Yuba River runs; and 3) evaluate the utility of scale characteristics as a tool for distinguishing between hatchery and wild Central Valley steelhead.

The *Narrows 2 Power Plant Flow Bypass System Project* (**ERP-02-P47**), implementation phase, was located on the Yuba River about 24 miles upstream of the confluence of the Yuba and Feather Rivers. The primary goal of the project was to eliminate or substantially reduce potentially catastrophic flow fluctuations and associated biological impacts on fish habitat for at-risk species in the lower Yuba River. An equally important goal was to provide continuous release of cold water from Englebright Reservoir during such events, as opposed to spilling warmer water over the top of Englebright Dam, thereby preventing potential downstream water temperature impacts to fish habitat. The lower reach of the Yuba River downstream of Englebright Dam supports significant naturally spawning populations of anadromous fish, including Central Valley fall-run and spring-run Chinook salmon, and steelhead trout. Historically, flow fluctuations were mainly caused by uncontrollable emergency shutdowns caused by electric transmission line failures and sometimes by maintenance shutdowns of the Narrows 2 Power Plant. Construction of the bypass system was successfully completed in February of 2007. The project goals were immediately realized by automatically sustaining flow in the lower Yuba River and releasing colder water from lower water depths within Englebright Reservoir during shutdown of the Narrows 2 Power Plant. This project contributes toward the ERP Central Valley streamflows target to supplement flows in the Yuba River to improve conditions for all

Chinook salmon, steelhead, and American shad life stages, and the Central Valley stream temperatures target to improve water quality conditions in the Yuba River to benefit anadromous habitat. It also contributes to the target that would reduce the incidence of stranding of juvenile fish (Yuba County Water Agency 2007). The planning phase of the project was funded by the AFRP under *Narrows 2 Hydro Power Plant Flow Bypass System Design* (**CVPIA-01-F01**).

The *Development of Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration* (**ERP-99-B09**) project was an environmental water management planning project that resulted in the "Draft Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration: Multi-Agency Plan to Direct Near-Term Implementation of Prioritized Restoration and Enhancement Actions and Studies to Achieve Long-Term Ecosystem and Watershed Management Goals" in October 2005. The plan focused on anadromous species in the lower Yuba River, and the geographic boundaries for habitat considerations extending from the confluence of the Yuba and Feather rivers, upstream to Englebright Dam, which is the first impassable barrier. Although the focus of the plan is on recovery of anadromous fish species, restoration priorities are made, in part, based on long-term ecosystem and watershed management goals (Lower Yuba River Fisheries Technical Working Group 2005). If implemented, the plan has the potential to contribute to the following ERP targets: Central Valley streamflows, coarse sediment supply, stream meander, riparian and riverine aquatic habitat, freshwater fish and essential fish habitat, and stranding. In addition to these benefits, MSCS covered species (e.g. fall-run Chinook salmon, spring-run Chinook salmon, steelhead, green sturgeon, American shad) would potentially realize benefits.

The *Conduct/Facilitate Meetings on the Upper Yuba River, Englebright Dam* (**ERP-98-C19**) project provided funds to facilitate stakeholder meetings to prioritize a set of studies to be accomplished in a Phase I reconnaissance study for restoring anadromous fish above Englebright Dam for the Upper Yuba River Studies Program (UYRSP). Additional UYRSP projects were conducted during Stage 1 and the results are discussed in the research/monitoring section below. The planning project produced a database of 325 participants, an email list, public meeting facilitation, a list of upper Yuba River restoration study issues, the development of stakeholder work groups, and a CALFED process paper titled, "Background and Timeline on the Proposal to Restore a Salmon and Steelhead Fishery Above Englebright Dam and Reservoir" (Wolf 1999). Planning done for the UYRSP has the potential to contribute to the following ERP targets: Central Valley streamflows for the Yuba River, coarse sediment supply, stream meander, natural floodplains and flood processes, Central Valley stream temperatures, riparian and riverine aquatic habitat, freshwater fish habitat and essential fish habitat, and dams and other structures. In addition, the following species targets for MSCS covered species including fall-run Chinook salmon, spring-run Chinook salmon, and steelhead would potentially realize benefits.

The *South Yuba River Coordinated Watershed Management Plan* (**ERP-98-E10**) is a

planning project completed in 2002. The objectives of the plan were to: 1) receive input from the Yuba Watershed Council's Recreation Committee involving stakeholders interested in the recreational impacts of the South Yuba River; 2) complete an inventory of preexisting information concerning recreational use on the South Yuba River; and 3) design and conduct a comprehensive survey that would research recreation use, public-private use conflicts and their respective impacts on the South Yuba River. The "South Yuba River 2000-2001 Recreation Study" was completed in 2002 which developed a baseline understanding of recreational uses and an understanding of the relationships between user levels and socially based carrying capacity at various locations in the study area. The "Yuba River Watershed Health Improvement and Monitoring Project" was prepared as a component of the recreation study. It was designed to examine the river's baseline condition, identify goals and objectives based on assessment results, and develop a coordinated management, implementation, and monitoring plan to meet watershed health goals and objectives. The water quality report states that generally the water quality in the South Yuba River is satisfactory with the exception of localized areas of sediment loading. Higher temperatures may not be conducive to supporting anadromous fish in the summer months. The water quality report's conclusions will be incorporated into a river management plan developed by a consortium of land managers and interested community leaders. The water quality report also contains a number of recommendations to be included in the plan (WRC-Environmental 2002). If implemented, this planning project has the potential to contribute toward the ERP Central Valley streamflows and temperatures targets.

The *Yuba Watershed Council: A Collaborative Approach* (**ERP-99-N17**) project is an ERP planning and education project that was completed in June 2003. The project funded a watershed coordinator staff position for the Yuba Watershed Council. The role of the watershed coordinator was to provide coordination, assistance, education, outreach, and program oversight for Yuba Watershed Council projects. Using a collaborative approach, the watershed coordinator worked in conjunction with Yuba Watershed Council members and other project coordinators on watershed restoration, stream rehabilitation, forest improvement, and water quality enhancement programs throughout the Yuba and Bear River watersheds. This project supported progress toward multiple ERP targets for the Yuba River EMU, such as Central Valley streamflows, coarse sediment supply, stream meander, natural floodplains and flood processes, Central Valley stream temperatures, riparian and riverine aquatic habitat, and stressors including water diversions and dams and other structures.

The *Yuba Feather Workgroup* (**ERP-01-N62**) reviewed technical data and gave input into tracking and planning projects that impact flood management in the Yuba/Feather River Watershed. Specific roles of the workgroup included: 1) providing comment on Yuba County Water Agency's Proposition 13 Supplemental Flood Control Program; 2) identifying enhancement measures specific to Yuba County Water Agency proposals; 3) identifying funding opportunities for regional enhancement and flood initiatives; 4) engaging consultants to identify alternative approaches to flood management in the

watersheds – resulting in an investigation of flood attenuation in the Goldfields parkway area; and 5) tracking other programs and processes that impact flood management in the region (CirclePoint 2006). The overall project supports the ERP vision to improve floodplain and flood processes and a natural stream flow pattern in the Feather River, to which most of the anadromous and resident fishes are adapted. If implemented, this planning project has the potential to contribute toward ERP ecological processes targets including Central Valley streamflows for the Yuba and Feather Rivers, Central Valley stream temperatures, coarse sediment supply, stream meander, and natural floodplains and flood processes. In addition, the target for riparian and riverine aquatic habitat and the stressor targets for water diversions and dams and other structures have the potential to receive positive benefits.

Several research and monitoring grants were given in the Yuba River EMU to determine if the introduction of wild Chinook salmon and steelhead trout to the upper Yuba River watershed is feasible in the long term. The overall project termed the "Upper Yuba River Studies Program (UYRSP)" was identified as a programmatic action in ERPP Volume 2 that would contribute to the dams and other structures target to increase the number of naturally produced Chinook salmon and steelhead in the Yuba River drainage and contribute to each of the species long-term sustainability. In addition, the UYRSP projects contribute to the knowledge base for the following other ERP targets: Central Valley streamflows for the Yuba River, coarse sediment supply, stream meander, natural floodplains and flood processes, Central Valley stream temperatures, riparian and riverine aquatic habitat, and freshwater fish habitat and essential fish habitat. The UYRSP research/monitoring projects and their results are discussed below.

Upper Yuba River Studies Program: Engineering, Environmental Services, Project Management and Facilitation (**ERP-02-C02-D**) is a research project designed to determine if the introduction of wild Chinook salmon and steelhead trout to the upper Yuba River watershed is feasible in the long term. The primary study area for the project includes Englebright Reservoir, the South Yuba River below Lake Spaulding, the Middle Yuba River below Milton Reservoir, the North Yuba River below New Bullards Bar Reservoir, and the lower Yuba River downstream of Englebright Dam. The assessment of potential flood risk also includes the section of the Feather River downstream of the Yuba River to the confluence with the Bear River. To date, an "Interim Report Summary of Current Conditions in the Yuba River Watershed" has been produced that 1) conveys general information on current conditions in the watershed (based on review of the literature and preliminary study results) to the work group and the technical review panel, 2) contributes to a common baseline level of understanding among stakeholders about the various issues under study, and 3) contributes to the basis for an informed evaluation by the technical review panel of proposed approaches to analyzing passage options. The information in the interim report will be updated and incorporated in a comprehensive report at the end of the study program.

The *Upper Yuba River Studies Program - Sediment Studies and Water Quality* (**ERP-**

02-C01-D) and the *Technical and Scientific Services for the Upper Yuba River Studies Program* (**ERP-01-C08-D**) projects were completed in 2006. Project data and results have been have been summarized by USGS in the Water Quality Chapter 3.4.

The ERP provided funding to support the UYRSP Technical Review Panel. A set of eight grants were made to conduct a multidisciplinary array of investigations to characterize existing conditions in the Yuba River watershed and to assess the potential for the river upstream of Englebright Dam to support wild Chinook salmon and steelhead:

- *Technical/Scientific Review of Upper Yuba River Studies Program: Ecotoxicology Expert* (**ERP-01-C10**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Hydrotechnical Engineering Expert* (**ERP-01-C11**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Environmental Economics Expert* (**ERP-01-C12**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Geomorphology Expert* (**ERP-01-C13**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Zoology Expert* (**ERP-01-C14**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Hydropower Expert* (**ERP-01-C15**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Marine Fisheries and Economics Expert* (**ERP-01-C16**)
- *Technical/Scientific Review of Upper Yuba River Studies Program: Geomorphology and Hydrology Expert* (**ERP-03-C04**)

These investigations were intended to provide sufficient technical data and analyses to assist decisions on the feasibility of re-introducing salmonids to the upper Yuba River upstream of Englebright Dam. The panel consisted of experts from the following disciplines: ecotoxicology, environmental economics, geomorphology, hydrology, hydropower, hydrotechnical engineering, and fisheries. A report was produced that presents the findings and recommendations of the TRP, based on a review of the program in October 2003.

Bear River and Honcut Creek Ecological Management Unit

Although several ERP funded projects worked toward meeting ERP targets in the Bear River and Honcut Creek EMU, there were none that specifically focused within this EMU.

Sutter Bypass Ecological Management Unit

As shown in Table 1, one implementation, four research/monitoring, and one planning project, totaling six projects, have been funded by ERP that work toward meeting ERP targets in the Sutter Bypass EMU.

The *Lower Butte Creek Project: Phase III Facilitation/Coordination and Construction of Three Fish Passage Modifications to Sutter Bypass West Side Water Control Structures* (**ERP-01-N54**) is a full-scale implementation project currently under consideration for an amendment that will extend the end date to December of 2008. To date, construction has been completed on a new East-West Weir to provide fish passage and improved control of the water diversion in the east and west channels in the Sutter Bypass. The new weir includes a three-pool fish ladder located on the right abutment of the weir. In addition, Weir No. 5 has been rehabilitated to control the water level in the West Side Channel, regulate the downstream flow, and to construct a new fish ladder and irrigation intake with a fish screen. The facility includes a five-pool fish ladder on the right abutment. The fish screen and cleaning system were installed on the Butte Slough Irrigation Company's 55 cfs capacity diversion. Currently underway is a study of the hydrology of existing drains in the Giusti Weir area. The project scope of work was recently amended to add a water drainage management plan for the Giusti Weir area. Specifically, this project contributes toward the ERP vision to screen those unscreened diversions, or those with inadequate screens where there is a potential to protect young fish in significant numbers in the Sutter Bypass. Additionally, the project contributes to the vision for Sutter Bypass EMU that would ensure passage of adult salmon migrating upstream through the Sutter Bypass. The project promotes recovery of MSCS species, in particular spring-run and winter-run Chinook salmon, steelhead trout, and splittail.

The *Real-Time Flow Monitoring Project* (**ERP-01-C02**) is a monitoring project that provided funds for continued operation and maintenance of flow monitoring stations on five Sacramento River tributaries to provide data on minimum instream flows and water quality for the recovery of at-risk fish species in the creeks. The monitoring site in the lower Sutter Bypass is on Sacramento Slough near Karnak Station. Monitoring has continued under *Real-Time Flow Monitoring* (**ERP-04D-S07**) and is currently scheduled for completion in September 2008. Together, these projects contribute valuable monitoring data to the vision for the Sutter Bypass EMU which would provide a healthy streamflow pattern in the bypass and emulate the natural runoff pattern, including a late-winter/early-spring flow event and summer-fall base flows that maintain important ecological processes, functions, habitats, and important species.

The *Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation Project* (**ERP-01-N49**) is a research project completed in 2006. This project has: 1) developed adult spring-run and fall-run Chinook salmon escapement estimates for Butte and Big Chico creeks; 2) monitored outmigration timing and relative abundance of age-0+ juvenile spring-run Chinook salmon within Butte and Big Chico creeks, including the Sutter Bypass; 3) documented outmigration of yearling spring-run Chinook; and 4) documented relative growth and residence time of juvenile spring-run Chinook in the Butte Creek system, including the Sutter Bypass, through coded-wire tagging (CWT) of juvenile salmon collected at the Parrott-Phelan Diversion Dam

(PPDD). Monitoring for the project occurred during five water years beginning in the 2001-2002 season. Sutter Bypass traps were fished a limited number of days due to budget constraints during the 2002-2003 and 2003-2004 seasons and were not operated during the 2004-2005 season. Annual reports summarizing monitoring activities have been prepared for each season through 2005-2006. Project results presented in the 2001-2002 report stated that the data collected for the study period continues to support the apparent value of the Sutter Bypass as a major nursery area. In addition, the report suggested that fish that exit the Sutter Bypass move rapidly downstream and do not use the main stem Sacramento River for rearing (Ward et al. 2003). Monitoring of the upper portion of the project area has continued under *Butte Creek Spring-run Chinook Salmon Life History Investigation* (**ERP-04-S10**) (Butte Basin EMZ), however, monitoring of lower Butte Creek within Sutter Bypass was not continued (Ward 2004). This project contributed valuable technical information toward the ERP species target for spring-run Chinook salmon, fall-run Chinook salmon, and steelhead trout.

The *Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming* Project (**ERP-05-S32**) is a research that began in May 2007 and is scheduled for completion in June 2010. This project will contribute valuable technical information toward the ERP species target for giant garter snake.

The Central Valley Habitat Joint Venture reported as of 2003 that 145 acres of seasonal wetlands have been protected and 760 acres have been restored. In addition, CVHJV has 33,168 acres of agricultural lands in the Sutter Basin. These acreages contribute toward the ERP targets for seasonal wetlands and agricultural lands.

Project Summary Table

A total of 35 projects have been funded by ERP that would benefit the Feather River/Sutter Basin EMZ. The projects are focused on ecosystem processes, habitats, stressors, and species. The projects, changes attributable to them, and the applicable MSCS species, are described in more detail in the Ecological Management Unit sections below. In addition, a group of projects that contributed to the overall knowledge base for the entire EMZ is discussed in the program-wide projects section.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Feather River/Sutter Basin EMZ-Wide Projects				
ERP-02-C03-D	**Mine Remediation Assessment and Field Investigations of the Middle Yuba River and other Watersheds** Performed site assessments of abandoned mine sites in the Bay-delta watershed, including database & GIS analysis, and generating reports on Putah and Yuba inventories. Produced legal guidance document on liability issues of abandoned mine remediation. Lead the Statewide Abandoned Mine Lands Forum. Developed and lead interagency workgroup to make recommendations on criteria for pilot mine remediation projects.	9/30/2005	$400,000	Partially completed.
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs** Synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region. Identified the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, developed recommendations for how such activities can best benefit breeding songbirds and evaluated the songbird monitoring strategy.	7/31/2007	$356,876	Complete.
ERP-05D-S20	**Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon** This is a marking/tagging program which provides CALFED the specific information needed to evaluate Ecosystem Restoration Program Plan (ERPP) actions and goals related to improving conditions for Central Valley Chinook salmon. Specifically, the project will provide CALFED the basis for 1) evaluating and revising Central Valley salmon hatchery operations, 2) being able to track restoration of all races of Chinook salmon, 3) tracking whether CALFED targets for population restoration of Chinook salmon are being reached, and 4) evaluating effects of harvest.	9/30/2008	$6,775,998	Ongoing.
ERP-96-M16	**Sacramento River and Major Tributaries Corridor Mapping Project** The CSU, Chico Geographic Information Center created a GIS package detailing riparian corridors along the Sacramento River and its major tributaries in portions of Glenn, Sutter, Colusa, Yuba, Yolo, and Sacramento Counties. Also, they obtained infra-red and enlargement aerial photographs, developed base-maps, interpreted vegetation and ground-truthed, digitized photo/vegetation information, developed GIS files, and completed the USVSCPP coverages.	12/31/1999	$145,200	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-B15	**Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking** Evaluated the feasibility of mass marking and/or tagging to increase the knowledge about juvenile salmon and steelhead distribution in inland and marine waters.	6/30/2002	$616,191	Complete.
ERP-99-N13	**Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead** Developed a plan to implement a Constant Fractional Marking (CFM) program that integrates traditional coded-wire tagging/fin marking (CWT) and otolith thermal marking (OTM) to address central Chinook salmon and steelhead management questions regarding the relative contribution of hatchery and natural production to adult populations as represented by fisheries and to develop a means to implement selective fisheries.	11/30/2004	$92,657	Complete.
ERP-99-N13b	**Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries** Focused primarily on Phase IV of the DFG contract (ERP-99-N13) to create a staged implementation plan segment for CFM of all hatchery-produced CV Chinook Salmon.	1/31/2004	$74,249	Complete.
Feather River Ecological Management Unit Projects				
ERP-00-B06	**Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed (Phase II)** This research addressed key areas of scientific uncertainty about green sturgeon to minimize harm to this species and its population(s) in the Lower Feather River. This multi-phase project determined baseline information regarding green sturgeons' biological requirements and the feasibility of this species' culture for further research and potential mitigational considerations.	5/31/2002	$205,013	Complete.
ERP-98-C15	**Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watersheds** Investigated green sturgeon's biological requirements, such as food and oxygen requirements at different water temperatures, swimming performance, larvae and fry development needs, and the effects of stressors on reproductive functioning.	10/31/2001	$241,000	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Yuba River Ecological Management Unit Projects				
ERP-01-C08-D	**Technical and Scientific Services for the Upper Yuba River Studies Program** USGS investigated water quality and sediment transport and yield in the Yuba River watershed. The overall objective was to improve understanding of sediment supply, transport, and storage of sediment in the Yuba River watershed, and to improve understanding of the current level of mercury contamination of Englebright Lake sediments and biota. An assessment of the transport of the existing sediment in the reservoir to the downstream reaches was performed following several potential management scenarios.	6/14/2005	$534,000	Complete.
ERP-01-C10	**Technical / Scientific Review of Upper Yuba River Studies Program: Ecotoxicology Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$44,000	Complete.
ERP-01-C11	**Technical / Scientific Review of Upper Yuba River Studies Program: Hydrotechnical Engineering Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$28,000	Complete.
ERP-01-C12	**Technical / Scientific Review of Upper Yuba River Studies Program: Environmental Economics Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$28,000	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-01-C13	**Technical / Scientific Review of Upper Yuba River Studies Program: Geomorphology Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$28,000	Complete.
ERP-01-C14	**Technical / Scientific Review of Upper Yuba River Studies Program: Zoology Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$28,000	Complete.
ERP-01-C15	**Technical/Scientific Review of Upper Yuba River Studies Program: Hydropower Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$26,000	Complete.
ERP-01-C16	**Technical / Scientific Review of Upper Yuba River Studies Program: Marine Fisheries and Economics Expert** Provided technical expertise to the CALFED Bay-Delta Program, Upper Yuba Rivers Studies Program. As a member of the Technical Review Panel, the contractor reviewed materials, attended workshops, participated in discussions, responded to inquiries and presented findings and advice. A three-day workshop was held during September 2001 during which the technical details of the proposed work on the UYRSP were discussed.	6/30/2006	$26,000	Complete.
ERP-01-N62	**Yuba Feather Work Group** Supported community-based stakeholder approach to providing input into Yuba County Water Agency's Proposition 13 Yuba Feather Flood Control Study on various non new-dam watershed management techniques to enhance flood protection while maintaining or improving natural process, habitat and populations of high priority at risk species, including Chinook salmon and steelhead.	8/31/2006	$297,632	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-C01-D	**Upper Yuba River Studies Program - Sediment Studies and Water Quality** Improved the understanding of the current level of mercury contamination in Englebright reservoir sediments and biota. Sediment studies improved the understanding of sediment supply, transport, and storage of sediment in the Yuba River watershed. An assessment of the transport of the existing sediment in the reservoir to its downstream reaches was performed following several potential management scenarios. Determined if the introduction of wild Chinook salmon and steelhead trout to the upper Yuba River is feasible in the long term.	6/30/2006	$4,794,966	Complete.
ERP-02-C02-D	**Upper Yuba River Studies Program: Engineering, Environmental Services, Project Management and Facilitation** Determined if the introduction of wild Chinook salmon and steelhead trout to the upper Yuba River watershed is feasible in the long term.	6/30/2006	$4,422,038	Complete.
ERP-02-P47	**Narrows 2 Power Plant Flow Bypass System Project** Provided a structural remedy to eliminate flow and temperature fluctuations from emergency and maintenance shutdowns at the Narrows 2 Hydropower Plant on the Yuba River by constructing a 3,000 cfs synchronous bypass system to maintain stable flow releases. Planning completed under CVPIA-01-F01.	6/30/2008	$8,535,567	Complete.
ERP-03-C04	**Technical / Scientific Review of Upper Yuba River Studies Program: Geomorphology and Hydrology Expert** Dr. Gordon Grant of the US Forest Service (USFS) provided technical expertise to the CALFED Bay-Delta Program's Upper Yuba Rivers Studies Program.	6/30/2006	$18,000	Complete.
ERP-96-M17	**Browns Valley Irrigation District Fish Screen Project** Reduced entrainment of important anadromous fish species by providing funds for the construction of a fish screen at the Browns Valley Irrigation District's diversion facility on the Yuba River. The project was completed as the fish screen was successfully placed in operation.	12/31/1998	$114,750	Complete.
ERP-98-C19	**Conduct/Facilitate Meetings on the Upper Yuba River, Englebright Dam** Funded three stakeholder meetings to prioritize a set of studies to be accomplished in a Phase I reconnaissance study for restoring anadromous fish above Englebright Dam. Provided a database of participants, created an on-line email list, produced meeting products, and provided information on the CBDA process by which the Upper Yuba River Studies would proceed. Other tasks included a Sierra Nevada Ecosystem Project Report on Yuba Salmon, responded to public questions via email and phone calls, and developed a list of potential organizational representatives for the next set of smaller stakeholder group meetings.	6/30/1999	$7,333	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-E10	**South Yuba River Coordinated Watershed Management Plan** Facilitated a broad based local stakeholder group in development of watershed plan. The South Yuba River Coordinated Watershed Management Plan was developed for the 40 miles of South Yuba River between Spaulding and Englebright reservoirs.	5/30/2003	$264,000	Complete.
ERP-98-N03	**Life History and Stock Composition of Steelhead Trout** Characterized the life history patterns and stock composition of steelhead in the Yuba River to support ecosystem restoration and species recovery programs. The primary benefit of this study was to provide basic information on the life history and stock composition of steelhead trout in the lower Yuba River for use in identifying and evaluating the effectiveness of proposed restoration and management actions directed at the species.	8/31/2006	$120,000	Ongoing.
ERP-99-B09	**Development of Implementation Plan for Lower Yuba River Anadromous Fish Habitat Restoration** Developed an implementation plan and conducted modeling, public outreach, and local involvement plans, all of which are related to the Lower Yuba River Anadromous Fish Habitat Restoration Actions.	7/15/2003	$171,000	Complete.
ERP-99-N17	**Yuba Watershed Council: A Collaborative Approach** Supported efforts of the Yuba Watershed Council (YWC) by funding a watershed coordinator, materials, equipment, and office space to provide coordination and assistance, adaptive management and monitoring, education and outreach, and continuity and program oversight of current and future watershed projects.	6/30/2003	$142,618	Complete.
Sutter Bypass Ecological Management Unit Projects				
ERP-01-C02	**Real-Time Flow Monitoring** Funded continued operation and maintenance of flow monitoring stations on five Sacramento River tributaries to provide data on minimum instream flows and water quality for the recovery of at-risk fish species in the creeks.	9/30/2005	$518,200	Complete.
ERP-01-N49	**Butte Creek, Big Chico Creek, and Sutter Bypass Chinook Salmon and Steelhead Evaluation** Provided information on the basic life history of spring-run Chinook salmon and steelhead trout populations in Butte and Big Chico Creeks to help evaluate the effectiveness of many fish restoration projects intended to improve anadromous fish populations in the two watersheds.	6/30/2006	$507,132	Complete.

Table 1. Feather River/Sutter Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-01-N54	**Lower Butte Creek Project: Phase III Facilitation/Coordination and Construction of Three Fish Passage Modifications to Sutter Bypass West Side Water Control Structures** Increased self-sustaining populations of spring-run and winter-run Chinook salmon, steelhead, and splittail by significantly improving accessibility to the natal holding and spawning areas in Butte Creek through improvement/installation of fish ladders and screens at three locations along the creek.	12/31/2008	$3,047,227	Ongoing.
ERP-04D-S07	**Real-Time Flow Monitoring** Operate and maintain 13 flow monitoring stations with temperature sensors.	9/30/2008	$330,000	Ongoing.
ERP-04-S10	**Butte Creek Spring-run Chinook Salmon Life History Investigation** Develop and refine SRCS adult escapement estimates.	6/30/2010	$513,144	Ongoing.
ERP-05-S32	**Evaluation of Giant Garter Snake Response to CALFED's Environmental Water Account Program: Adaptive Management for Wildlife Friendly Farming** Evaluate effects of rice field fallowing on GGS in order to meet the needs for regulatory guidelines for the EWA program.	6/30/2010	$1,187,367	Ongoing.

Other Programs Contributing to ERP Vision

Other programs and organizations that have contributed to meeting ERP goals in the Feather River/Sutter Basin EMZ include:

- The Integrated Regional Water Management Plan for the Cosumnes, American, Bear, and Yuba Watersheds, California (2006) (http://caby.watershedportal.net).
- The South Yuba River Citizens League. A community-based educational nonprofit corporation committed to the protection, preservation and restoration of the entire Yuba Watershed (http://www.syrcl.org).
- Sutter County Resource Conservation District. The district covers 363,556 of the 386,425 acres in Sutter County. The county extends north from the confluence of the Sacramento and Feather Rivers, to just north of the Sutter Buttes in North Central California. The Sacramento River and Butte Creek form the western border of the county. The Feather River forms the eastern boundary. South of the confluence of the Bear and Feather Rivers, the RCD extends east to the base of the Sierra Nevada foothills (http://www.carcd.org/wisp/sutter/index.htm).

One of the more significant contributors to restoration actions in the Feather River Ecological Management Unit will be provided by the California Department of Water Resources. DWR filed a license application with the Federal Energy Commission for a

major new license to continue to own, operate, and maintain the Oroville Facilities on January 26, 2005. The 762-megawatt project is located on the Feather River in Butte County, California, and occupies 1,620 acres of federal lands managed by the U.S. Department of Agriculture, Forest Service, within the Plumas and Lassen National Forests and 4,620 acres managed by the U.S. Bureau of Land Management. The 2005 application included a preliminary draft environmental assessment. DWR's license application outlined its proposal to continue operating the Oroville Facilities in accordance with certain existing and interim operational and environmental measures.

DWR filed a comprehensive Offer of Settlement (Settlement Agreement) with the Commission on March 24, 2006. The terms of the Settlement Agreement include a wide range of measures, and also include a set of measures that DWR proposes to implement outside of the project license. Under the proposed action, DWR would implement six programs designed to enhance habitats for coldwater fisheries to benefit the threatened and endangered Central Valley spring-run Chinook salmon and Central Valley steelhead in the Feather River, and warm water fisheries in Lake Oroville. The proposed action includes a comprehensive program to monitor water quality and bacteria levels at project waters for the benefit of the fisheries and of visitors using the project's swimming areas. Wildlife would be enhanced through proposed measures to manage the Oroville Wildlife Area. These measures include protecting nesting grebes and vernal pool habitat; minimizing disturbance to nesting bald eagles; protecting threatened and endangered species, including the giant garter snake, California red-legged frog, and valley elderberry longhorn beetles; providing upland food and nesting cover for waterfowl; and managing invasive plants. The substantial recreational opportunities of the Oroville Facilities would be enhanced and expanded through the implementation of the "Recreation Management Plan" which includes upgrades to existing facilities, construction of new facilities, and comprehensive monitoring of recreation use over the term of any license issued for the project.

As part of the agreement, within three years following license issuance, DWR shall develop a comprehensive "Lower Feather River Habitat Improvement Plan". The following programs and plans shall be included in the comprehensive plan:

- Gravel Supplementation and Improvement Program
- Channel Improvement Program
- Structural Habitat Supplementation and Improvement Program
- Fish Weir Program
- Riparian and Floodplain Improvement Program, including the evaluation of pulse/flood flows
- Feather River Fish Hatchery Improvement Program
- Oroville Wildlife Area Management Plan
- Comprehensive Water Quality Monitoring Program
- Instream Flow and Temperature Improvement for Anadromous Fish.

The complete text of the DWR Relicensing Settlement Agreement can be viewed online at: http://orovillerelicensing.water.ca.gov/pdf_docs/Settlement%20Agreement.pdf

Five CVPIA projects were funded that contributed to work done on the Yuba River: *Spawning Habitat Integrated Rehabilitation Approach-based Analysis on the Yuba River-SHIRA-based Analysis, Phase II* (**CVPIA-XX-V02**), *Modify Life History/Evaluation in Lower Yuba River to Include Tag Recovery and Analysis of Wild Stock* **(CVPIA-XX-V08**), *Yuba River Replacement Barrier* (**CVPIA-XX-V18**), *Lower Butte Creek – Sutter Bypass Willow Slough Weir Fish Passage Project* **(CVPIA-02-V04**), and *Narrows 2 Hydro Power Plant Flow Bypass System Design* (**CVPIA-01-F01**).

CVPIA-XX-V02 collaborated with on-going biological, hydrological, and geomorphic studies so that an integrated database of monitoring information useful for SHIRA can be organized. It characterized the fluvial geomorphology, sediment transport dynamics, and in-stream hydraulics of key potential spawning reaches above and below the lower Yuba River Narrows at the ecologically relevant scale of 0.1-1 m resolution, and experimented on different gravel placement strategies for the lower Yuba River, taking advantage of the available annual high discharges to evaluate sediment transport processes. **CVPIA-XX-V08** determined the genetic uniqueness of the Yuba River steelhead population relative to populations in the Feather River and other Central Valley rivers, and identified successful life history strategies for steelhead in the Yuba. **CVPIA-XX-V18** replaced the existing temporary barrier with a permanent "leaky-dike" barrier to prevent the migration of Yuba River Chinook salmon and steelhead into the goldfields. Operational flexibility of Willow Slough Weir was designed into the new structure in **CVPIA-02-V04**, so that adjustments can be made to optimize fish passage past the weir structure based on stream flows, hydraulic criteria, and fish passage performance. The planning phase of the *Narrows 2 Hydro Power Plant Flow Bypass System Design* (**CVPIA-01-F01**) project was funded by the AFRP.

Status of Area Today

The majority of the projects have been research/monitoring and planning projects that lay the groundwork for implementation initiated during Stage 2 of the Program. The following is a summary of the progress made in each of the Ecological Management Units and the corresponding ERP targets.

Feather River Ecological Management Unit

Planning has been completed that will help guide restoration projects to meet ERP targets for ecological processes including: Central Valley streamflows, Central Valley stream temperatures, coarse sediment supply, stream meander, natural floodplains and flood processes, riparian and riverine aquatic habitat, and stressors such as water diversions, dams and other structures. In addition, green sturgeon research has been

conducted that will inform restoration done for the species on the Feather River.

Yuba River Ecological Management Unit

Several implementation projects have contributed toward the successful completion of the ERP targets for ecological processes including Central Valley streamflows and Central Valley stream temperatures, and stressors including water diversions and stranding. Planning projects have been completed for the upper Yuba River, lower Yuba River, and South Yuba River that have the potential to meet ERP targets for ecological processes, habitats, stressors, and species including fall-run Chinook salmon, spring-run Chinook salmon, steelhead, green sturgeon, and American shad. In addition, intense research on the upper Yuba River has resulted in new information for ERP targets for ecological processes, habitats, stressors such as dams and other structures, and species such as Chinook salmon and steelhead.

Bear River and Honcut Creek Ecological Management Unit

A planning project has been completed that will help guide restoration to meet ERP targets for ecological processes, riparian and riverine aquatic habitats, and stressors including dams, water diversions and other structures.

Sutter Bypass Ecological Management Unit

An implementation project is currently in progress that will contribute toward the ERP Vision to ensure fish passage and promotes recovery of MSCS Species. Planning has been completed that also contributes toward the vision to ensure passage of adult salmon, including spring-run Chinook. In addition, research and monitoring projects have been completed in the EMU that will contribute new knowledge to the ERP Vision for the EMU that would improve streamflow and ERP targets for species (spring-run Chinook salmon, fall-run Chinook salmon, steelhead trout, and giant garter snake).

Planned Projects for Implementation

*The Lower Butte Creek – Sutter Bypass Willow Slough Weir Fish Passage Proj*ect (**CVPIA-02-V04**) completed a Preliminary Engineering Technical Report for this phased fish passage project during Stage 1 (California Department of Water Resources 2005). Funding for additional planning and construction phases of this project should be considered in collaboration with the Anadromous Fish Restoration Program to ensure adequate review and federal cost-share funding. For additional information see section 5.1 WATER DIVERSIONS.

Impediments to Implementation

The availability of funding is the most significant impediment to further implementation of projects in the Feather River/Sutter Basin Ecological Management Zone.

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APPENDIX A

A.9. AMERICAN RIVER BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The American River Basin Ecological Management Zone (EMZ) is located east of the Sacramento River and lies between the Bear River to the north and the Cosumnes River to the south (Figure 1). Its eastern boundary is the Sierra foothills and its western boundary is the Sacramento River and Delta. The American River Basin was once an important wintering area for migratory waterfowl, and is an essential watershed for the spawning, rearing, and migrating fall-run Chinook salmon, steelhead, striped bass, and American shad. Seasonal stream flow and water temperature are the two ecological factors with the greatest influence on anadromous fishes of the lower American River. In addition, spawning gravel, stream-channel dynamics, shaded riverine aquatic (SRA) and riparian habitats also are important factors, stressors such as dams, legal and illegal harvest, water quality (e.g. water temperature and toxins from urban runoff), and artificial propagation of anadromous fish further affect the population dynamics of anadromous fish in watersheds of the zone.

The American River Basin EMZ includes the following Ecological Management Units (EMUs):

- American Basin EMU
- Lower American River EMU

American Basin Ecological Management Unit

Once filled with large wetland areas, the American Basin floodplain is now principally rice fields in the north and central areas, with the metropolitan area of the City of Sacramento in the south. The central portion of the unit is a mixture of agricultural lands, grasslands, and oak woodlands. The upper eastern portion of the unit consists of the upper watersheds of Coon Creek, Auburn Ravine, and Dry Creek. Stream flows have been modified by water diversions, subsidence in ground water tables, and watershed activities such as grazing, road building, wetland management, forest management, and agriculture. Important habitats in the unit are wetlands, riparian forests, seasonal wetlands, and grasslands. Once widespread, marshes are now restricted to remnant patches. Riparian habitat, both forest and shrub, is found on the water and land side of levees and along creek channels of the unit. This habitat ranges in value from disturbed to relatively undisturbed. Upland habitats are found on the

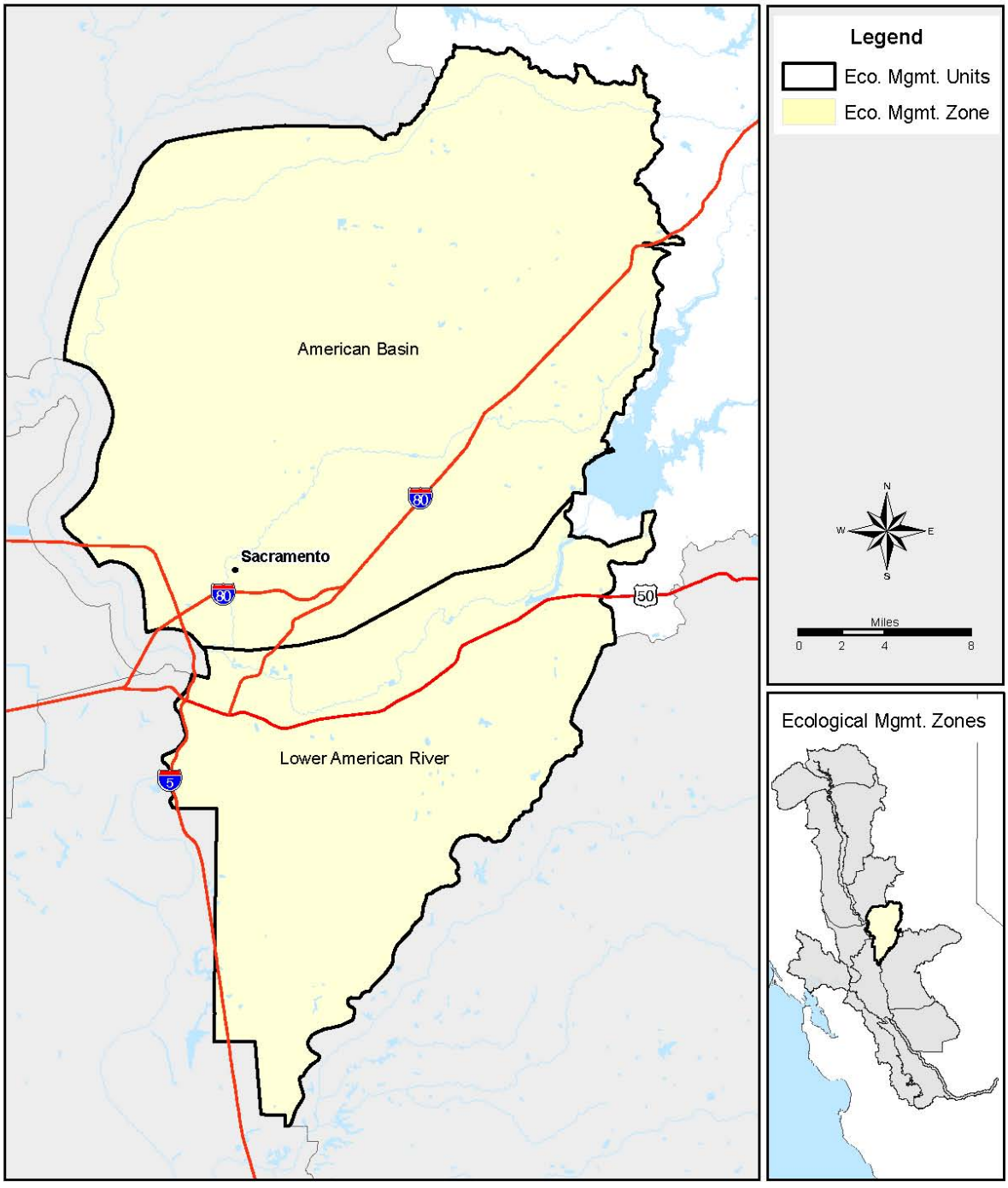

Figure 1. American River Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. American River Basin EMZ map

eastern floodplain and foothills and consist primarily of grasslands and oak woodland and oak savanna.

These perennial grasslands are an important transition habitat for many wildlife species and are buffers to protect wetland and riparian habitats. Important biological resources in this EMU include the giant garter snake, Swainson's hawk, fall-run Chinook salmon, steelhead, waterfowl, as well as many other native plants and wildlife found within the diversity of habitat types.

Lower American River Ecological Management Unit

Important aquatic resources that depend on the Lower American River and its riparian habitats include naturally spawning fall-run Chinook salmon, steelhead, American shad, other native fish assemblages, amphibian populations, and lower trophic organisms. Important aquatic habitats and factors include holding, spawning, rearing, and migration habitats for all fish species; sufficient quantities of high-quality water at the appropriate temperature; and riparian and SRA habitats.

Among the most significant factors affecting the American River ecosystem are altered natural runoff patterns, impaired channel maintenance processes, and loss of connectivity between upstream spawning and rearing habitats and the lower river following construction of Folsom and Nimbus Dams. These changes have resulted in the following: exclusion of salmon and steelhead from many of their historic upstream spawning and rearing areas, altered seasonal river flow and water temperature, significant reduction in high-quality spawning and rearing habitats, armoring of existing instream gravel resources, elimination of natural stream meanders, and loss of islands and riparian vegetation.

Applicable ERP Vision

The vision for the American River Basin EMZ includes restoring important fishery, wildlife, and plant communities by restoring ecological processes, habitats and reducing the adverse affects of stressors (CALFED 2000a). The vision for this Ecological Management Zone focuses on restoring an ecologically based streamflow plan, improving the supply and accessibility of sediments, maintaining the existing stream meander configurations, maintaining water temperatures in the lower American River to support anadromous fish, and supporting the development of locally sponsored watershed planning. The vision also encourages restoring a variety of aquatic, riparian, and terrestrial habitats for fish, wildlife, and plant communities.

American Basin Ecological Management Unit

The vision for the American Basin EMU is to improve water quantity and quality to sustain aquatic, wetland, riparian and upland habitats that support natural production of an abundance of resident fish and wildlife, as well as waterfowl and other migratory birds that use the Pacific Flyway each winter (CALFED 2000a). The vision includes improving, restoring, and enlarging areas of remaining native riparian, emergent wetlands, season wetlands, and grasslands habitats and establishing connectivity of those areas.

Floodplain habitat improvement would be the focus of efforts in the western portion of the unit. Riparian and stream channel improvements would be the focus of efforts in the middle and upper watersheds. Throughout much of the central and upper (eastern) portion of the unit creek restoration would provide higher quality water and improved habitats for salmon and steelhead. Exclusion of cattle along the streams and creeks, limitation of gravel mining, and reduction of diversions would improve stream channels and riparian corridors. Facilitating passage at numerous seasonal dams would allow better access to upstream spawning and rearing habitat.

Lower American River Ecological Management Unit

The vision for the Lower American River EMU is to restore important fishery, wildlife, and plant communities (CALFED 2000a). This vision will be accomplished by restoring or reinitiating important ecological processes and functions that create and maintain important habitats for fish, wildlife, and plant communities along the lower American River. Numerous and diverse actions may be implemented taken on a broad scale to restore and maintain sustainable, naturally spawning stocks of Chinook salmon and steelhead in the American River, including improving seasonal flow and temperature regimes, in-channel and riparian habitats, fishery regulations, and hatchery operations.

Stage 1 Expectations

The Stage 1 expectations for the American River Basin Ecological Management Zone were to improve ecological functions such as streamflow and water temperature, sediment transport and deposition, and natural floodplain processes as a means to improve habitat for a variety of aquatic and terrestrial species (CALFED 2000b).

American Basin Ecological Management Unit

The Stage 1 expectation for the American Basin EMU was to control or eradicate non-native riparian plants and to revegetate with native plants (CALFED 2000b).

Lower American River Ecological Management Unit

The Stage 1 expectations for the Lower American River EMU were to manage the removal of or to introduce instream large woody debris within selected river reaches to improve aquatic habitats for fish species (CALFED 2000b). The expectations also included improved hatchery management and fish release practices at the Nimbus Hatchery to better protect the genetic integrity of wild anadromous fish.

Changes Attributable to ERP

American River Basin Ecological Management Zone

The ERP provided funds to support the efforts of the American River Watershed Institute (ARWI) to implement the *Learning Watershed Project* (**ERP-99-B23**), which was a comprehensive learning project with a focus on the watershed and community. As part of this project, the ARWI conducted seven workshops in conjunction with the pre-restoration monitoring, prescription and restoration, and post-restoration monitoring on two tributaries to Deep Creek on the Middle Fork of the American (ARWI 2002).

A suite of research and monitoring projects were undertaken on a program-wide level which contributed to the vision for Artificial Fish Propagation in the American River Basin EMZ. Together, these projects (*Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking* (**ERP-98-B15**), *Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon and Steelhead* **(ERP-99-N13**), *Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries* (**ERP-99-N13b**) have resulted in the development of recommendations regarding 1) the coded wire tagging program in the Central Valley, 2) specific marking and tagging and implementation recommendations associated with a comprehensive marking and tagging program, 3) selective fishing options in the marine or freshwater environments if they are implemented in the future, and 4) constant fractional marking levels and some of the other manipulable factors (Newman et al. 2000, Newman et al. 2004). In addition, an ongoing project, *Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon* (**ERP-05D-S20**), will provide the basis for evaluating and revising Central Valley salmon hatchery operations, being able to track restoration of all races of Chinook salmon, tracking whether CALFED targets for population restoration of Chinook salmon are being reached, and evaluating effects of harvest.

The Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs Project (**ERP-02-P17**) is an ongoing research effort designed to evaluate the results of past and current riparian bird system research and monitoring

across the entire CALFED region. Information learned from this study will contribute to the successful implementation of ERP riparian and riverine aquatic habitat targets for the American River Basin EMZ.

The program-wide *Arundo Eradication and Coordination Project* (**ERP-02D-P68**) is an ongoing effort to contribute toward the control of invasive riparian plants to allow native riparian plant species to naturally propagate. This project, which is projected to end in 2009, plans to remove *Arundo donax* (giant reed) from the banks of the Lower American River, North Fork American River, and Arcade, Dry, Morrison and Elder Creeks within the American River Basin EMZ. Benefits from this project are expected to be realized immediately upon completion.

The Assessment and Implementation of Urban Use Reduction of Diazinon and Chlorpyrifos Project (**ERP-97-N01**) has contributed new information which will assist in the contaminant reduction target identified in the ERP for the American River Basin EMZ. The objective of this project was to collect water column chemistry data to characterize the extent of diazinon and chlorpyrifos contamination and the time of the year that it occurs. Intensive monitoring of diazinon and chlorpyrifos was conducted on various water sources in the Sacramento area. The data generated by this study was then evaluated along with water quality monitoring data from previous monitoring efforts. The project final report presents findings which generally support existing hypotheses regarding diazinon and chlorpyrifos levels in Sacramento area waterways as well as recommendations for future work (City of Sacramento 2001).

American Basin Ecological Management Unit

The Duncan Canyon/Long Canyon Paired Watershed Study (**ERP-99-B15**) has contributed information which will assist in achieving the ERP targets to develop and implement an ecologically based streamflow regulation plan for the American Basin creeks and lower American River. The Duncan Canyon and Long Canyon watersheds occur upstream of the American River Basin EMZ on the Middle Fork of the American River. The primary purpose of the study was to determine why unexpected flow differences are evident when comparing streamflow records of Duncan Canyon and Long Canyon. The secondary purpose of the paired watershed study was to assess the influence of vegetative management on decision-making. The field work completed for the study resulted in two main conclusions. First, the specific geologic and geomorphologic circumstances of these small watersheds are primary driving factors in the sources of baseflows and an understanding of these features is needed to understand the baseflow portion of watershed processes and function. Second, the field work tends to confirm the PRMS model in that for extreme baseflow circumstances, soil moisture discharges near the headwaters are an important factor in the baseflow regime regardless of other geologic and geomorphic factors, and in spite of the small contributing watershed area to these headwater reaches. Therefore if baseflow management were a defined resources value, vegetation management above

about 6200 feet along the main stem would be an important consideration (Watson and Humphrey 2003).

The Auburn Ravine/Coon Creek Ecosystem Restoration Plan (**ERP-97-N05**) was funded by ERP and Placer County to evaluate the Auburn Ravine, Coon Creek and Markham watersheds. This plan contributed toward the ERP targets for streamflow, coarse sediment supply, and riparian and riverine aquatic habitat. The plan evaluates the current condition of the watershed and proposes a number of projects to protect or improve upon the baseline condition over time. The plan focuses on the restoration and management of stream channel dynamics and riparian corridors. Plan implementation would improve habitat for anadromous fish including steelhead, spring-run Chinook salmon, fall-run Chinook salmon as well as other native fish species. In addition, habitat for wildlife species that utilize the streams and adjacent riparian and upland habitat would also be improved. It is projected that habitat restoration activities would also result in water quality improvements downstream (Placer County Planning Department 2002).

The American Basin Fish Screen and Habitat Improvement Project Phases I-III (**ERP-98-B29**, **ERP-01-N60**, and **ERP-02-P09-D**) have been funded during Stage 1. This ongoing project would also contribute toward the ERP target to reduce losses of juvenile salmon and steelhead in the lower American River and American Basin creeks due to entrainment at water intake structures. The overall goal of the project is to remove all facilities from the Natomas Cross Canal and consolidate diversions on the Sacramento River to the extent possible. This project was also specifically identified in ERPP Volume II as a programmatic action. To date, only the feasibility study and environmental assessment have been successfully completed under Phase I. The final design and permitting begun under Phase II has encountered significant cost overruns and delays related to the completion of an Action Specific Implementation Plan (ASIP) and EIR/EIS. Construction funded under Phase III has not begun because of delayed environmental documents.

Lower American River Ecological Management Unit

The Lower American River Temperature Reduction Modeling Project (**CVPIA-02-V03**) has contributed new modeling information which will assist in achieving temperature reduction targets identified in the ERP for the lower American River below Nimbus Dam. Modeling results will provide information deemed critical to eliminating uncertainties in the performance of the potential improvements. The purpose of the study was to model and evaluate five identified actions that may improve transport of cold water through Lake Natoma and reduce the temperature of the lower American River. The five identified actions were a Nimbus Dam curtain, a Lake Natoma plunge zone curtain, Nimbus Powerplant debris wall removal, dredging Lake Natoma, and modifying Folsom Powerplant peak loading operation. Results and recommendations of the modeling runs are described further in the next section (American River Basin EMZ Planned Projects).

The Development of a River Corridor Management Plan (RCMP) for the Lower American River Project (**ERP-99-N21**) contributed toward the ERP target for streamflow, stream temperature, and riparian and riverine aquatic habitat. In addition, the project completed the ERP programmatic action which called for the development of a riparian corridor restoration and management plan for the lower American River. The RCMP was completed in 2002 and the purpose was to institute a cooperative approach to managing and enhancing the lower American River corridor's aquatic and terrestrial ecosystems, flood-control systems, and recreation values. Implementation of the RCMP is expected to improve and increase aquatic and terrestrial habitats and improve ecological health of targeted species, preserve the flood-carrying capacity and ensure the long-term reliability of existing and planned flood-control improvements, and preserve and enhance wild and scenic recreation value. Affected MSCS Species include fall-run Chinook salmon, steelhead trout, splittail, and valley elderberry longhorn beetle (VELB).

The Water Intake Fish Screen Replacement Project (**ERP-98-B28** (design) and **ERP-01-N51** (full-scale implementation)) contributed toward the ERP target to reduce losses of juvenile salmon and steelhead in the lower American River and American Basin creeks due to entrainment at water intake structures. Under this project, the E.A. Fairbairn Water Treatment Plant (EAFWTP) intake structure located on the lower American River was brought into compliance with current fish screen design standards. This project was specifically identified in ERPP Volume II as a programmatic action. The project achieved fish screen design standard compliance for the EAFWTP intake structure by 1) modifying the existing intake structure with new fish screens and fish screen cleaning systems, and 2) adding more fish screen area by extending the intake structure approximately 80 feet downstream. The fish screens were completed in February 2004 using standards required for the protection of MSCS species including juvenile fish species including all four runs of Chinook salmon, steelhead trout, Sacramento splittail, and green sturgeon (MWH Americas Inc. 2004). Benefits from this project were expected to be realized immediately upon completion.

Project Summary Table

As shown in Table 1, 18 projects have been funded that would benefit the American River Basin EMZ. In addition, two projects were selected for funding, but were not successfully implemented. The projects are focused on ecosystem processes, habitats, and stressors. These projects are described in more detail in the following section.

Table 1. American River Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
American River Basin Ecological Management Zone -Wide Projects				
ERP-02D-P68	**Arundo Eradication and Coordination, Phase II** This is Phase II of the *Arundo donax* eradication and coordination project. Phase II provides funding for ongoing monitoring and follow-up treatments for 5 Phase I projects, and adds 5 new partners.	3/15/2009	$2,033,859	Ongoing
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs** The applicant synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region. They identified the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, developed recommendations for how such activities can best benefit breeding songbirds and evaluated the songbird monitoring strategy.	7/31/2007	$356,876	Ongoing
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed** The broad goal of this project is to assess the role of vegetation in shaping the watershed's hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Ongoing
ERP-05D-S20	**Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon** the proposed project will provide CALFED the basis for (i) evaluating and revising Central Valley salmon hatchery operations, (ii) being able to track restoration of all races of Chinook salmon, (iii) tracking whether CALFED targets for population restoration of Chinook salmon are being reached , and (iv) evaluating effects of harvest.	9/30/2008	$6,775,998	Ongoing
ERP-97-N01	**Assessment and Implementation of Urban Use Reduction of Diazinon and Chlorpyrifos (Sacramento County)** Identified, evaluated and controlled the toxicity runoff caused by elevated levels of diazinon and chlorpyrifos within Sacramento County. Tasks included water quality monitoring to determine baseline conditions, developing outreach/education program for residential and other urban users (through the use of surveys and subsequent evaluations), and performing analyses of the fate, transport and risk assessment for the chemicals.	1/1/2001	$663,500	Complete

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-B15	**Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking** Evaluated current tagging practices and demonstrated a technique for the mass marking of hatchery produced salmon, to support subsequent evaluation of harvest practices. Data analysis only, no data collection.	6/30/2002	$616,190	Complete
ERP-99-B23	**The Learning Watershed Project** Funded efforts of the American River Watershed Institute (ARWI) to implement the Learning Watershed Project.	9/30/2002	$45,573	Complete
ERP-99-N13	**Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead** Developed a plan to implement a Constant Fractional Marking (CFM) program that integrates traditional coded-wire tagging/fin marking (CWT) and otolith thermal marking (OTM) to address central Chinook salmon and steelhead management questions. ERP-99-N13b is a continuation of this contract.	11/30/2004	$92,657	Complete
ERP-99-N13b	**Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries** A subcontract with DFG to complete a portion of the original ERP-99-N13 contract. Focused primarily on Phase IV of the DFG contract (ERP-99-N13) to create a staged implementation plan segment for CFM of all hatchery-produced CV Chinook Salmon.	1/31/2004	$74,249	Complete
American Basin Ecological Management Unit Projects				
ERP-01-N60	**American Basin Habitat Improvement Project** Phase II of American Basin Fish Screen and Habitat Improvement Project. Project was not completed within budget. A draft NEPA/CEQA document was prepared, but environmental permitting has not been completed. Additional funds for this project were obtained through USBR. Project phases I and III were funded through ERP-98-B29 and ERP-02-P09-D.	12/31/2006	$1,450,000	Contract ended. Project tasks were not complete at the end of the contract term. Work has continued with USBR funding.
ERP-02-P09-D	**American Basin Fish Screen and Habitat Improvement Project** Phase III of American Basin Fish Screen and Habitat Improvement Project. This project is the removal of a diversion dam, consolidation of diversions and the addition of state-of-the-art fish screens to NMWC's diversion on the Sacramento River. Project phases I and II were funded through ERP-98-B29 and ERP-01-N60.	12/31/2009	$12,600,000	Ongoing. Project is under review by ERP and implementation has been delayed.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-05-S28	**American Basin Working Landscapes Project** Develop a GIS-based "working landscapes" model/plan for the American basin. The project includes the following components: (1) working landscape strategy; (2) four riparian restoration projects; and, (3) farmland protections through the use of agricultural easements.	6/30/2010	$1,860,898	Ongoing
ERP-97-N05	**Auburn River/Coon Creek Restoration Plan** Developed Coordinated Resource Management Plans addressing the protection of habitat and improvement in water quality on the North and Middle Forks of the American River and the Auburn Ravine-Coon Creek watershed. Draft Auburn River/Coon Creek Ecosystem Restoration Plan were completed in June 2002.	4/30/2002	$222,530	Complete
ERP-98-B29	**American Basin Fish Screen and Habitat Improvement Project** Phase I of American Basin Fish Screen and Habitat Improvement Project. Funded feasibility study and preliminary design and environmental compliance work for the American Basis Fish Screen and Habitat Improvement Project. Project phases II and III were funded through ERP-01-N60 and ERP-02-P09-D.	6/30/2002	$450,000	Complete
ERP-99-B15	**Duncan/Long Canyon Paired - Watershed Project** Conducted a paired-watershed evaluation of watershed process and function in the very important high elevation headwater areas of the Sierra Nevada with the goal of improving the health of the upper American River.	2/28/2003	$83,600	Complete
Lower American River Ecological Management Unit Projects				
CVPIA-02-V03	**Lower American River Temperature Reduction Modeling Project** The goal of this project is to increase natural steelhead and fall-run Chinook salmon production and survival in the Lower American River (LAR). Modeling results provide information deemed critical to eliminating uncertainties in the performance of the potential improvements.	4/30/2007	$466,082	Complete
ERP-01-N51	**Water Intake Fish Screen Replacement Project** Funded ongoing effort to replace fish screens on the Sacramento River for the benefit of aquatic resources in the lower American and Sacramento Rivers. Consisted of two components, replacing the intake and access bridge for the Sacramento River Water Treatment Plant (WTP) and modifying the intake at the EA Fairbairn WTP. The design phase was funded under ERP-98-B28.	5/28/2004	$6,142,141	Complete

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-B28	**The City of Sacramento Water Intake Fish Screen Replacement Projects: Sacramento River Water Treatment Plant and the E.A. Fairbairn Water Treatment Plant** Funded preparation of final design for replacing fish screens at two water treatment plants, one on the Sacramento River and the other on the American, to reduce entrainment of anadromous fish. The construction of these fish screens was funded by ERP-01-N51.	6/30/2001	$1,964,500	Complete. The construction of the fish screens was funded by ERP-01-N51.
ERP-99-N19	**American River (South and Middle Fork) Watershed Stewardship Project** Produced a Watershed Management Plan and Stewardship Strategy for the South and Middle Forks of the American River. Tasks undertaken as part of the planning efforts of this project: 1) project management and scoping; 2) watershed assessment; 3) watershed evaluation; 4) draft integration plan and stewardship strategy; 5) watershed monitoring; 6) integrated watershed stewardship strategy.	5/15/2004	$253,738	Complete
ERP-99-N21	**Development of a River Corridor Management Plan for the Lower American River** Developed a River Corridor Management Plan (RCMP) for the lower American River between the Sacramento River and the Nimbus Dam in Sacramento County to serve as a planning framework and consensus-building process for pursuing CALFED's vision and objective for ecosystem restoration along the American River.	4/1/2002	$250,000	Complete

Other Programs Contributing to ERP Vision

Other programs and organizations that have contributed to meeting ERP Goals in the Lower American River EMU include:

- The Lower American River Task Force (LARTF), which promotes implementation of the River Corridor Management Plan (RCMP) consisting of an aquatic habitat management element, a floodway management element, and a recreation management element.
- The American River Parkway Invasive Plant Management Plan (ARP IPMP), County Parks, SAFCA, and Sacramento Weed Warriors.
- In 2004, the OEHHA evaluated findings on mercury in fish from Lake Natoma and the Lower American River (collected by USGS) and, in April 2004, released a report providing health guidelines for consumption of fish from these water bodies.
- A Lower American River Erosion Monitoring Plan is being developed by the Corps that would identify and monitor potential erosion sites relative to flood control concerns.

- American River Parkway Foundation.
- American River Operations Work Group, which focused on "real-time" management of the Lower American River, particularly water temperature and flow issues.

Status of Area Today

In total 18 projects have been funded by the ERP that would benefit the American River EMZ. The majority of these projects have been focused on research and monitoring (10 projects). The research and monitoring projects have provided valuable information that should guide future implementation projects during stage 2. The remaining projects have been focused on planning (5 projects), implementation (2 projects), and education (1 project). Three of the planning projects led to full scale implementation projects, and two of the planning projects have resulted in watershed plans that should also guide future restoration projects in the EMZ.

In addition to these projects, the 2004 Milestone and EWA Assessment reported that Ducks Unlimited projects contributed 3,187 acres toward the restoration, protection, and enhancement of seasonal wetlands and 72,000 acres of lands managed for wildlife friendly agriculture in the American River Basin EMZ. The target for seasonal wetland restoration and enhancement is 5,150 acres and the target for lands managed for wildlife friendly agriculture is 20,500 during Stage 1. More information on the status of habitat restoration targets can be found in Chapter 4.

Planned Projects for Implementation

The planning and research projects prepared for the American River Basin EMZ have resulted in a broad range of recommended actions which build upon previous information to improve the status of the American River Basin. The following is a list of these projects and the types of projects that are recommended:

- *Lower American River Temperature Reduction Modeling Project* (**CVPIA-02-V03**) suggested potential projects to improve temperature conditions in the lower American River (Bender et al. 2007).
- The Auburn Ravine/Coon Creek Ecosystem Restoration Plan proposed a number of projects to protect or improve upon the baseline condition over time. Implementation of the plan would focus restoration and management of stream channel dynamics and riparian corridors. Plan implementation would also improve habitat for anadromous fish including steelhead, spring-run Chinook salmon, fall-run Chinook salmon as well as other native fish species.
- Lower American River Corridor Management Plan (RCMP) and presented actions to improve ecological processes, habitats, and reduce stressors in the Lower American River EMU.

- *The Assessment and Implementation of Urban Use Reduction of Diazinon and Chlorpyrifos (Sacramento County)* (**ERP-97-N01**) final report presented recommendations for future work in the Sacramento Area regarding diazinon and chlorpyrifos levels (City of Sacramento 2001).

Impediments to Implementation

Impediments to implementation of ERP restoration goals and objectives in the American River Basin EMZ include stressors such as dams, bank protection, contaminants, and nonnative invasive species. These stressors were described in the River Corridor Management Plan for the Lower American River (LARTF 2002) (*Development of a River Corridor Management Plan for the Lower American River* (**ERP-99-N21**) and are identified below:

- Fish passage to the upper American River watershed has been blocked by dams. Opportunities to increase or improve physical habitat are limited to the 23-mile stretch of the Lower American River.
- Operation of the dams has dramatically altered aquatic and riparian habitat by altering the timing, rate, and temperature of Lower American River flows. Modifying the operation of dams is challenging because of the many physical limitations and institutional requirements (e.g. water supply and flood control).
- Bank protection of levees has degraded nearshore aquatic habitats and restricted the recruitment of in-stream woody material, and some stretches of the Lower American River have become noticeably deficient in vegetation and large woody debris. These factors, as well as modifications of spring and summer flow, have resulted in simplification of the channel; with construction of dams, they have contributed to declines in the quantity, quality, and diversity of nearshore habitat.
- Minimum flow and ramping criteria and temperature targets need to be able to adapt to available annual coldwater pool and water supplies.
- Groundwater contamination associated with the Aerojet facility in Rancho Cordova exists underneath the Lower American River. Although this contamination does not currently pose a threat to fisheries resources, a reduction in groundwater supply could increase demand on surface water supplies and increase stress on the Lower American River.
- The Lower American River floodplain is now considerably higher than the adjacent channel bottom in places. Therefore, the distance to the water table is now greater than before stream channel degradation. Thus, while vegetation colonized the floodplain during the period of aggradation (raising) and the mature plants with deep root systems continue to grow today, a limited amount of natural regeneration of the riparian forest is taking place today as a result of the floodplain being inundated less often and the water table being deeper. As a result, historically riparian habitats are converting to upland habitats.

- The reductions in sediment supply to the LAR have also affected the soil material required for plant establishment and growth. Because no major streams are tributary to the LAR downstream of the sediment-trapping reservoirs, little sediment is available to develop new habitat along the edges of the main river channel, and all new sediment is currently derived from bank erosion.
- The reductions in sediment supply to the LAR have also affected the soil material required for plant establishment and growth. Because no major streams are tributary to the LAR downstream of the sediment-trapping reservoirs, little sediment is available to develop new habitat along the edges of the main river channel, and all new sediment is currently derived from bank erosion.
- The amount of nonnative invasive vegetation has increased steadily; in some cases, it is outcompeting important native vegetation. The result is a reduction in the overall quality of vegetation communities and wildlife habitats.
- Parkway habitat values are diminished by the spread of invasive weeds and the destruction of native plants, fish, and wildlife as a result of inadequate regulation of human activity in sensitive and densely vegetated areas of the Parkway and inadequate funding to enforce regulations. Problems associated with illegal use of the Parkway should be addressed systematically throughout the Parkway so that they are not transferred to other ecologically sensitive areas.
- Uncontrolled feral cats and dogs in the Parkway diminish habitat values and threaten native wildlife. Deer, coyote, beaver, and other native wildlife could diminish habitat values if their populations exceed the Parkway's carrying capacity.

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APPENDIX A

A.10. YOLO BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The Yolo Basin Ecological Management Zone (EMZ) encompasses the southwest portion of the Sacramento Valley adjacent to the Delta (Figure 1). The Yolo Basin EMZ includes:

- Cache Creek Ecological Management Unit (EMU)
- Putah Creek EMU
- Solano EMU
- Willow Slough EMU

Portions of the Yolo Basin EMZ are extensively developed for urban and agricultural land uses; however it still provides important habitat for a wide variety of fish, wildlife, and plant communities, primarily native resident fishes, riparian communities, seasonally and permanently flooded wetlands, wildlife, waterfowl, occasionally fall-run Chinook salmon and possibly steelhead. Additional information regarding the Yolo Bypass is presented in the Sacramento-San Joaquin Delta section of this report.

The segment of the Yolo Bypass north of the Interstate 80 causeway is included in this EMZ and is an important migratory route during wet years for downstream migrant anadromous species such as Chinook salmon, steelhead, and other native fish originating from up-stream areas. When flooded, the Yolo Bypass provides valuable spawning habitat for native resident fish, especially splittail. Flow also enters the Bypass from several smaller west side streams including the Knight's Landing Ridge Cut, Cache Creek, Willow Slough Bypass, and Putah Creek. The Yolo Basin is closely connected with the North Delta through a system of sloughs and drains and, during periods of flood, the Yolo Bypass. The Yolo Bypass south of the causeway is within the North Delta EMU of the Sacramento-San Joaquin EMZ.

Cache Creek Ecological Management Unit

Cache Creek has a watershed of about 1,300 square miles and flows east from the coastal mountains to enter the Sacramento Valley floor near Esparto. Cache Creek enters the Yolo Bypass at Cache Creek settling basin (a reclaimed tule marsh-seasonal lake area) and then flows south into the Delta through the Conway Canal, Tule Canal, lower Cache Creek and other small sloughs in the bypass. Most of the flow in Cache Creek is diverted in the spring and summer for irrigation. High winter and early spring flows move south through the flooded Yolo Bypass or connecting sloughs to enter the

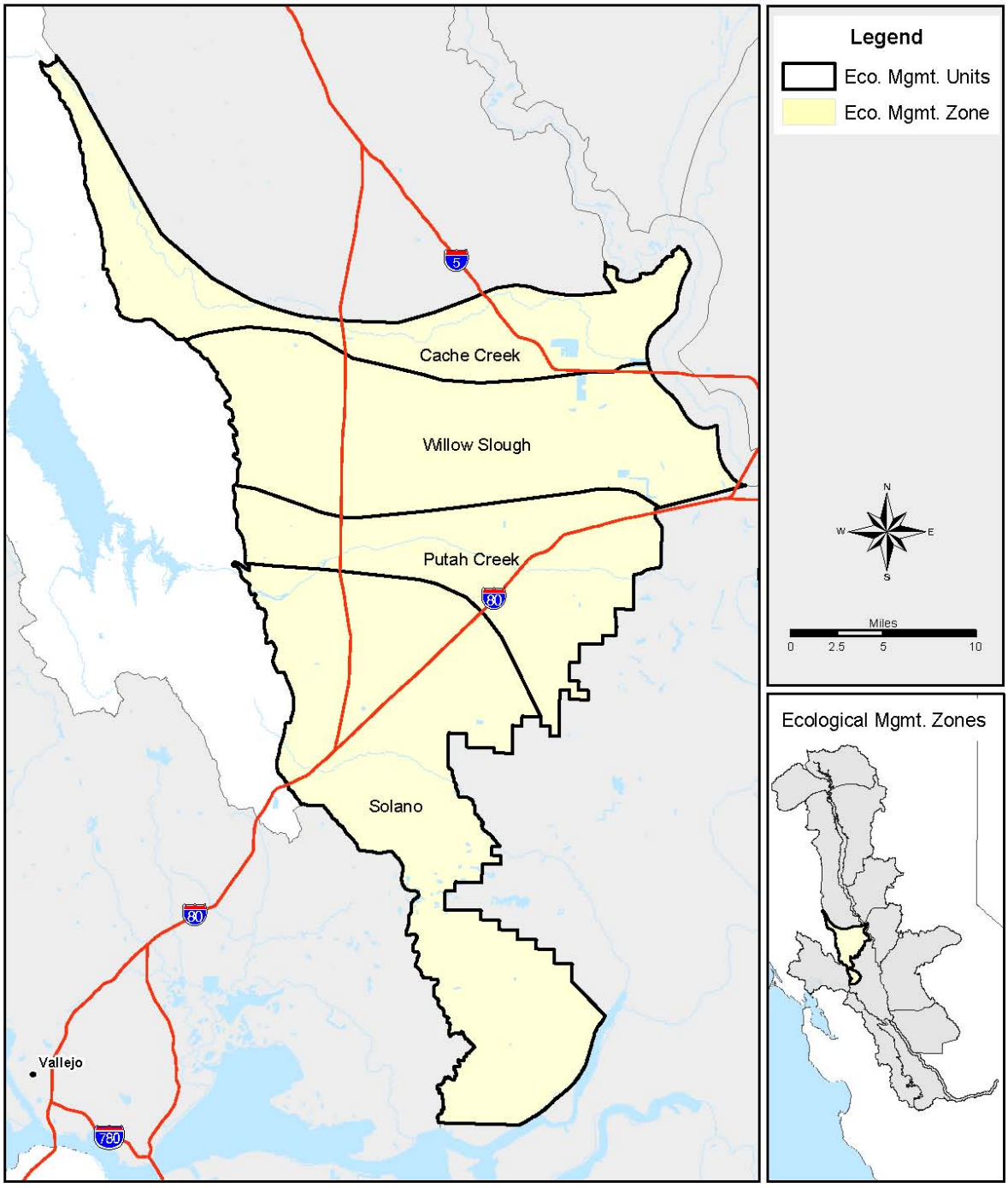

Figure 1. Yolo Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Yolo Basin EMZ Map

Delta through Cache Slough which then flows to the Sacramento River north of Rio Vista.

Cache Creek has a natural flow pattern of high winter, moderate spring, and low summer-fall flows, typical of many western Sacramento Valley streams that originate from chaparral and oak studded foothills rather than higher snow-laden mountains. Portions of the stream are dry during summer and fall months, except for small sections upstream of Woodland receiving groundwater. Inflows to the lower basin at Rumsey in the wettest years have averaged 5,000 to 10,000 cubic feet per second (cfs) in winter months and 300 to 700 cfs in summer months.

No minimum flow requirements have been set for Cache Creek below Capay Dam. In some places between Capay Dam and the Yolo Bypass, the creek flows through areas where gravel mining has recently occurred, but which have not yet had time to recover naturally. In other areas, deep gravel deposits and low water tables inhibit the establishment of a sustained low-flow channel.

Putah Creek Ecological Management Unit

Putah Creek has a watershed of about 710 square miles and flows out of the coastal mountains to enter the Sacramento Valley floor near Winters. Putah Creek flows into the Yolo Bypass at the Putah Creek sinks (a historical tule marsh-lake area). In most wet years, the creek flows to the Yolo Bypass and then flows south through Tule Canal to the Sacramento River. Monticello Dam (constructed in 1956) forms Lake Berryessa from Putah Creek on the east side of the coastal range. Below Monticello Dam, the creek flows into Solano Lake, formed by the Solano Diversion Dam (constructed in 1959). Below Solano Diversion Dam, the creek flows east through Winters and Davis.

Most of Putah Creek's flow below Monticello Dam originates from Lake Berryessa, which has an average outflow of approximately 350 cfs. Unimpaired flows into the Lake Berryessa watershed formerly peaked in winter. In wettest years, winter flows averaged 4,000 to 9,000 cfs. Lowest flows occur in summer and fall. In driest years, flows in winter months averaged only 20 to 70 cfs. In wetter years, summer and early fall flows averaged 20 to 100 cfs. Presently, flows from Monticello Dam are high in summer and low in winter in all but the wettest years. In the driest years, irrigation releases from late spring to early fall are 200 to 400 cfs above Solano Dam but near zero below the diversion dam.

Solano Ecological Management Unit

The southern portion of the Yolo Basin EMZ is the Solano EMU. This unit encompasses small watersheds above the tidal Delta, south of Putah Creek and east to the Delta. Most of this area is within the Cache Slough and Lindsey Slough watersheds. The unit also includes the Montezuma Hills.

Although salmon and steelhead are rarely found in this unit, native resident fish do occupy creeks and sloughs. Riparian corridors of these creeks and sloughs support vegetation, waterfowl, and wildlife. Upland habitats include vernal pools, valley oak woodlands, and grasslands. Scattered areas of seasonal and perennial wetlands and aquatic habitats exist throughout the unit.

Many of the vernal pools within this EMU are in a degraded condition due to land use practices (e.g. disking and cultivation) and could be improved. The potential for restoring native perennial bunch grass and some of the rare vernal pool plant species is high.

Willow Slough Ecological Management Unit

Willow Slough EMU is comprised of approximately 131,000 acres of productive farmland. The watershed is bounded and intersected by half a dozen natural riparian waterways, supporting an extensive irrigation and drainage system. Winter runoff from the Vaca foothills to the west enters this series of tributaries to terminate in the Yolo Bypass. Even during years of normal rainfall some downstream areas flood, and larger events have involved parts of the cities of Davis and Winters. Very little winter water is held back or captured in the natural systems. Summer use links the natural system with Cache Creek diversions and the Yolo County Flood Control and Water Conservation Districts (FCD) canal system to deliver irrigation water and remove related drainage flows.

Agriculture is the primary economic enterprise throughout the watershed. Crops include lowland acres of alfalfa, irrigated row crops such as tomatoes, and orchards. Dry-land grains and rangeland grazing characterize the upland hills. The lower irrigated croplands are made up of highly productive deep alluvial soil as well as heavier clay and alkali soils. The latter are generally used for rice production. Intensive “clean” agricultural practices in the watershed have had significant negative impacts on riparian systems, wetlands, upland wildlife habitat, water quality, and flooding.

The highest elevations of the watershed consist of chaparral and blue oak woodlands. Most of the habitats are in relatively good condition, although heavy grazing pressure impacts the grasslands and riparian areas, especially in the lower reaches. The lower foothills are mixed blue oak woodlands and grassland or dry-land grain areas. Much of this acreage is enrolled in the federal Conservation Reserve Program (CRP) and consists of non-native annual grasses and forbs.

Applicable ERP Vision

Overall, the vision for the Yolo Basin EMZ is to protect natural ecological processes and habitats to support native resident fish populations. Additional visions address the health of ecological processes, habitats, species, and the reduction of stressors. The visions were based on the potential to provide direct connections between the Sacramento River, on the northern portion of the EMZ, to the Delta, on the southern end of the EMZ. Part of the vision rationale was its location between the Sacramento River and the Delta, the presence of the Yolo Bypass in the northern portion of the Basin, and the potential value of Cache and Putah Creeks to native resident and anadromous fishes.

As the vision evolved, it embraced the concept of a migration corridor between the Delta and upstream habitats for terrestrial and aquatic species. It was part of the vision to increase seasonal flooding of leveed lands, particularly in the Yolo Bypass that includes the lower portions of the Cache Creek and Willow Slough EMUs. The vision also acknowledged the need to develop cooperative programs with local landowners since much of the Bypass is privately owned. For Cache and Putah creeks, it was apparent there was a need to develop additional water supplies to support sustainable populations of native resident fish species, and to contribute to the recovery of fall-run Chinook salmon and steelhead populations. Other problems that were folded into the vision included the need to control invasive plants, improve habitat for native species, reduce toxin inputs from discharges and contaminated soil, improve aquatic habitats and stream channel/floodplain processes to benefit native fish species, and to protect and restore plant species and communities in conjunction with restoring wetland, riparian, and riverine aquatic habitats.

Cache Creek Ecological Management Unit

The vision for the Cache Creek EMU is to sustain native resident fish by improving streamflows, fish passage, riparian habitat, and spawning gravel recruitment, and by screening unscreened diversions.

Putah Creek Ecological Management Unit

The Putah Creek EMU vision is that native resident fish will be protected and enhanced by improving stream channel characteristics, instream habitat, streamflows, fish passage, riparian habitat, spawning gravel recruitment, and by screening unscreened diversions.

Solano Ecological Management Unit

The Solano EMU vision is that creeks and sloughs and the associated riparian, wetland, and upland habitats in the unit will provide connections to the North Delta. Populations

of native resident fish, including Sacramento splittail and delta smelt, may be enhanced by improving conditions in these habitats.

Willow Slough Ecological Management Unit

The Willow Slough EMU vision is to integrate agriculture, natural habitats, and urban development in a manner that supports ecological health.

Stage 1 Expectations

No expectations were specified in the ERPP for the Yolo Basin EMZ. However, the visions described above lay out the plan ERP had for the area during Stage 1 and beyond.

Changes Attributable to ERP

Yolo Basin Ecological Management Zone-Wide Projects

A total of 15 restoration projects ($10,777,380) have been funded for work within the Yolo Basin (Table 2). These projects are expected to be fully implemented by June 2008.

Cache Creek Ecological Management Unit

The objective of the *Regulatory Activities of Inactive Mine Sites Affecting Delta Water Quality Project* (**ERP-03-C03**) was to prepare waste discharge requirements and enforcement orders for inactive mercury mines that are affecting Bay-Delta water quality. As a result, the Central Valley Regional Water Quality Control Board issued a draft cleanup and abatement order to the U.S. Bureau of Land Management (BLM) for the Rathburn and Rathburn-Petray Mercury Mines in Colusa County. The discharge from the mines enters Cache Creek from Bear and Sulphur Creeks. Under terms of the order, the BLM will be required to conduct a variety of actions and prepare a site assessment plan, public participation plan, final site assessment report, feasibility study/remedial options evaluation report, conduct a well water survey, and prepare a health risk assessment. Additional information on mercury-related projects is reported in the section addressing mercury.

The Cache Creek Settling Basin Feasibility Study Phase 3: Cache Creek Mercury Sampling Program (**ERP-01-C07-D**) assessed the potential for increasing sediment deposition and mercury removal in a proposed flood control structure at the mouth of Cache Creek. The overall objective of the effort could lead to increased sediment and mercury deposition while improving the quality of Cache Creek outflows, especially as

Cache Creek has been identified a major source of mercury loads discharged into the Delta.

The Cache Creek Feasibility Study has identified six draft alternative strategies that include combinations of baseline (no additional actions), excavation, raising the weir early or late, and enlarging the size of the settling basin. Table 1 compares the performance rating of each alternative by evaluation criteria.

Table 1. Comparison of alternative strategies from the Cache Creek Feasibility Study

Alternative	Evaluation Criteria				
	Cost ($)	Effectiveness (Mercury Trapping Efficiency)	O&M Effort	Potential Implementability	Public Acceptability
- Baseline	--	52%	Low	High	High
- Raise Weir Early	5,860,000	60%	High	High	Medium
- Excavate	3,600,000	58%	High	High	Low
- Enlarge Basin	14,300,000	55%	Medium	Low	High
- Excavate and Raise Weir Early	9,500,000	63%	High	High	Low
- Enlarge Basin and Raise Weir Early	20,200,000	61%	High	Low	Medium

No preferred alternative is identified through the Cache Creek program. Amounts of sediments trapped range from 52 to 63% which also mirrors the mercury trapping efficiency. The amount of sediment captured is large. For example, the excavation of the settling basin would consist of removing approximately 500,000 cubic yards of soil over an area of approximately 900 acres every 5 years. The Program also found that any alternative needs to include some element of increased, regular sediment removal to prolong the life of settling basin; otherwise, even with the baseline project, the settling basin will fill with sediment, which will impact areas upstream and downstream, and increase flood risk in the future.

The Program is valuable in describing actions that could be implemented in the future to reduce sediment input to the Yolo Bypass and in reducing the quantities of mercury that enter the Bay-Delta system. Additional information on mercury-related projects is reported in the section of this report addressing mercury.

The Habitat Restoration/Flood Control Bypasses System Project (**ERP-98-A02**) was funded to evaluate restoration needs and opportunities, reduce fish stranding, and improve connectivity between the Sacramento River and the north Delta. The major deliverable of this multi-agency effort was the preparation of a plan that assesses the feasibility of managing a portion of the Yolo Bypass floodplain to support aquatic species. This project is discussed in greater detail in the Putah Creek chapter.

The Yolo Bypass Fish Habitat Project (**ERP-96-M13**) provided an opportunity to examine the relationship between the Yolo Bypass and the estuary. This was a multi-partner effort to examine the feasibility of managing a portion of the Yolo Bypass to improve habitat for aquatic species, particularly Chinook salmon and splittail. This effort emphasized that there was a universe of legal and regulatory compliance issues that would arise for long-term and short-term restoration strategies proposed for the Bypass. The 1997 study provided seining data on salmon length gathered at ponds formed by receding floodwaters. Mean salmon size increased faster in the Bypass than in the Sacramento River, suggesting better growth rates. An estimate of salmon stranding was developed and estimated at a few hundred thousand fish. The Bypass appears to be a valuable link in the downstream estuarine food web (California Department of Water Resources 1998). Sampling in 1998 suggested that the bypass produced large pulses of phytoplankton downstream in the estuary following successive filling and draining cycles of the floodplain (California Department of Water Resources 1999).

Overall, the studies found that the bypass supported at least 40 species of fish including delta smelt, steelhead trout, sturgeon, and winter-run Chinook salmon. Suggested habitat improvements for the system included modifications to increase the frequency and duration of flooding, recommendation for a no net loss policy for seasonal floodplains, modification of weirs to reduce fish passage and stranding problems, and improved connectivity between floodplain ponds and the Toe Drain to lessen stranding. Organic carbon studies suggested that the Bypass is a primary pathway for organic carbon to enter the estuary which relies heavily on detrital sources.

The *Arundo donax Eradication and Coordination* project (**ERP-02D-P68**) continued and expanded giant reed control efforts begun under an earlier phase. Project expansion during this phase included the addition of Cache Creek and Putah Creek as partners. The objective of this project is to complete the inventory of various streams in the Upper Cache Creek Watershed. The main emphasis has been on the eradication of *Arundo* from already identified sites (approximately 300 sites) and newly identified sites within the Upper Cache Creek watershed, and the effectiveness monitoring of treatment. All necessary permits were obtained and work commenced upstream and worked downward.

The project has four phases:

- Phase I: Work with landowners to secure written permission to access private property for surveying and eradication work, and locate, map and prioritize the *Arundo* infestations.
- Phase II: Complete the inventory of the Upper Cache Creek Watershed.
- Phase III: Eradication of *Arundo*, which is the main focus of project.

- Phase IV: Monitoring of eradicated sites, including retreatment if necessary. Numerous sites were treated, and where necessary, retreatment has been completed.

The *Yolo Bypass Management Strategy, Phase II* (**ERP-01-N12**) was implemented and continued ongoing technical research, planning, and stakeholder development efforts begun under and earlier project, *Watershed Restoration Strategy for the Yolo Bypass* (**ERP-98-E11**).

Ecological and Economic Costs and Benefits of Alternative Agricultural Practices Project (**ERP-02-P36**) was funded to investigate agricultural practices in row cropping systems and to evaluate winter runoff and alternative farming practices. The program produced numerous press releases, journal articles, a photo library, and public outreach materials.

The *Two-Dimensional Detailed hydraulic Model for Determining Flood Conveyance Impacts of Ecosystem Restoration Projects in the Yolo Bypass* (**ERP-02-C04-D**) provided updated topographic data and improvement of the existing Yolo Bypass RMA-2 2-D hydraulic model. The model's geometry was updated and refined, calibrated, validated, and tested.

Putah Creek Ecological Management Unit

The At-Risk Plant Species, Habitat Restoration and Recovery, and Non-Native Invasive Species Management Project (**ERP-02-P46**) provided funding to the Yolo County Planning and Public Works Department to protect, manage and restore habitat quality of vernal pool wetlands on 320 acres in Yolo County at the McClellan Air Force Base's Davis Communication Site in Davis. The project provided a draft and final biological assessment for a non-native invasive plant species eradication experiment. A Final Conservation Management Plan was also produced.

The proposed action included scientific studies and experiments to determine the most effective methods to eradicate NIS in different areas of the proposed management site. The overall effort was to aid in the recovery of Crampton's tuctoria, alkali milk vetch, and other special status plant species. Invasive species included yellow star thistle, medusa head, and pepperweed.

Yolo County produced a variety of reports including a baseline conditions report that included a site description, vernal pool mapping, topographic survey, descriptions of soils, hydrology, plant communities, at-risk and rare plants, and non-native invasive species and wildlife. Yolo County also produced a final monitoring report for the site and a final monitoring and adaptive management plan.

Overall, the data generated from the Project were incorporated into the USFWS vernal pool recovery plan for California and Oregon and the Yolo County HCP/NCCP, and is the

basis of the multiple species Conservation and Management Plan that was prepared for Yolo County. The County was successful in obtaining a grant under the Central Valley Project Conservation Program for restoring areas of degraded vernal pools on the site for the reintroduction of the At-Risk species that will help to meet recovery goals.

The Pacific Flyway Center Initial Planning Project (**ERP-02D-P60**) was funded to investigate the potential for an educational and interpretive center on a 69-acre parcel acquired by the Wildlife Conservation Board in 2001. The parcel is in close proximity to the Vic Fazio Yolo Wildlife area and the City of Davis wetlands. One of the deliverables produced was a capital outlay budget change proposal for the California Department of Finance. This document provided information on the design, engineering and construction of the proposed Pacific Flyway Center building, parking area, building infrastructure, and immediate building surroundings. The Department of Fish and Game prepared an initial study for the project and issued a Notice of Determination for the Pacific Flyway Center Initial Study/Mitigated Negative Declaration.

The Yolo Bypass Fish Habitat Project (**ERP-96-M13**) provided an opportunity to examine the relationship between the Yolo Bypass and the estuary. See the write-up in the previous Cache Creek section for more information.

The *Arundo donax Eradication and Coordination* project (**ERP-02D-P68**) continued and expanded on giant reed control efforts begun under an earlier phase. Project expansion during this phase included the addition of Cache Creek and Putah Creek as partners (see the Cache Creek section for more information).

The *Yolo Bypass Management Strategy, Phase II* (**ERP-01-N12**) was implemented and continued ongoing technical research, planning, and stakeholder development efforts begun under and earlier project, *Watershed Restoration Strategy for the Yolo Bypass* (**ERP-98-E11**).

The Ecological and Economic Costs and Benefits of Alternative Agricultural Practices Project (**ERP-02-P36**) was funded to investigate agricultural practices in row cropping systems and to evaluate winter runoff and alternative farming practices. The program produced numerous press releases, journal articles, a photo library, and public outreach materials.

The *Habitat Restoration/Flood Control Bypasses System* project (**ERP-98-A02**) evaluated restoration opportunities and needs in the Yolo Bypass. A result of this project was the completion a cooperative study that assessed the feasibility of managing a portion of the Yolo Bypass floodplain to support aquatic species (Natural Heritage Institute et al. 2002). The report also developed a long-term adaptive management plan for the Bypass and presented conceptual models and a proposed monitoring plan. The planning team developed several restoration alternatives and recommended an alternative for demonstration-scale managed floodplain inundation. Putah Creek was identified as the most promising location for construction of a pilot

scale demonstration project. Potential actions included various combinations for channel realignment, checking dam operation, and floodplain excavation. One Putah Creek scenario would inundate a substantial area of floodplain habitat (up to 1,100 acres), would create an opportunity to improve fish passage to allow Chinook salmon better access to Putah Creek, and would mesh with the existing topography to simulate historical alignment and floodplain features of Putah Creek.

One journal article resulting from this work observed that the Yolo Bypass provided better rearing and migration habitat for juvenile Chinook salmon than adjacent river channels. During 1997 and 1998, salmon increased in size at a substantially greater rate in the inundated floodplain than in the Sacramento River (Sommer et al. 2001).

The *Two-Dimensional Detailed hydraulic Model for Determining Flood Conveyance Impacts of Ecosystem Restoration Projects in the Yolo Bypass* (**ERP-02-C04-D**) provided updated topographic data and improvement of the existing Yolo Bypass RMA-2 2-D hydraulic model. The model's geometry was updated and refined, calibrated, validated, and tested.

The *Lower Putah Creek Watershed Stewardship Program* (**ERP-98-E16**) contributed to a community-based watershed stewardship program for lower Putah Creek to restore ecosystem processes, reduce environmental stressors, and integrate aquatic and riparian habitat enhancement, vegetation management, water quality protection and improvement, agricultural economic viability and water use, and public education. The program built on previous public involvement and stakeholder outreach programs to identify and prioritize the major resource issues and planning objectives, built consensus among interested parties, and ensured that the watershed strategy addresses the needs and concerns of the stakeholders while respecting the rights of private individuals. This project organized the stewardship group; collected, analyzed, and presented resources information needed to develop the watershed strategy; conducted meetings and workshops; solicited input from resources agencies; and prepared a watershed strategy.

Solano Ecological Management Unit

No projects were funded in the Solano Ecological Management Unit.

Willow Slough Ecological Management Unit

The Sustaining Agriculture and Wildlife Beyond the Riparian Corridor Project (**ERP-01-N25**) was funded to assess watershed conditions and test the efficacy of agricultural conservation practices primarily for water quality and wildlife benefits in the lower Union School Slough Watershed. This project conducted a limited-scope watershed assessment, prepared specific watershed improvements, increased landowner awareness of implementation practices and engaged their participation in watershed

restoration projects, and developed an internet-based conservation decision-support tool for landowners and professionals.

The Willow Slough Watershed Rangeland Stewardship Program (**ERP-01-N31**) builds on the effort from the previously described Union School Slough Watershed Improvement Program. The program collected data from 17 rangeland project sites on five properties including two cattle ranches, one sheep ranch, on orchard/open space property, and one residential ranchette.

One specific effort was the development of a habitat management plan for the Black Family property on the foothills of the inner Coast Range west of Esparto. Efforts included establishing pond and riparian vegetation, native grassland restoration, and a variety of erosion control practices and wildlife enhancements.

Another project funded through this Program was the development of a habitat management plan for Chapman Reservoir which is owned and managed by the Yolo County Flood Control and Water Conservation District. The purpose of the Chapman Reservoir project was to enhance wildlife habitat and to help stabilize the banks of the reservoir by establishing native trees, shrubs and herbaceous plants around its perimeter.

The Union School Slough Watershed Improvement Program (**ERP-98-E13**) conducted four upper watershed riparian restoration programs, four upper watershed rangeland restoration programs, constructed six tailwater ponds, and conducted revegetation of one irrigation canal, and conducted one lower watershed riparian restoration project (Audubon California 2002). Rangeland enhancements include control measures for medusa head, goat grass, and yellow star thistle. Numerous prescribed burns were conducted to eradicate invasive weeds and restore perennial grasslands. Much effort went into landowner training and workshops. One workshop was “Using Prescribed Fire for Grassland Restoration and Vegetation Management” (Audubon California 1999).

Project Summary Table

Table 2. Yolo Basin Ecological Management Zone Project Summary

Cache Creek Ecological Management Unit				
ERP Project Number	**Project Name and Description**	**End Date**	**Total Funding**	**Project Status**
ERP-01-C07-D	**Cache Creek Settling Basin Feasibility Study** This study investigates the feasibility of enhancing a flood control basin on Cache Creek to trap mercury laden sediments from the Cache Creek watershed (including abandoned mercury mines) and prevent the movement of mercury into the Yolo Bypass and Delta.	12/31/2006	$97,620	Ongoing. Most of the tasks are complete. The Feasibility Study Report is a draft.
ERP-01-N12	**Yolo Bypass Management Strategy, Phase II** The objective of this project is to continue the technical research, planning, and stakeholder development efforts begun under the current Management Strategy project to ensure existence of the necessary data, assurances, and support for implementation of potential habitat enhancement projects of the Yolo Bypass. This project continues the efforts begun under ERP-98-E11.	12/31/2006	$284,142	Complete. Prepared the Lower Yolo Bypass Stakeholder Process Feasibility Assessment, and recommend a collaborative stakeholder process to address lower Yolo Bypass conditions.
ERP-02-C04-D	**Two-Dimensional Detailed Hydraulic Model for Determining Flood Conveyance Impacts of Ecosystem Restoration Projects in the Yolo Bypass** The objective of this project is the topographic update and improvement of the existing Yolo Bypass RMA-2 2-D hydraulic model. The model's geometry would be updated and refined, calibrated, validated, and tested.	6/1/2006	$500,257	Complete. Final Report titled: "Yolo Bypass 2-D Model Update and Revision: Revised Project Management Plan" completed in 2004.
ERP-02D-P68	***Arundo donax* Eradication and Coordination** This is Phase II of the *Arundo donax* eradication and coordination project. Phase II provides funding for ongoing monitoring and follow-up treatments for Phase I projects, and added 5 new partners. This project aims to remove approximately 273 acres of Arundo on over 63 miles of rivers and creeks.	3/15/2009	$2,033,859	Ongoing.
ERP-02-P36	**The Ecological and Economic Costs and Benefits of Alternative Agricultural Practices** The purpose of this research project is to study the effects of conservation tillage and cover cropping on several sensitive resources. The project goal is to quantify the ecological and economic costs and benefits of alternative agricultural practices in irrigated row cropping systems, at the farm and societal levels. Tasks include: 1) Measure quantity and quality of winter runoff at several sites; 2) Evaluate alternative farming systems for feasibility, sustainability, ecological and economic costs; Demonstrate the farming systems under study and disseminate research results.	6/1/2008	$1,402,159	Ongoing. UC Davis produced extensive public outreach materials and conducted field tours. Multiple reports have been completed.

ERP-03-C03	**Regulatory Activities of Inactive Mine Sites Affecting Delta Water Quality** This project provides for CVRWQCB staff to prepare waste discharge requirements and enforcement orders to reduce discharges from inactive mercury mines in the CA Coastal mountains that are affecting Bay Delta water quality.	12/31/2005	$100,000	Ongoing. CVRQCB issued a draft Cleanup and Abatement Order to BLM owned properties.
ERP-96-M13	**Yolo Bypass Fish Habitat** The objectives for this study are to examine the relationship between the Yolo Bypass and the rest of the Estuary and to develop recommendations for restoration actions that would improve Bypass habitat for fisheries and other aquatic organisms.	11/30/2000	$226,000	Complete. DWR provided reports, results and recommendations for Yolo Bypass Studies.
ERP-98-A02	**Habitat Restoration/Flood Control Bypasses System** Project evaluated restoration needs and opportunities to improve habitat, reduce stranding and improve connectivity with the Sacramento River and the north Delta.	12/31/2002	$1,200,000	Complete. Project partners completed a report "Habitat Improvement for Native Fish in the Yolo Bypass". A journal article was also prepared: Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival
ERP-98-E11	**Watershed Restoration Strategy for the Yolo Bypass** Facilitate broad based local stakeholder group in development of watershed plan.	6/29/2000	$244,188	Complete.
Putah Creek Ecological Management Unit				
ERP-01-N12	**Yolo Bypass Management Strategy, Phase II** The objective of this project is to continue the technical research, planning, and stakeholder development efforts begun under the current Management Strategy project to ensure existence of the necessary data, assurances, and support for implementation of potential habitat enhancement projects of the Yolo Bypass. This project continues the efforts begun under ERP-98-E11.	12/31/2006	$284,142	Complete. The Center for Collaborative Policy prepared the Lower Yolo Bypass Stakeholder Process Feasibility Assessment and recommended a collaborative stakeholder process be convened to address lower Yolo Bypass conditions. (01-N21-FS_8-12-05_LYB_Feasibility_Assessment.pdf)
ERP-02-C04-D	**Two-Dimensional Detailed Hydraulic Model for Determining Flood Conveyance Impacts of Ecosystem Restoration Projects in the Yolo Bypass** The objective of this project is the topographic update and improvement of the existing Yolo Bypass RMA-2 2-D hydraulic model. The model's geometry would be updated and refined, calibrated, validated, and tested.	6/1/2006	$500,257	Complete. Final Report titled: "Yolo Bypass 2-D Model Update and Revision: Revised Project Management Plan" completed in 2004.

ERP-02D-P60	**Pacific Flyway Center Initial Planning Project** The purpose of this project is to fund the initial planning phase of the Flyway Center (PFC), a proposed educational and interpretive center intended to serve the general public. This project proposes to investigate the potential for development of an on the 69-acre parcel site in close proximity to the Vic Fazio Yolo Wildlife area and the City of Davis' wetlands. The ultimate facility and site is anticipated to include the wetland habitats, trails, and a 12,000 square foot building presenting educational programs based on regional ecosystems, the functions of the Bypass, and showcasing an array of ERP actions.	1/3/2008	$334,021	Ongoing. Project partners completed a Capital Outlay Budget Change Proposal for the Yolo Wildlife Pacific Flyway. EDAW prepared the Pacific Flyway Center Initial Study/Mitigated Negative Declaration for the Pacific Flyway Center for DFG DFG issued a Notice of Determination for the Pacific Flyway Center Initial Study/Mitigated Negative Declaration
ERP-02D-P68	***Arundo donax* Eradication and Coordination** This is Phase II of the *Arundo donax* eradication and coordination project. Phase II provides funding for ongoing monitoring and follow-up treatments for Phase I projects, and added 5 new partners. This project aims to remove approximately 273 acres of Arundo on over 63 miles of rivers and creeks.	3/15/2009	$2,033,859	Ongoing.
ERP-02-P36	**The Ecological and Economic Costs and Benefits of Alternative Agricultural Practices** The purpose of this research project is to study the effects of conservation tillage and cover cropping on several sensitive resources. The project goal is to quantify the ecological and economic costs and benefits of alternative agricultural practices in irrigated row cropping systems, at the farm and societal levels. Tasks include: 1) Measure quantity and quality of winter runoff at several sites; 2) Evaluate alternative farming systems for feasibility, sustainability, ecological and economic costs; Demonstrate the farming systems under study and disseminate research results	6/1/2008	$1,402,159	Ongoing. UCD produced public outreach materials, conducted field tours, and completed several reports including: -A Natural Resource Economics Taxonomy for Agricultural Sustainability Indicators -Rainfall dynamics at the sustainable agriculture farming systems (SAFS) project site in California's Sacramento Valley -Economic Benefits, Costs, and Sustainability of Alternative Farming Systems and Sustainability Indicators -Weed Control, yield, and Quality of Processing Tomato Production Under Different Irrigation, Tillage, and Herbicide Systems

ERP-02-P46	**At-Risk Plant Species, Habitat Restoration and Recovery, and Non-Native Invasive Species Management** This project worked to protect, manage and restore habitat quality of vernal pool wetlands, particularly for Crampton's tuctoria and alkali milk vetch, through eradication of non-native invasive species on 320 acres in Yolo County.	6/30/2006	$400,000	Complete. Documents completed for the McClellan Air Force Base's Davis Global Communications site: Biological Assessment for a non-native species; eradication experiment Baseline Conditions Report; Final Conservation Management Plan.
ERP-96-M13	**Yolo Bypass Fish Habitat** The objectives for this study are to examine the relationship between the Yolo Bypass and the rest of the Estuary and to develop recommendations for restoration actions that would improve Bypass habitat for fisheries and other aquatic organisms.	11/30/2000	$226,000	Complete. DWR provided reports, results and recommendations for Yolo Bypass Studies.
ERP-98-A02	**Habitat Restoration/Flood Control Bypasses System** Project evaluated restoration needs and opportunities to improve habitat, reduce stranding and improve connectivity with the Sacramento River and the north Delta.	12/31/2002	$1,200,000	Complete. Project partners completed a report "Habitat Improvement for Native Fish in the Yolo Bypass". A journal article was also prepared: Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival
ERP-98-E11	**Watershed Restoration Strategy for the Yolo Bypass** Facilitate broad based local stakeholder group in development of watershed plan.	6/29/2000	$244,188	Complete.
ERP-98-E16	**Lower Putah Creek Watershed Stewardship Program** This project developed a community-based watershed stewardship program from the lower Putah Creek through a collaborative process involving stakeholders, landowners, state and federal resources agencies, and local groups.	5/31/2002	$100,500	Complete.
Willow Slough Ecological Management Unit				

ERP-01-N25	**Sustaining Agriculture and Wildlife Beyond the Riparian Corridor** This project represents a collaborative effort between many local, state, and federal organizations to assess watershed conditions and test the efficacy of agricultural conservation practices, primarily for water quality and wildlife benefits in the Bay-Delta. This project is expected to result in 1) a working assessment of the Union School Slough watershed; 2) installation of conservation sites; 3) quantified and published results of water quality and wildlife habitat benefits of all practices, including those along canals and stream banks; 4) a beta-stage conservation planning-assistance tool (OnePlan); and 5) a highly directed project outreach program. All these products are expected to lead to more resource and habitat conservation activities in the watershed and throughout the county and Bay-Delta region.	2/7/2007	$1,464.167	Complete. Yolo County Resource Conservation District prepared the following: - Ecological Monitoring Plan - Final Report. - Sustaining Agriculture and Wildlife Beyond the Riparian Corridor (Lower Union School Slough Watershed Improvement Program).
ERP-01-N31	**Willow Slough Watershed Rangeland Stewardship Program** This project builds upon the efforts of a previously funded project (ERP-98-E13) in the Union Slough watershed to develop an expanded watershed stewardship program to the greater Willow Slough watershed. The main goals of this project are to enhance and restore riparian and grassland habitats, improve forage quality, improve water quality, and reduce erosion. The project will initiate systematic efforts to assess the contribution of restoration and conservation activities to overall watershed health. This data-driven approach, undertaken together with farm- and ranch-owner participants will provide needed information to feed back into an adaptive management program. It will also provide effective models for partnering with agriculture. www.plantbiology.msu.edu/malmstrom/Audubon/index.htm	12/31/2005	$1,800,668	Complete. Audubon California prepared numerous reports and brochures for this project including: -Frequently Asked Questions about Restoration Site Maintenance. -Final Report and Project Habitat Management Plan for the Black Family Property. -Final Report and Project Habitat Management Plan for the Chapman Reservoir.

ERP-98-E13	**Union School Slough Watershed Improvement Program** The Yolo RCD together with Audubon-California enacted portions of the 1996 Willow Slough Integrated Resources Management Plan, which Union School Slough is a part. Project staff worked with the landowner group and an advisory committee comprised of stakeholder agencies to implement a set of conservation and restoration practices, identified further opportunities and project partners, overcome barriers and constraints, and disseminate technical, practical, and legal information. This watershed model can be replicated throughout the greater Bay-Delta ecosystem. Nine project tasks included: 1) convening a landowner stewardship group and advisory committee, 2) landowner training workshops, 3) upper slough riparian restoration, 4) upper slough restoration, 5) construction of hill ponds for wildlife, 6) construction of tailwater ponds, 7) revegetation of irrigation canals, 8) lower slough and floodplain planning and restoration, and 9) project management and administration, reporting, and legal compliance. Created implementation and monitoring plans for restoration sites.	7/10/2002	$636,000	Complete. Audubon California prepared a series of implementation plans for properties in the watershed and provided a final report and also conducted extensive landowner training in conservation management practices.

Other Programs Contributing to ERP Vision

In addition to the targets and objectives set forth in the ERPP, the following integration issues, constraints, and opportunities were identified for restoration activities within the Yolo Bypass. Although only a portion of the Bypass is within the Yolo Basin EMZ, the constraints and opportunities are relevant.

Overall, the intent is to increase the ecological benefits from existing flood bypasses so that they provide improved habitat for waterfowl, fish spawning and rearing, and possibly as a source of food and nutrients for the estuarine foodweb. For example, when the Yolo Bypass is flooded, it effectively doubles the wetted surface area of the Delta, mostly in shallow-water habitat. More frequent inundation of existing flood bypasses could expand the ecosystem benefits that they provide, but managing the bypasses for the benefit of fish and wildlife must be balanced with their use for flood control and farming. Achieving this balance of flood management, land use, and ecosystem benefits will require activities such as:

- Evaluating structural alternatives for directing water into bypasses so that they inundate more frequently.
- Experimenting with different inundation scenarios to study fish and wildlife preferences and benefits.
- Examining how ecosystem habitats affect flood conveyance of bypasses.
- Evaluating the relative importance of flood bypass contributions to estuarine foodweb productivity.

- Studying what multiple uses are compatible in flood bypasses (e.g. what types of agricultural practices used in the bypasses and what types of fish and wildlife use are and are not compatible).

Because of the importance of the Yolo Bypass, the ERP Independent Science Board convened an Adaptive Management Workshop in 2002 to look at several restoration areas including the Yolo Bypass. The summary of the workshop found that the Yolo Bypass is well suited for adaptive management. It is a large, highly visible project near a metropolitan center, close to agency and university support, with a high potential for habitat enhancement with minimal alterations. The opportunities for adaptive management on the Yolo Bypass include:

- ***Land***: Through recent acquisitions, there are now over 16,000 acres available for habitat restoration by State and Federal agencies. Larger areas could potentially be included after coordination with local landowners and wildlife organizations. The area of floodplain that can be inundated is large enough to incorporate different habitat features.
- ***Land Use***: The proposed actions are reasonably consistent with existing land uses but need further evaluations. The timing, duration, and frequency of operation of current weirs may conflict with agricultural operations which could impact agriculture in the bypass.
- ***Water***: Procuring increased flows through dam releases for floodplain inundation on Sacramento and San Joaquin River tributaries is typically a major constraint to floodplain adaptive management. However, most of the water used to inundate the Yolo Bypass is returned to the river as it enters the Delta, so there is little net consumptive loss. Since water flowing through the Bypass is returned to the Delta before the major diversions, water rights may be less of an issue.
- ***Flexibility***: Successful adaptive management requires the ability to make adjustments to the project as the study progresses. Minor modifications to the Fremont Weir or changes in operation of the Sacramento Weir could drastically alter periods of inundation in the Bypass. Modifications to the Lisbon Weir, Fremont Weir, the Tule Canal and Toe Drain would affect fish passage to varying degrees. Most of these changes would be done incrementally and would be reversible if adverse effects are detected.
- ***Low Cost of Error***: The actions to be taken will involve changes in seasonal floodplain inundation and will not result in the permanent loss of resources or land. Since almost all the actions being considered are easily reversed, any adverse effects detected through monitoring such as mercury methylation or organic carbon production could be addressed.
- ***Availability of Baseline Data***: Pre-project data is available through recent studies in the Yolo Bypass. Data from ongoing studies on the Cosumnes River will also provide a reference and control to actions taken. Long term monitoring of the Delta by the Interagency Ecological Program and its agencies will also

provide a good baseline to examine system-wide responses and background variability of the biota.

- ***Time Scale***: Previous research on the Yolo Bypass and Cosumnes River suggests that lower trophic levels respond to floodplain inundation on a scale of weeks. Higher trophic levels such as fish or macroinvertebrates respond on an order of months. These time scales provide the opportunity to make adjustments between years or even within the seasons.
- ***High Signal to Noise Ratio***: Through previous studies, it is apparent that experimental floodplain restoration studies will yield statistically useful data. Statistically significant differences in the aquatic biota of river channel versus floodplain habitat have been observed, and detection of changes in lower trophic level biomass between the inlet and outlet of the floodplain has also been achieved.
- ***Strong Downstream Benefits***: Previous studies suggest that increased floodplain area and inundation may benefit the downstream Estuary. Adaptive management studies utilizing manipulation of flood flows, periods of inundation and extent of inundation may provide additional enhancement of the estuarine food web.

Status of Area Today

The Yolo Bypass remains an area of great interest and encompasses portions of the Yolo Basin EMZ and the Sacramento-San Joaquin Delta EMZ (the Yolo Bypass is also discussed in the section on the North Delta EMU within this report). The projects funded thus far have helped to better define the value of the bypass as seasonal habitat for MSCS fish species. The studies have also improved our knowledge of the role of the bypass in supporting local and Delta zooplankton species and organic carbon input which could benefit MSCS species in the Delta. The areas in which we have made significant progress in better defining the ecological problems, developing restoration strategies, and implementing restoration/management actions in the Yolo Basin EMZ include:

- The ecological and biological value of seasonal flooding.
- The role of wildlife refuges and wetlands in supporting dependent species.
- Better understanding of fish passage needs and stranding problems.
- The contribution of Cache and Putah Creeks to flooding.
- The control of invasive weeds species in upland areas.
- Watershed management and improvements at the local level.
- Restoration of perennial grasslands.
- Opportunities to reduce sediment and mercury input reduction to the Delta.

Generally, we know much more about the Yolo Basin EMZ now than when the ERP was released in July 2000. This is a direct result of providing funding for a wide variety of

monitoring, research, implementation, planning, and educational programs that focused on the Cache Creek, Putah Creek, Solano, and Willow Slough watersheds and the Yolo Bypass.

Some of the key points that resulted from efforts throughout the Yolo Basin EMZ, and the Yolo Bypass in particular, is that the there is an increased public dialog regarding "restoration" activities in the Zone, a need to reevaluate restoration targets and actions, an overwhelming need to fully integrate local property rights and landowner concerns in to the planning and implementation of revised targets, and a need to base recommendations on science.

Contaminant input to the basin and downstream areas, including the Delta, are potentially addressed by the Cache Creek settling basin and proposed actions to remediate mercury from abandoned mines on BLM-owned lands in the watershed. These types of actions will provide reductions in sediment and mercury input to the system.

Land uses in the basin, particularly grazing and row crops may benefit from efforts to support local land and watershed management actions to improve rangelands and perennial grasslands. Efforts to identify means to implement conservation tillage as a standard agricultural practice could reduce sediment input by improving the quantity and quality of winter runoff. But much still needs to be done in this area.

Although the ERP did not specify actions to improve or support educational and interpretive facilities, public education regarding ecosystem management is extremely valuable to develop additional support for habitat restoration. The Pacific Flyway Center is an example of how the general public can become informed and support wildlife habitat restoration and management.

Improvement of the sediment trapping efficiency of the Cache Creek Settling Basin (*Cache Creek Settling Basin Feasibility Study* (**ERP-01-C07-D**)) has been identified as one of the most cost-effective ways to reduce loads of mercury and methylmercury in the Yolo Bypass, one of the largest contributors of these contaminants to the Delta (Wood et al. 2006, Stephenson et al. 2007).

There is a need to complete a feasibility study for the improvement of sediment trapping efficiency of the Cache Creek Settling Basin. This project is important for local flood control, but mercury issues have not yet been adequately addressed. There is a need to determine environmentally safe uses for the trapped and subsequently excavated material. It is currently unknown whether the material would be suitable for application on agricultural fields, for use by Yolo County at their landfill for construction and waste disposal operations, or for levee construction. It needs to be determined whether the characteristics of this sediment, in terms of mercury concentration and speciation, organic carbon content and quality, and other properties, make it likely to

contain mercury that would be available for methylation and possible release to the environment in these settings (Alpers 2007).

Planned Projects for Implementation

Many of the projects described thus far have had strong planning components with limited project implementation. Clearly, efforts to improve floodplain inundation, reduce contaminants, improve fish passage in the Yolo Bypass and Cache and Putah creeks, reduce stranding of native fish species, establish a habitat migration corridor between the Sacramento River on the north and the Delta on the south, and to provide educational opportunities for the general public should be implemented.

We have learned much regarding the ecological and biological value of seasonal flooding. Still, implementable projects in the Yolo Basin EMZ have not yet to come to fruition. The opportunities most likely align with State-owned lands in the Zone. For example, plans addressing lower Putah Creek realignment and floodplain restoration should be refined and implemented. In all likelihood, State-owned lands within the Yolo Basin EMZ may be the foundation for restoration actions within the EMZ to improve wetland habitats, improve floodplain inundation, and improve fish passage into Putah Creek.

Efforts to reduce mercury and sediment input to the EMZ have value, but projects need to be evaluated in the context of a larger, comprehensive view of mercury in the entire system. This is discussed in the chapter on mercury.

The *Arundo donax Eradication and Coordination* project (**ERP-02D-P68**) is continuing Arundo treatment and monitoring in the Cache Creek EMU. The *Regulatory Activities of Inactive Mine Sites Affecting Delta Water Quality* (**ERP-03-C03**) project is ongoing.

The *Arundo donax Eradication and Coordination* project (**ERP-02D-P68**) is continuing Arundo treatment and monitoring in the Putah Creek EMU. The *Pacific Flyway Center Initial Planning Project* (**ERP-02D-P60**) project is also ongoing.

The Department of Fish and Game has completed a draft Land Management Plan for the Yolo Bypass Wildlife Area consistent with Department policy for wildlife areas. The plan presents numerous goals including several goals for aquatic habitat. One goal is to restore and enhance aquatic ecosystems to conditions that provide desired ecological functions.

In recent years, substantial achievements have been made to restore habitat and improve flow regimes throughout the lower Putah Creek watershed. These efforts have resulted in the historic return of small Chinook salmon spawning runs in the lower creek in recent years. Continued efforts are ongoing to address remaining limiting factors

through additional collaborative restoration planning and implementation. The DFG supports the continued restoration efforts in the lower Putah Creek watershed, especially those opportunities that exist in the lowermost segment of Putah Creek that runs through the Yolo Bypass Wildlife Area.

This goal includes tasks to restore and enhance aquatic habitat and passage in the segment of Putah Creek flowing through the Wildlife Area, restoration of intertidal marsh habitat adjacent to the East Toe Drain, and reintroduction of rare native species including Sacramento perch into appropriate water bodies throughout the Wildlife Area.

Potential projects developed through the planning effort include creating a new realigned Putah Creek channel through the Tule Ranch Unit (Putah Creek from above the Los Rios Check Dam to the East Toe Drain below the Lisbon Weir). A second effort is to explore the potential for restoration of intertidal marsh habitat and/or seasonal managed floodplain habitat at the southeast portion of Tule Ranch adjacent to the East Toe Drain for the benefit of native fish species such as splittail.

Impediments to Implementation

Many actions in the future can be targeted of State owned land with this Zone. However, it is important to integrate local property rights and landowner concerns in to future planning and implementation. Landowner awareness of implementation practices and their engaged participation in watershed restoration projects is essential. For example, managing the bypasses for the benefit of fish and wildlife must be balanced with use for flood control and farming.

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APPENDIX A

A.11. EASTSIDE DELTA TRIBUTARIES ECOLOGICAL MANAGEMENT ZONE

Introduction

The Eastside Delta Tributary Ecological Management Zone (EMZ) is located east of the San Joaquin River and lies between the American River basin to the north and the Stanislaus River basin to the south (Figure 1). Its eastern boundary is the Sierra foothills. The western boundary is the San Joaquin River and the Delta.

Fish and wildlife resources in the basin include fall-run Chinook salmon, steelhead, splittail, other native resident fish, Neotropical migratory birds and waterfowl. The baseline condition of the EMZ described fall-run Chinook salmon and steelhead populations as generally unhealthy due to poor habitat conditions (CALFED 2000). Therefore, achieving healthy status for these salmonid populations, as well as for splittail, was dependent on actions implemented in this zone and on complementary restoration actions in the Sacramento-San Joaquin Delta EMZ. The confluences of the Mokelumne, Cosumnes, and Calaveras rivers, as they enter the Delta, are important backwater floodplain areas that support excellent riparian habitats. These areas provide important habitat for juvenile Chinook salmon, delta smelt, splittail, giant garter snake, and sandhill crane.

Important ecological processes within the Eastside Delta Tributaries Ecological Management Zone include streamflow, stream meander, gravel recruitment and cleansing, sediment transport, flood and floodplain processes, and water temperature. Important habitats include seasonal wetlands, riparian and shaded riverine aquatic (SRA) habitat.

Notable stressors to ecological functions, processes, habitats, and resources within the zone include:

- altered instream flows,
- altered water temperature regimes,
- separation of rivers from their floodplains,
- interruption of gravel recruitment and cleansing processes,
- reduced sediment transport,
- poor land use and livestock grazing practices,
- high levels of predation on juvenile salmonids,
- entrainment of aquatic organisms in water diversions,
- restriction of fish passage at dams and diversion structures,

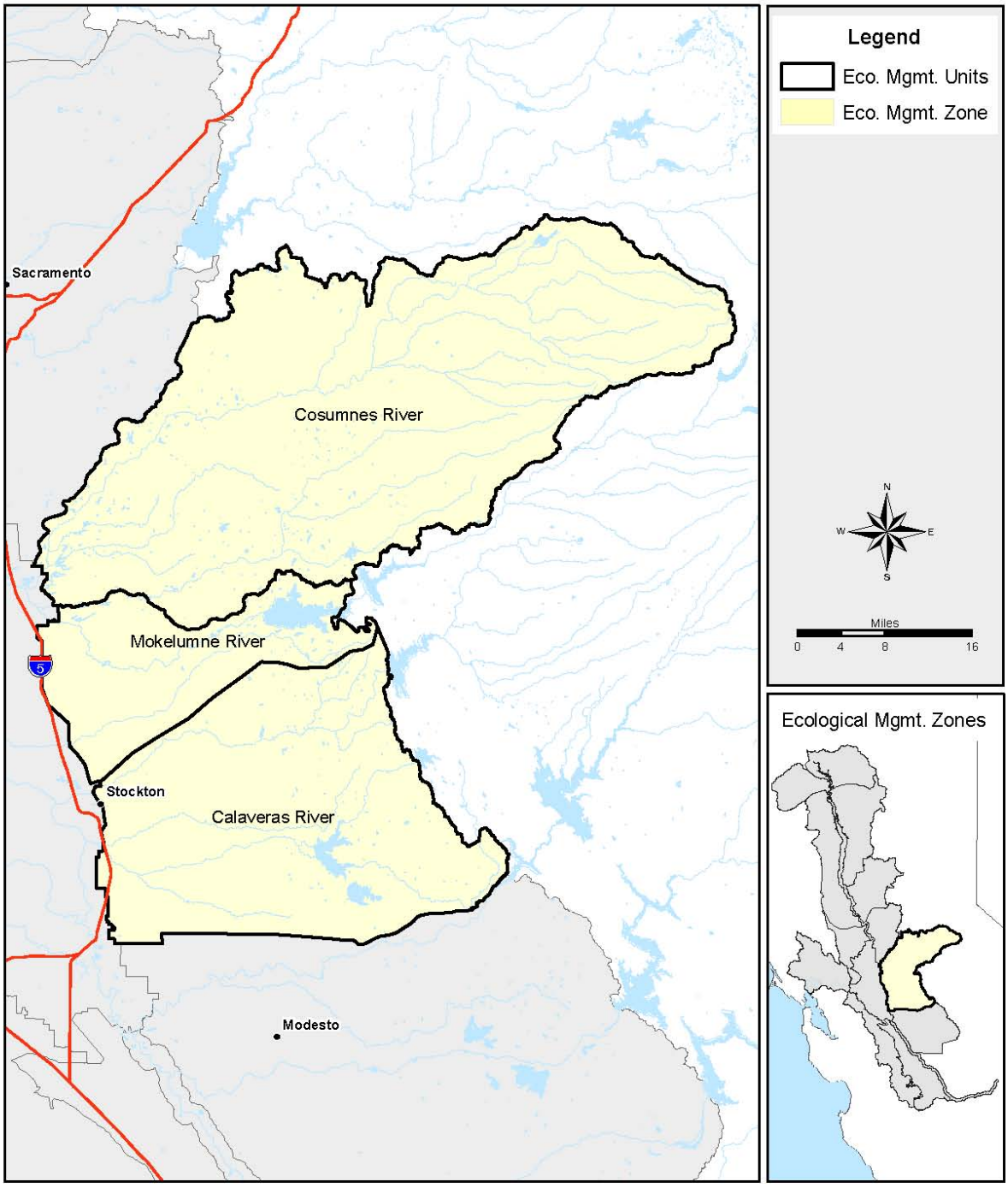

Figure 1. Eastside Delta Tributaries Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. Eastside Delta Tributaries EMZ Map

- input of contaminants,
- illegal salmon and steelhead harvest, and
- riparian vegetation removal.

The Eastside Delta Tributaries EMZ includes the three major tributaries entering the Sacramento-San Joaquin Delta on its east side. Each of the tributaries is an Ecological Management Unit (EMU) within the EMZ:

- Cosumnes River EMU
- Mokelumne River EMU
- Calaveras River EMU

Cosumnes River Ecological Management Unit

The Cosumnes River, with a watershed of approximately 1,265 square miles, drains the Sierra Nevada foothills and joins the Mokelumne River north of the town of Thornton in the Delta. Flow records are available for Michigan Bar (535-square mile watershed), located near the base of the foothills as the river flows onto the valley floor. The Sly Park Dam (Jenkinson Lake) has a capacity of 40,000 acre-feet on the North Fork Cosumnes, with a watershed of 60 square miles. Releases are primarily into the Camino conduit for irrigation in Cosumnes and South Fork American River basins (average of about 25 cubic feet per second [cfs]). There are no other major impoundments in the Cosumnes River watershed, although several agricultural diversions are located between Michigan Bar and Thornton. Due to the low elevation of its headwaters, the river receives most of its water from rainfall rather than snowmelt. The entire Cosumnes River watershed is included in this EMZ from its headwaters to the confluences with the Mokelumne River. The Cosumnes River floodplain lies primarily within the legally defined Delta boundary.

Mokelumne River Ecological Management Unit

The Mokelumne River, the largest eastside Delta tributary, drains approximately 661 square miles with its headwaters at 10,000 elevation feet on the Sierra Nevada crest. Downstream of the town of Thornton, the river splits into the North and South Fork channels. The Delta Cross Channel and Georgiana Slough divert water from the Sacramento River into the North Fork Mokelumne River channel. The river enters the lower San Joaquin River northwest of Stockton. The median historical unimpaired runoff is 696,000 acre-feet (af), with a range of 129,000 to 1.8 million af.

Calaveras River Ecological Management Unit

The Calaveras River drains approximately 362 square miles in the foothills south of the Mokelumne River with an average annual runoff of 166,000 af. The river flows through the City of Stockton and enters the San Joaquin River channel in the Delta. The

ecological management unit includes the lower Calaveras River from New Hogan Dam to the confluence with the lower San Joaquin River.

Applicable ERP Vision

The vision for the Eastside Delta Tributaries EMZ is to improve the values of the rivers and riparian zones as fish and wildlife corridors from the delta to the upland and upstream habitats; restore tidal wetlands; create and maintain permanent freshwater marshes, seasonal wetlands, floodplain habitat, and spawning areas for splittail; restore rearing, spawning, and foraging habitat for fall-run Chinook salmon and steelhead, and improve habitat for the giant garter snake. The vision focuses on improving streamflows, stream channel and gravel recruitment processes needed to support habitat for anadromous salmonids and other fish species, and restoring tidal wetlands, floodplains, seasonal floodplain inundation, and natural flood regimes.

Cosumnes River Ecological Management Unit

The vision for the Cosumnes River EMU is to restore floodplains, seasonally flooded habitat, tidal wetlands, splittail and Chinook salmon rearing habitat, sandhill crane habitat, and a riparian plant community. The fall-run Chinook salmon population can be sustained through improvements in streamflow, channel and floodplain morphology, spawning and rearing habitat, fish passage at diversion dams, and reducing losses to unscreened diversions and illegal harvest.

The vision for the Cosumnes River includes improved streamflow and riparian habitat, modified floodplain and channel conditions, and reduced fish passage problems and unscreened diversions. These actions will improve habitat conditions for fall-run Chinook salmon and other wildlife species. The flow regime is the primary factor affecting the size of the Cosumnes River salmon run. In drier years, the early portion of the run experiences difficulty negotiating the shallow bar and shoal areas.

Mokelumne River Ecological Management Unit

The vision for the Mokelumne River EMU is to support self-sustaining fall-run Chinook salmon and steelhead populations by improving streamflows, riparian and SRA habitat, natural sediment supply and gravel recruitment, and fish passage; reducing predation and illegal harvest; eliminating unscreened and poorly screened diversions; and improving and upgrading hatchery facilities and management strategies.

The vision for the Mokelumne River includes improved streamflow, gravel recruitment, floodplain configuration, fish passage, salmon spawning and rearing habitat, riparian habitat, screening of diversions, and enforcement of fishing regulations. Under this vision, the Mokelumne River would better support naturally spawning steelhead trout,

fall-run Chinook salmon, American shad, and resident native fishes. For the Mokelumne River, this means improving flows from spring through fall below Camanche and Woodbridge dams. Higher and more natural flows will help steelhead move upstream during the late fall and early winter. Higher flows will benefit downstream migrating juvenile fall-run Chinook salmon and steelhead, as well as juvenile salmon and steelhead migrating out of the Sacramento and San Joaquin Rivers and their tributaries through the Delta. These flows will also benefit stream channel and riparian vegetation processes in the lower river, which in turn will benefit fish populations.

Calaveras River Ecological Management Unit

The vision for the Calaveras River EMU is to restore and maintain important ecological processes that support a sustainable migration corridor for fall-run Chinook salmon and other terrestrial and aquatic species and their upstream habitat. This includes improved streamflow, gravel recruitment, floodplain configuration, fish passage, riparian and stream channel habitat, screening of diversions, and enforcement of fishing regulations. Proper conditions will maintain more consistent fall-run Chinook runs.

Restoring instream flows adequate to maintain anadromous fish habitat will be the focus element. Maintaining an adequate water temperature regime, improving fish passage at irrigation dams, and reducing entrainment at water diversions will also be important.

Stage 1 Expectations

The Stage 1 expectations for the Eastside Delta Tributaries EMZ was to restore and rehabilitate a contiguous corridor of riparian, shaded riverine aquatic, tidal freshwater, and seasonal and perennial habitats along the South Fork of the Mokelumne River.

Changes Attributable to ERP

Eastside Delta Tributaries Ecological Management Zone

The purpose of the *Purple Loosestrife Prevention, Detection & Control in the Sac/SJ Delta & Associated Hydrologic Units Project* (**ERP-99-F08**) was to coordinate the prevention, detection and control of purple loosestrife in the Sacramento-San Joaquin River Delta system and associated hydrological units with the CALFED Bay-Delta Program. The initial three years of the project addressed the occurrence of purple loosestrife in multiple locations in the Sacramento-San Joaquin Delta system and contiguous water basins, by implementing an adaptive management program specific to each infestation, allowing the most appropriate management technique(s) to be utilized. Over the past three years, the California Department of Food and Agriculture,

Integrated Pest Control Branch has assisted local, state, federal, and private entities in carrying out a series of tasks that have resulted in an exhaustive yearly survey of the Sacramento-San Joaquin Delta, its contiguous water basins, and adjoining watersheds; local eradication of loosestrife in the Delta and other hydrological units; focused perimeter delimitation and survey of all loosestrife infestations in the CALFED focus area; training of agency personnel, working in and near the Delta, to recognize and report purple loosestrife and other aquatic nonnative invasive species; and education of the boating, waterfowl hunting, and similar public citizenry (Butler 2003). This project directly contributed toward the ERP target to reduce the adverse effects of invasive riparian and marsh plants in the Eastside Delta Tributaries EMZ.

The *Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs Project* (**ERP-02-P17**) is an ongoing research effort designed to evaluate the results of past and current riparian bird system research and monitoring across the entire CALFED region. Information learned from this study will contribute to the successful implementation of ERP riparian and riverine aquatic habitat targets for the Eastside Delta Tributaries EMZ.

The ongoing project in which the ERP provided funds to the University of California, San Diego, Scripps Institute of Oceanography is the *Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed* (**ERP-02-P38**). The United States Geological Survey (USGS) has used the model called BIOME-BGC, which is a vegetation ecosystem process model (USGS 2007).

A suite of research and monitoring projects were undertaken on a program-wide level which contributed to the vision for artificial fish propagation in the Eastside Delta Tributaries EMZ. Together, these projects (*Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking* (**ERP-98-B15**), *Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon & Steelhead* (**ERP-99-N13**), *Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries* (**ERP-99-N13b**) have resulted in the development of recommendations regarding the coded wire tagging program in the Central Valley, specific marking, tagging and implementation recommendations associated with a comprehensive marking and tagging program, selective fishing options in the marine or freshwater environments if they are implemented in the future, and constant fractional marking levels and some of the other manipulable factors (Newman et al. 2000 and Newman et al. 2004). In addition, an ongoing project, *Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon* (**ERP-05D-S20**), will provide the basis for evaluating and revising Central Valley salmon hatchery operations, being able to track restoration of all races of Chinook salmon, tracking whether CALFED targets for

population restoration of Chinook salmon are being reached, and evaluating effects of harvest.

The ERP provided funds to the San Joaquin County School District to implement an environmental education program for grades K-12, *Delta Studies Program: San Joaquin County Schools* (**ERP-01-N38**). A curriculum was established for each grade level with a focus on the Delta environment. Thirty teachers have been trained to be part of the Delta Educational Leaders for Teaching and Action (DELTA). This project also established a Delta Resource Education Center. The project educates children about the importance of protecting the Sacramento-San Joaquin Delta Ecosystem and increases their awareness of problems and potential solutions. This project may potentially contribute toward multiple ERP targets. Specifically, the education program may have a positive impact on the following ERP targets: recovery of anadromous fish species, improved harvest management strategies for fish species, restoration of seasonal wetland, riparian and riverine aquatic habitats, limited spread of invasive and riparian and marsh plants, and reduced loadings and concentrations of toxic contaminants (San Joaquin County Office of Education 2007).

Cosumnes River Ecological Management Unit

As shown in Table 1, 14 projects (six acquisition, one implementation, three planning, and four research/monitoring) have been funded by the ERP that work toward meeting ERP targets in the Cosumnes River Ecological Management Unit (EMU). In addition, one research/monitoring project was selected for funding, but was later combined with another project. The Cosumnes River Preserve played a significant role during Stage 1 of Program implementation. Projects that contributed to the Cosumnes River Preserve will be discussed as a group. The projects that occurred outside of the Cosumnes River Preserve, but within the Cosumnes River EMU, will be discussed in a separate section.

Cosumnes River Preserve

Since the completion of what is now thought of as the Phase I restoration program, the Cosumnes River Preserve partners have acquired fee and easement interests in approximately 12,000 acres of additional land in the lower Cosumnes floodplain, for a total of 28,500 protected acres within the floodplain. A significant portion of this acreage is in the bottomlands of the river corridor, with a unique combination of soils and elevations suitable for floodplain and riparian forest if natural flooding can be restored through levee removal or breaches (Whitener 2007). The following ERP projects contributed funding toward the acquisition of approximately 4,022 acres of the floodplain acreage purchased in the Preserve: *Cosumnes Start-up Stewardship and Restoration* (**ERP-97-N14**), *Cosumnes Floodplain Acquisition and Restoration* (**ERP-98-B17**), *Cosumnes River Floodplain Acquisition, Restoration Planning, and Demonstration* (**ERP-98-F19**), and *Cosumnes/Mokelumne Corridor Floodplain Acquisitions, Management, and Restoration Planning* (**ERP-01-N10**).

Several key Preserve properties currently in ownership and located within the Middle Floodplain of the Cosumnes River together present an opportunity for restoration on the scale of the Phase I program:

- The 500-acre Denier property located just north of Twin Cities Road, purchased using CALFED funding and owned by TNC.
- The 319-acre Oneto properties, lying just north and east of the Denier Property, recently acquired by TNC, partially funding by the Authority.
- The 597-acre Shaw property, lying just north of Oneto and owned by the California Department of Fish and Game (DFG).
- The 291-acre Whaley property, lying just east of Denier and owned by DFG and the State Lands Commission.

These properties in combination contain the primary Cosumnes channel, several historic secondary channels, and adjacent acreage that were levied for agricultural use. In aggregate, these properties present an opportunity for levee removals or breaches and associated grading to restore approximately 1,000 acres of seasonal floodplain and riparian forestland. Because of their location, they present significant opportunities for expanded riparian habitat, seasonal waterfowl, shorebird and native fish habitat restoration, attenuation of flood flows, expanded songbird nesting habitat and groundwater recharge (Whitener 2007).

The *Cosumnes and Mokelumne Rivers Floodplain Integrated Resources Management Plan* (**ERP-99-C01/C02**), an ERP funded effort to study a wide range of floodplain restoration projects in the lower Cosumnes and Mokelumne River watersheds, is currently under way. The stakeholders, with agreement of the Oversight Committee, identified the hydraulic reconnection of the Cosumnes River and its floodplain as the main objective in this reach, and also identified a specific area where this restoration was most viable. To evaluate the feasibility of reconnecting the river with a specific area of historical floodplain, a 2-dimensional floodplain model was developed for the project area. The result of the modeling exercise showed that the strategic removal of levees will significantly increase the inundation frequency of this portion of the historic floodplain. The Management Plan will provide scoping, modeling and preliminary design for the Phase II restoration project. Funding for final design, permitting and construction will be sought following the completion of the Management Plan (Whitener 2007).

The Cosumnes Research Group's collaborative study of the watersheds, *Linked Hydrogeomorphic-Ecosystem Models to Support Adaptive Management - Cosumnes-Mokelumne Paired Basin Project* (**ERP-99-N06**), began in July of 1998. The study site was the restored experimental floodplain located on the Cosumnes River Preserve (CRP), comprising over 18,000 hectares of land managed by a consortium of state, federal and non-profit organizations. The initial multi-year segment of the project was

funded primarily by the ERP, and was completed in December of 2002. Research and monitoring efforts were directed to five broad areas: hydrology, geomorphology, water quality, aquatic resources, and data management. Beginning in January of 2001, a second, overlapping phase of study was begun, funded entirely by the ERP project *The Influence of Flood Regimes, Vegetative and Geomorphic Structures on the Links between Aquatic & Terrestrial Systems* (**ERP-01-N01**). For this now completed phase, the focus was extended to include flood regimes, riparian restoration success, groundwater and vegetation interaction, linking aquatic and terrestrial ecosystems, bird populations as ecosystem indicators, data management, and floodplain monitoring. The final report for the research completed by the Cosumnes Research Group included chapters on flood regime, floodplain restoration, groundwater, linkage of aquatic and terrestrial systems, bird populations, data management, and floodplain monitoring. The final report contains project data, results, and management/monitoring recommendations on each of these topic areas. In addition, numerous articles have been published on information learned from the project (Cosumnes Research Group 2006).

Trophic Transfer in the San Francisco Bay/Delta: Identifying Critical Processes for the Ecosystem Restoration Program (**ERP-02-P40**) is an ERP-funded research project focused on processes that affect the biogeochemical transformations and transfers of mercury among physical (sediment and water) and biotic (food web) compartments at Frank's Tract (central Delta) and the Cosumnes River. The project has completed sampling focused on spatial and temporal variability associated with mercury dynamics in the three primary sub-habitats (emergent marsh, open water, and *Egeria*-dominated submerged aquatic vegetation). Sampling was also completed on the Cosumnes River Floodplain that included experiments on mercury uptake in caged fish on and off the floodplain. The study was expanded to include mercury bioaccumulation into larval fish in the Cosumnes River Floodplain by obtaining and assaying preserved samples from two previous years of studies assessing the biokinetics of mercury trophic transfer. Two papers were published with laboratory trophic transfer studies and data presented at a wide range of public forums. The project resulted in process-level information regarding how mercury is cycled in different regions, in key sub-habitats, and through food webs of the Bay-Delta ecosystem. A summary of finding by hypothesis is described in the Mercury chapter 5.8.2. This project supports improved water and sediment quality by filling critical gaps in our process-level understanding of how mercury cycles and bioaccumulates in the San Francisco Bay-Delta Watershed.

The Cosumnes River Preserve Perennial Pepperweed Control Project (**ERP-02D-P66**) is another ERP-funded research project designed to develop strategies and an adaptive management framework for the control of perennial pepperweed (*Lepidium latifolium)* at the Cosumnes River Preserve. The ongoing project will address several scientific needs of the ERP via targeted research and pilot projects regarding adaptive management and monitoring of weed control efforts in general and *Lepidium* specifically. Annual inventories of perennial pepperweed on the experimental floodplain

and other areas of the preserve have been completed for the 2005 and 2006 field seasons. In addition, soil chemical and physical properties have been collected in a seed bank experiment. Using the inventory data, data from the seed bank experiment, and new findings within the research community, it was determined that pepperweed control needs to be executed across an entire patch population, including all of the target species within 1-3 meters of each individual. Using this new information, the project was adaptively managed to expand treatment plots where eradication would occur for all plants within three meters of each other. The contract term was also extended to allow the plots to be monitored for treatment success and non-target vegetation response in 2008 and 2009. This amended experimental design is hypothesized to more effectively treat *Lepidium* populations. Additionally, LIDAR and Arc GIS data are being analyzed to determine *Lepidium* population patterns and trends. The project has produced the Cosumnes River Preserve Virtual Herbarium and the Final Phloroglucinol Root Staining Report. Plants of the Cosumnes River Preserve Virtual Herbarium displays information on each plant species known to occur at the Cosumnes River Preserve including photos, plant characteristics, blooming season, nativity, habitat, existence of an herbarium specimen at the UC Davis Herbarium, Cal IPC status, CNPS rarity, as well as links to keep this information as up to date as possible (Hutchinson et al. 2007a). Results of the root staining report suggested that root-based aging is likely to be less effective for project purposes than survey and marking methods to determine the age structure of pepperweed patches (Hutchinson et al. 2007b). This project has contributed valuable research toward reducing the adverse effects of invasive riparian plants on native species and ecosystem processes, water quality and conveyance systems, and major rivers and their tributaries. In addition, pilot-scale eradication of perennial pepperweed has begun in the Cosumnes River Preserve under this project.

The Cosumnes River Salmonid Barrier Program (**ERP-98-B25**) is an ERP-funded implementation project that evaluated and implemented construction of structures to improve adult salmonid passage over existing diversion structures in the Cosumnes River. The Fishery Foundation of California (FFC) began working in partnership with the Nature Conservancy in 1996 to restore the salmon run on the Cosumnes River. Initial efforts focused on floodplain rearing habitat near the mouth of the river in the Cosumnes Preserve. More recent efforts focused on adult salmon passage. The FFC constructed a culvert at a partially impassable road crossing in the lower river in 2001 with a grant from CALFED, AFRP, and USBR. In 2002 the FFC constructed a fish ladder at Granlees Dam in Rancho Murieta with funds from CALFED, AFRP, and USBR (Kennedy 2004).

The Cosumnes River Salmonid Barrier Program (**ERP-98-B25**) has contributed toward the ERP target that would improve anadromous fish passage at dams and diversion structures.

Projects Outside the Cosumnes River Preserve

Under the *Upper Cosumnes River Watershed Conservation Project* (**ERP-02-P02**) an 1,814 acre conservation easement was purchased on the north fork of the Cosumnes River. This conservation easement protects water quality and riparian habitat and prevents development at the confluence of the Middle and North forks of the Cosumnes River. Species to potentially benefit from this project include fall-run Chinook salmon, red-legged frog, and foothill yellow-legged frog.

The *Deer Creek Hills Project* (**ERP-02-P49**) provided funding for the acquisition of 294 acres of the 4,062 acre Deer Creek Hills Property in eastern Sacramento County. The entire property was acquired by the Sacramento Valley Conservancy, County of Sacramento, and California Department of Parks and Recreation as permanent open space and has one of the largest stands of blue oaks remaining in Sacramento County. The acquisition was completed in September of 2003 for $11.4 million. Other cost share partners included Wildlife Conservation Board, County of Sacramento, Park Bonds 12 and 40, and Off-Highway Vehicle Recreation Division of the State of California Department of Parks and Recreation. In May of 2007 the County of Sacramento began preparation of a master plan for the Deer Creek Hills Preserve that will include inventories and assessments of conditions and resources at the Preserve, planned future uses of the Preserve, and implementation strategies for funding, operations and development (County of Sacramento 2007).

Acquisition of these conservation easements has contributed toward the ERP target to protect existing riparian habitat along the Cosumnes River.

The planning completed under the *Restoration of Eastern Delta Floodplain Habitats on Grizzly Slough in the Cosumnes River Watershed – Phase 1 Project* (**ERP-02-C08**) has produced a set of restoration alternatives for the Grizzly Slough site which is part of the North Delta Improvements Program. The alternatives recommend breaching and/or degrading levees and excavating a starter channel/swale to reconnect Grizzly and Bear Sloughs with the site's floodplains. If constructed, the resulting frequently-inundated floodplain is expected to be valuable habitat for fish, such as splittail and juvenile steelhead and salmon from the Cosumnes and Mokelumne Rivers. Twenty five acres of channel, 244 acres of riparian and floodplain forest, and 220 acres of upland landscaped with valley oaks and native grasses would result from the project (if implemented), improving habitat for migrating songbirds, Swainson's hawks, elderberry beetles, and other species. These acres are adjacent to existing nature areas and other sites planned for restoration, creating an opportunity to knit the region's fragmented habitats into a large, cooperatively managed ecosystem. If implemented, this planning project has the potential to contribute to restoring riparian habitat along the Cosumnes River.

The purpose of the *Cat Creek Watershed Project, Review of the Forest Road System for Repair, Relocation or Obliteration Project* (**ERP-98-B10**) was to survey the existing road system within the Cat Creek Watershed to assess the condition of the roads, and determine if there were opportunities to reduce the risk to water quality from sediment generated from the roads during runoff events. The goal of the project was to provide a long-term transportation system that is maintainable, allowing for public and administrative access, with the least amount of risk to water quality, by developing a method for resources to have a trackable, logical, approach to roads analysis. To meet this goal, a process was developed for the Cat Creek Watershed that would allow resource specialists to evaluate both the risks and the values to a resource from a particular road.

The major management objective for the *Cosumnes River Reach Component of the East Delta Corridor Habitat Studies: Cosumnes and Mokelumne Rivers Feasibility Study Project* (**ERP-99-C01/C02**) was to manage flood flows along the Cosumnes River by utilizing the Cosumnes River and Deer Creek floodplain. The Cosumnes River has the unique distinction of being the last free flowing river on the western slope of the Sierra Nevada range. The Oversight Committee and stakeholder group for the project identified a management scenario of developing overflow weirs that moved high flood flows from the leveed Cosumnes River into the floodplain. Under the scenario it was hoped that the peak flood on the Cosumnes River would be attenuated, thereby reducing the peak flood downstream of Highway 99 and to the Delta. A two-dimensional floodplain model was developed to evaluate the effectiveness of this flood management scenario. The results of the modeling exercise showed that there was little if any potential to attenuate flood flows in the shared Cosumnes River and Deer Creek floodplain. The total inflow (both rate and volume) was not reduced at the lower end of the reach, Highway 99, and the Delta further downstream. The potential benefit of this project would be localized to the communities of Wilton and Sheldon and to agricultural levees. After a review by the Oversight Committee and key stakeholders in the reach, it was determined that this flood management option had little potential to be implemented. Further, no other viable options for flood management exist within this reach of the Cosumnes River. Since this flood management option is not likely to be implemented, the Oversight Committee has recommended that it not be included in the final implementation plan. This planning project has directly contributed valuable knowledge toward restoring and improving opportunities for rivers to inundate their floodplain seasonally.

Mokelumne River Ecological Management Unit

The Restoration and Monitoring of Riparian Habitat Corridors Along the Lower Mokelumne River Project (**ERP-02-P20**) restored approximately two miles (45 acres) of riparian habitat along the lower Mokelumne River. In addition, songbird species were monitored along the lower Mokelumne River from Camanche Dam to the Cosumnes River to assess breeding status, distribution, and abundance in existing and

restored riparian habitats for a period of three years. The response of Neotropical migrant songbird species to riparian restoration was monitored along Murphy Creek, a tributary of the Mokelumne River, for three years. The owner of one of the restored properties is now interested in maintaining and enhancing the restored area and perhaps selling a conservation easement. The San Joaquin County Resource Conservation District is currently working with the landowner to facilitate the easement process either through the San Joaquin Council of Governments or the Natural Resources Conservation Service of the United States Department of Agriculture. The project has also resulted in the first programmatic safe harbor agreement for the entire watershed covering elderberry plants and the Valley Elderberry longhorn beetle. The safe harbor agreement was approved in the spring of 2006 and the Lange property involved in this project was the first to sign on to this agreement, the first non-mitigation programmatic safe harbor agreement put in place in the state of California. The expected outcomes based on the hypotheses were to increase Valley Foothill Riparian Habitat along the Lower Mokelumne River, increase avian species richness and diversity within the Lower Mokelumne River Watershed, show that phased riparian restoration projects will sufficiently mimic a disturbance regime in creating a diversity in age class and canopy structure to create a more naturally complex riparian habitat system, and native plants used in riparian restoration can out-compete or eliminate non-native invasive plants, especially when combined with a weed removal program prior to and active maintenance following riparian restoration. Part of the weed removal inadequacy was due to evolving knowledge about the best way to treat and remove these non-native invasive species. Species of a particularly troublesome nature in this project were Himalayan Blackberry (*Rubus discolor*) and giant reed (*Arundo donax*).

Two planning projects were funded that contributed toward implementation of the *Lower Mokelumne River Restoration Program*. The purpose of *Lower Mokelumne River Restoration Plan - Phase 1* (**ERP-98-B11**) was to improve fish passage at Woodbridge Dam. Phase 1 resulted in final construction design drawings and specifications for the replacement of the Woodbridge Irrigation District dam and fish ladder. The documents prepared during Phase 1 included Biological Assessments, an EIR/EIS, a fish screen preliminary design and evaluation, Clean Water Act Section 401 and 404 permits, alternative analysis, Notification of Lake or Streambed Alteration, and construction design drawings and specifications. The purpose of *Lower Mokelumne River Restoration Program - Phase 2* (**ERP-01-N57**) was to improve fish screening at Woodbridge Dam. Phase 2 resulted in final plans and specifications for a fish screen system and construction bid documents. Construction of new fish passage facilities on the new Woodbridge Dam were completed in the summer of 2006. The reconstructed dam should improve the opportunity for fall-run Chinook salmon to reach their spawning habitats in a timely manner. Together, these projects contributed valuable planning assistance toward the ERP targets to lessen adverse effects caused by water diversions, as well as dams and other structures.

The primary management objective for the *Mokelumne River Reach of the East Delta Corridor Habitat Studies: Cosumnes and Mokelumne Rivers Feasibility Study Project* (**ERP-99-C01/C02**) was to support the development of a prioritization process for small-scale landowner-driven restoration projects along the Mokelumne River corridor and its tributaries. This prioritization process is being developed in coordination with a concurrent project funded through the San Joaquin County Resource Conservation District with Proposition 50 grant funds. To develop the prioritization process, a series of stakeholder workshops were held to identify a specific set of management objectives that met the management issues facing local landowners and key stakeholders. The result of this process was the development of specific objectives that have been ranked in order of importance and a prioritization process was developed to rank restoration projects. This process is supported with the development of a Management Plan which identifies the management, project ranking mechanism, and outreach program that will carry this process into the future, and a Conservation Handbook targeted to local landowners that identifies the type of restoration and conservation practices that meet identified management objectives. Upon completion, this component of the East Delta Corridor Habitat Studies Project will contribute toward the ERP targets that would restore riparian and riverine aquatic habitats and seasonal wetlands, improve natural floodplain and flood processes, and reduce the adverse effects of invasive riparian and marsh plants along the Mokelumne River.

*The Lower Mokelumne River Watershed Stewardship Plan Phases I-III Project*s (**ERP-98-E12** and **ERP-99-N15**) resulted in the development of a final Lower Mokelumne River Watershed Stewardship Plan. The plan is an umbrella document that includes the following components: Lower Mokelumne River Watershed Stewardship Plan, Mokelumne River Watershed Owners' Manual, Reflections in the River Video, Keeping our Rivers Clean presentation, and a website for the San Joaquin County Resource Conservation District (www.sjcrcd.org). In addition to the plan, historical assessment and mapping of the Lower Mokelumne River was completed that provides a detailed study of past riparian functions between channel dynamics, floodplain disturbance, and vegetation, and will assist watershed managers in attaining management goals in the areas of watershed condition, wildlife habitat, and aquatic ecology. With this knowledge, managers will be able to develop clear restoration objectives, prioritize restoration activities and asses the success of restoration efforts. A watershed map prepared by a professional hydrologist was also completed that established the precise boundaries of the Lower Mokelumne River watershed and gathered overlay information reflecting the 100-year and 500-year flood for the Lower Mokelumne River. During the grant period, several additional grants were awarded to assist in the implementation of the plan's programs. These projects included: *Restoration and Monitoring of Riparian Habitat Corridors Along the Lower Mokelumne River- Songbird Use of Existing and Restored Habitats* (**ERP-02-P20**), *Murphy Creek Restoration* funded through the CALFED Watershed Program, Department of Conservation *Resource Conservation District Watershed Coordinator*, *Swainson's Hawk Distribution Study* funded by Lower Mokelumne River Partnership Grant, *and Lower Mokelumne River Riparian Restoration*

Project funded by Lower Mokelumne River Partnership Grant (Evans and Augustine 2002). If fully implemented, the Lower Mokelumne River Watershed Stewardship Plan will contribute toward improvements to the natural floodplain and flood processes, and restore riparian and riverine aquatic habitats on the Mokelumne River.

The purpose of the *Large-Scale Pilot Demonstration of Passivation Technology for Restoration of Newton Copper Mine Project* (**ERP-01-N21**) was to demonstrate the application of passivation technology for the remediation and restoration of the Newton Copper Mine located in Amador County. The mine property is traversed by, and has surface drainage to, an unnamed tributary to Copper Creek. Copper Creek is tributary to Sutter Creek, which is tributary to Dry Creek, which is tributary to the Mokelumne River. As per the recommendation of the funding agency, only the laboratory-scale research and development work was performed. Three different acid-generating samples from the Newton Copper Mine were tested in this investigation. Two different passivation methods were evaluated in the laboratory for controlling acid generation from the Newton samples. Both preliminary and column tests were conducted. Passivated samples were tested using an accelerated weathering method to determine the resistance to oxidation. In addition, fundamental characterization of the passivated samples was conducted using a Scanning Electron Microscope and an Atomic Force Microscope and Energy-Dispersive X-ray. Research and development work indicates that the passivation process has demonstrated potential to control acid mine drainage. This process can successfully be used for the restoration of the Newton Copper Mine. However, it is recommended that an on-site pilot test project should be conducted prior to the final restoration project (Misra 2003). This project contributed valuable contaminant research information that would restore and maintain water quality in Camanche Reservoir on the Mokelumne River.

Calaveras River Ecological Management Unit

The Stockton East Water District (SEWD) and Calaveras County Water District (CCWD) *Fish Screen Facilities in Calaveras River* (**ERP-01-N59**, same as **CVPIA-XX-V11**) project has the goal of reducing fish passage and fish entrainment concerns associated with water diversions on the Calaveras River between the New Hogan Dam and Bellota. Fish entrainment has been identified as one limiting factor affecting the recovery of the lower Calaveras River steelhead populations. There are thirty water diversions within the SEWD and CCWD, of which 28 are privately owned pumps and intake pipes. The Bellota Weir has been evaluated and a new set of designs have been established and are ready for implementation. The project will have contributed to reducing the entrainment of juvenile fish in the Calaveras River Unit due to unscreened water diversions.

The Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development (**ERP-01-N30**) project has made the soils information more accessible to those involved in ecosystem restoration projects program wide. The project will help improve

the responsiveness of these projects to establish habitat and support sustainable populations of valuable species. The study of soil as a limiting factor or controlling variable to the survival of a species will help address many of the scientific uncertainties outlined in the ERP Strategic Plan. These include the natural flow regime, decline in productivity, non-native species and beyond the riparian corridor, as well as protecting at-risk species, restoring habitat, eradicating non-native invasive species, and maintaining ecosystem processes (Smith 2004).

Project Summary Table

A total of 33 Projects were funded in the Eastside Delta Tributaries EMZ. The projects are focused on ecosystem processes, habitats, stressors, and species. The projects, changes attributable to them, and the applicable MSCS species are described in more detail in the Ecological Management Unit sections below. In addition, a group of projects that contributed to the overall knowledge base for the entire EMZ is discussed in the program-wide projects section.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
Eastside Delta Tributaries Ecological Management Zone-Wide Projects				
ERP-01-N38	**Delta Studies Program: San Joaquin County Schools** This project increased student and teacher knowledge at sixty targeted schools in San Joaquin County. The program developed a Delta Studies Curriculum, developed and maintained a Delta Education Resource Center, and recruited, identified, trained, and supported a cadre of thirty teacher leaders each per years two and three called Delta Educational Leaders for Teaching and Action (DELTA).	6/30/2004	$323,198	Complete. A comprehensive curriculum for teaching about the Delta was established for San Joaquin County Schools from K-12.
ERP-02-P17	**Songbird Population Responses to Riparian Management and Restoration at Multiple Scales: Comparative Analysis, Predictive Modeling, and the Evaluation of Monitoring Programs** The applicant synthesized the results of past and current riparian bird system research and monitoring across the entire CALFED region. They identified the major factors influencing the success of hydrological, vegetation management, and restoration activities in providing habitat for self-sustaining bird populations, developed recommendations for how such activities can best benefit breeding songbirds and evaluated the songbird monitoring strategy.	7/31/2007	$356,876	Complete.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P38	**Effects of Climate Variability and Change on the Vegetation and Hydrology of the Bay-Delta Watershed** The broad goal of this project is to assess the role of vegetation in shaping the watershed's hydrologic response to climate variability and global climate change.	2/29/2008	$562,924	Ongoing.
ERP-05D-S20	**Implementation of a Constant Fractional Marking/Tagging Program for Central Valley Hatchery Chinook Salmon** The proposed marking/tagging program will provide CALFED the specific information needed to evaluate Ecosystem Restoration Program Plan (ERPP) actions and goals related to improving conditions for Central Valley Chinook salmon.	9/30/2008	$6,775,998	Ongoing. Project tasks have been successfully implemented to date.
ERP-98-B15	**Evaluation of Increasing Tagging Levels for Chinook Salmon and Steelhead and a Demonstration Project on Mass Marking** This project evaluated current tagging practices and demonstrated a technique for the mass marking of hatchery produced salmon, to support subsequent evaluation of harvest practices. Tasks included the evaluation of hatchery stocking, tagging, recovery data, alternative tagging approaches and concomitant benefits/risks, and the demonstration tagging of hatchery stock at various Central Valley hatcheries. Data analysis only, no data collection.	6/30/2002	$616,190	Complete. A contribution rate final report was completed in 2000 and a selective fishing final report was completed in 2001.
ERP-99-F08	**Purple Loosestrife Prevention, Detection and Control in the Sacramento / San Joaquin Delta and Associated Hydrologic Units** Over a three year period, the Integrated Pest Control Branch of the California Department of Food and Agriculture carried out a series of tasks which resulted in: 1) exhaustive survey of the Sacramento-San Joaquin Delta; 2) local eradication of loosestrife in Phase I and II areas; 3) focused delimitation and survey of all loosestrife infestations in the CALFED focus area; 4) training of agency personnel to recognize purple loosestrife and other aquatic non-native invasive species; and 5) education of the boating, water fowl hunting, and similar public citizenry. Project is tied to ERP-99-N11 and ERP-99-N11b.	5/31/2003	$221,306	Complete. Contiguous Basin Survey and Map which included the Eastside Delta Tributaries EMZ was produced in 2003.
ERP-99-N13	**Development of a Comprehensive Implementation Plan for a Statistically-Designed Marking/Tagging and Recovery Program for CV Hatchery-Produced Chinook Salmon and Steelhead** This project developed a plan to implement a Constant Fractional Marking (CFM) program that integrates traditional coded-wire tagging/fin marking (CWT) and otolith thermal marking (OTM) to address central Chinook salmon and steelhead management questions. ERP-99-N13B was a continuation of this contract.	11/30/2004	$92,657	Complete.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-N13b	**Development of a Staged Implementation Plan for Coordinated Marking of Chinook Salmon at Sacramento River System Hatcheries** This project focused primarily on Phase IV of the DFG contract (99-N13) to create a staged implementation plan segment for CFM of all hatchery-produced CV Chinook Salmon.	1/31/2004	$74,249	Complete. A report titled, "A marking, tagging, and recovery program for Central Valley hatchery Chinook salmon" was prepared in 2004.
Cosumnes River Ecological Management Unit Projects				
ERP-01-N01	**The Influence of Flood Regimes, Vegetative and Geomorphic Structures on the Links between Aquatic and Terrestrial Systems** This project examined the floodplain dynamics in the Cosumnes River watershed by assessing levee breaches and other flow restoration efforts under which ecological succession is effective in restoring the structure and foodweb dynamics characteristic of functioning native ecosystems.	6/30/2006	$2,652,750	Complete. Final Report titled, “The Influence of Flood Regimes, Vegetative and Geomorphic Structures on the Links Between Aquatic and Terrestrial Systems: Applications to CALFED Restoration and Watershed Monitoring Strategies" completed in 2006.
ERP-01-N10	**Cosumnes / Mokelumne Corridor Floodplain Acquisitions, Management, and Restoration Planning** Planning phase which included acquisition. Phase I of a two-part flood management and ecosystem restoration project in Sacramento County, which will ultimately result in 600 acres of land along the Cosumnes and Mokelumne Rivers incorporated into non-structural flood management practices of the Cosumnes River Preserve. Phase 1 will identified and acquired, from willing sellers, suitable parcels and conduct start-up stewardship activities, including baseline monitoring and preliminary restoration planning.	9/30/2007	$3,044,342	Ongoing. At least 90% complete.
ERP-02-C08	**Restoration of Eastern Delta Floodplain Habitats on Grizzly Slough in the Cosumnes River Watershed - Phase I** This project was Phase 1 in an effort to restore function to an historic seasonal floodplain on Grizzly Slough in the Cosumnes River watershed. The project was formerly ERP-02-P05. This project was part of a multi-project interagency agreement with DWR #264000.	6/30/2006	$300,000	Complete. The project produced a set of scientifically sound and ecologically based restoration alternatives for the Grizzly Slough site.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02D-P66	**Cosumnes River Preserve Perennial Pepperweed Control Project** Based on inventory and continued monitoring of exisitng *Lepidium* populations at the Cosumnes River Preserve, this project developed targeted research about control of *Lepidium* focused on physical and chemical aspects of the soil and on the response of surrounding vegetation to *Lepidium* populations.	6/30/2009	$481,634	Ongoing. Inventory data has been collected and analyzed for the 2005 and 2006 field seasons and the project has been adaptively managed using results. Cosumnes River Preserve Virtual Herbarium and Final Phloroglucinol Root Staining Report have also been completed.
ERP-02-P02	**Upper Cosumnes River Watershed Conservation Project** The purpose of this project was to purchase a conservation easement across a 1,814 acre ranch, and either of conservation easement or a fee title interest on a 348 acre property, totaling approximately 2,160 acres of riparian and upslope habitat along the North Fork of the Cosumnes River, within the Upper Cosumnes River Basin.	7/14/2004	$2,000,000	Complete. A 1,814 acre conservation easement was purchased on the north fork of the Cosumnes River. This conservation easement protects water quality and riparian habitat and prevents development at the confluence of the Middle and North Forks of the Cosumnes River.
ERP-02-P40	**Trophic Transfer in the San Francisco Bay/Delta: Identifying Critical Processes for the Ecosystem Restoration Program** This project examined processes that affect the biogeochemical transformations and transfers of mercury among physical (sediment and water) and biotic (food web) compartments at Frank's Tract (central Delta) and the Cosumnes River. The processes included methylmercury production and degradation, transfer of methylmercury between sediment and water, the entry of methylmercury into the food web, and its transfer and biomagnification in the food web. (R/M)	6/30/2007	$2,684,824	Complete. A summary of findings by hypothesis is described in the Mercury chapter.
ERP-02-P49	**Deer Creek Hills Project** Acquisition of 294 +/- acres of the Deer Creek Hills property in the Eastside Delta tributaries ecozone, Cosumnes River watershed. Protection of this land will provide downstream watershed benefits including instream water quality and ecosystem health benefits.	3/31/2004	$800,000	Complete. Acquisition of 294 acres was completed in 2003. This project completed Phase 1 of the Deer Creek Hills acquisition (total of 2,257acres) and is a part of the larger 4,062 acre property being acquired.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-N14	**Cosumnes Start-up Stewardship and Restoration** Completion of this project resulted in achieving conservation objectives for approximately 3,100 acres across six properties to protect and enhance fisheries, riparian, and wetland habitats along the lower Cosumnes River floodplain. Also included in this effort was the clean-up and repair of the properties (demolition of buildings, repair and/or replacement or fencing, etc.), planning for restoration and monitoring, biological and archaeological surveys, and irrigation system installation.	9/30/2002	$2,305,730	Complete.
ERP-98-B10	**Cat Creek Watershed Project, Review of the Forest Road System for Repair, Relocation or Obliteration** Reclamation and the U.S. Forest Service developed and field tested a method to prioritize forest roads in the Cat Creek watershed for repair, re-location, closure, or decommission. If the recommendations resulting from this project are implemented, there will be a reduction in the amount of sediment moving into the Cosumnes River. This sediment reduction will result in improvements in water quality and in aquatic habitat for fall-run Chinook salmon.	6/30/2000	$38,000	Complete. A process was developed for the Cat Creek Watershed would allow resource specialists to evaluate both the risks and the values to a resource from a particular road.
ERP-98-B17	**Cosumnes Floodplain Acquisition and Restoration** Project funded for acquisition only to restore and improve floodplain functions, and riparian and wetland vegetation.	12/31/1998	$3,500,000	Complete. Partially funded acquisition of Park, Whaley, and Denier properties in the Cosumnes River Preserve. (Acreage is included in ERP-97-N14)
ERP-98-B25	**Cosumnes River Salmonid Barrier Program** This project evaluated and implemented construction of structures to improve adult salmonid passage over existing diversion structures in the Cosumnes River. Tasks included evaluation of alternatives, finalizing engineering specifications; bidding, construction and monitoring.	10/31/2004	$230,255	Complete. This project included construction of 3 small dams, a box culvert, and a fish ladder and post project performance monitoring.
ERP-98-F19	**Cosumnes River Floodplain Acquisition, Restoration Planning, and Demonstration** This project acquired property for fisheries, riparian, and wetland habitats along the lower Consumes River floodplain. Supplemental funding for the acquisition of the Denier property purchased in project ERP-97-N14.	9/30/2001	$750,000	Complete. Partially funded acquisition of the Denier property. (Acreage is included in ERP-97-N14)

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-C01/C02	**East Delta Corridor Habitat Studies: Cosumnes and Mokelumne Rivers Feasibility Study** The project was combined with the Mokelumne River Feasibility Study, which was planned to be simultaneously conducted by the Corps and the Mokelumne River Feasibility Study. This study identifies designs and estimates costs for environmental restoration and flood damage reduction opportunities along the Cosumnes River. The project is being carried out in conjunction with an extensive public involvement program to ensure that all potential stakeholders are provided a format for project-related discussion, education and decision-making. Implementation of these opportunities will occur in the future as funding and land management allows. Environmental compliance documents as required by NEPA and CEQA have been prepared.	12/31/2007	$1,007,800	Ongoing.
ERP-99-N06	**Linked Hydrogeomorphic-Ecosystem Models to Support Adaptive Management - Cosumnes-Mokelumne Paired Basin Project** This project collected long term multidisciplinary, monitoring data to be used to develop ecologically based models predicting the combination of factors that will maximize ecosystem benefits in ways that are compatible with other water uses.	6/30/2003	$1,546,016	Complete. Final report including aquatic, data management, geomorphology, hydrology, and water quality components completed in 2002.
Mokelumne River Ecological Management Unit Projects				
ERP-01-N21	**Large-Scale Pilot Demonstration of Passivation Technology for Restoration of Newton Copper Mine** The intent of this project was to conduct an on-site full-scale pilot demonstration of passivation technology in controlling the acid drainage from the inactive acid-generating Newton Copper Mine site.	1/31/2003	$60,000	Complete. Partially implemented as per the recommendation of the funding agency only the laboratory scale research and development work was performed. Research and development work indicates that the passivation process has demonstrated potential to control acid mine drainage.
ERP-01-N57	**Lower Mokelumne River Restoration Program - Phase 2** This project implemented phase 2 of the Lower Mokelumne River Restoration Program. Phase 2 involved preparing design and specifications for a low stage fish screen at Woodbridge Dam and a fish screen at the canal diversion point and contemplated the replacement of Woodbridge Irrigation District's existing canal fish screen.	2/28/2002	$680,000	Complete. Phase 2 resulted in final plans and specifications for a fish screen system and construction bid documents.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P20	**Restoration and Monitoring of Riparian Habitat Corridors Along The Lower Mokelumne River** Restored approximately 45 acres of riparian habitat along two miles of Lower Mokelumne River for birds. Restored degraded riparian ecosystems through invasive species removal and native plant restoration and to monitor the response of Neo-tropical migratory songbirds to the restoration are included.	1/31/2007	$859,405	Complete. Populations of Neotropical migratory songbirds were monitored along the lower Mokelumne River and Murphy Creek.
ERP-98-B11	**Lower Mokelumne River Restoration Plan - Phase 1** This project completed Phase I of the Lower Mokelumne River Restoration Program (LMRRP). This involved completing environmental clearance and permitting for fish passage improvements at Woodbridge Dam, completing final design of fish passage improvements at Woodbridge Dam, and completing environmental clearance and permitting for improvements to the fish screens of Woodbridge Irrigation District and North San Joaquin Water Conservation District.	12/31/2001	$1,920,000	Complete. Construction design drawings and specifications were completed for replacement of Woodbridge Irrigation District's fish ladder and dam.
ERP-98-E12	**Lower Mokelumne River Watershed Stewardship Program (Phase I)** The San Joaquin County Resource Conservation District (SJRCD) has developed a comprehensive plan for the Lower Mokelumne River Watershed Stewardship Program (LMRWSP) through a community-based ecosystem management approach, which strives to reconcile livable communities with ecological integrity.	9/1/2000	$159,000	Complete. Developed a watershed stewardship coordination plan, an environmental farm plan, and Neotropical migratory bird monitoring. The LMRWSP will ultimately benefit primary and secondary CALFED priority species including fall-run Chinook salmon, steelhead trout, and migratory birds.
ERP-99-C01/C02	**East Delta Corridor Habitat Studies: Cosumnes and Mokelumne Rivers Feasibility Study** The project was combined with the Mokelumne River Feasibility Study, which was planned to be simultaneously conducted by the Corps and the Mokelumne River Feasibility Study. This study identifies design and estimate costs for environmental restoration and flood damage reduction opportunities along the Cosumnes River.	12/31/2007	$1,007,800	Ongoing.

Table 1. Eastside Delta Tributaries Ecological Management Zone Project Summary.

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-N15	**Lower Mokelumne River Watershed Stewardship Plan Program (Phase II/III)** This project continued work on the Lower Mokelumne River Watershed Stewardship Program (WSP) initiated in 1998-1999 (Phase 1: ERP-98-E12). Phase 1 built a strong foundation of community support for the program, and resulted in the formation of a steering committee and a vision for future watershed development. This two-year project will initiate phases II and III of the WSP.	6/30/2002	$227,000	Complete. Expansion of Phase I. Prepared a Watershed Stewardship Plan, Watershed Owners Manual (describing the stakeholder's common watershed land management goals and objectives and coordinating these actions), prepared an Action Plan, implemented initial watershed stewardship actions, and a WSP Monitoring and Evaluation Program.
Calaveras River Ecological Management Unit Projects				
ERP-01-N30	**Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development** This project made soils information more accessible to individuals and groups engaged in ecosystem restoration projects in the Bay-Delta Region. In doing so, it improves the responsiveness of these projects for establishing habitat and supporting sustainable populations of valuable species.	8/15/2004	$430,390	Complete. Completed a final report titled, "Digital Soil Survey Mapping and Digital Orthophotoquad Imagery Development".
ERP-01-N59 (CVPIA-XX-V11)	**Stockton East Water District and Calaveras County Water District Fish Screen Facilities - Calaveras River** This project evaluated diversion structures between Bellota and New Hogan Dam on the Calaveras River.	1/31/2006	$797,920	Complete.

Other Programs Contributing to ERP Vision

In 1995, the Cosumnes River Preserve partners, led by The Nature Conservancy (TNC), launched an ambitious, multi-faceted program of restoration in the bottomlands of the lower Cosumnes River floodplain. The effort capitalized on land acquisition that had taken place over the previous decade (beginning with TNC's first Cosumnes acquisition in 1984), creating opportunities for large scale approaches. It drew upon the best available science and brought in new and important partners such as the Army Corps of Engineers and the University of California, Davis. The effort ultimately resulted in the reopening of approximately 2,500 acres of seasonal wetlands to regular flooding, breaching of about 6 miles of historic levee, and the initiation of natural reforestation on 250 acres of land. The effort was closely coordinated with private landowners near the Preserve and has demonstrated to them the range of values associated with floodplain

restoration, including the practical benefit of increasing flood storage and reducing flood stages in the river (Whitener 2007).

Research in the Cosumnes River Preserve has been led by the Cosumnes Research Group. U.C. Davis, in association with the partners of the Cosumnes River Preserve, has established a coordinated research partnership dedicated to advancing watershed science to support more effective and sustainable watershed restoration practices and address the information needs of adaptive management in the North Delta and Cosumnes and Mokelumne River watersheds. The following four ERP funded research projects have advanced the state of knowledge in the areas of hydrodynamics, sediment transport and flow regimes, ecosystem water and sediment quality, and non-native invasive species.

In the fall of 2002, the Fishery Foundation undertook evaluations of the effectiveness of these fish passage improvements (as discussed above by **ERP-98-B25**) in improving passage, spawning success, and production of young salmon in the lower Cosumnes River. The monitoring program is funded by grants from CALFED, the Anadromous Fish Restoration Program (AFRP), and the Bureau of Reclamation (USBR) to improve salmon passage, escapement to spawning grounds, and overall salmon production in the Cosumnes River and Central Valley of California. Adult salmon were monitored in spawning surveys that located live adult salmon, spawning beds (redds), and carcasses (Kennedy 2004). The project's final report summarized the results of these monitoring programs and made the following conclusions regarding the project's success:

- Flows in the fall of 2002 were insufficient in terms of magnitude and duration to support the spawning run of fall-run Chinook salmon in the lower Cosumnes River. Approximately one-half the run was unable to reach the spawning grounds upstream from Meise Road to Latrobe Falls. Of those that failed to make it, about half spawned in poor quality habitat and the other half died without spawning, having become stranded after flows receded in the lower river.
- Passage at three of the four summer dams did not appear to hinder migration as long as there was a reasonable flow over the approaches and crests (Q>40 cfs). Rooney Dam still serves as a formidable barrier to upstream passage at flows below 70cfs based on observed schools of milling salmon and spawning below the dam in marginal habitat. Modifications to the approaches to Rooney Dam including rock and sandbag placement at the weir appeared to improve passage at flows greater than 70 cfs but were ineffective at lower flows. Permanent improvements to these dams including concrete flow-focusing curbs and the creation of step pools in the rock approaches were designed and implemented by the FFC prior to the fall 2003 season. These improvements were successful in three of four dams in reducing the minimum flow requirements to approximately 20 cfs. Rooney remains a problem to this day due to the steep rock approach and the relatively large material used in its creation. As Rooney Dam is located

approximately two miles below the traditional spawning habitat it is imperative that passage at this site is improved. The FFC is presently seeking additional funding for a permanent solution.

- Passage at Granlees Dam was greatly improved with the new south ladder as salmon readily passed through the ladder with little or no delay. Passage through the pre-existing north ladder appeared less effective despite the FFC modifications based on the time it took fish to pass through the ladder and a number of unsuccessful attempts observed.
- Passage at the road crossing below Highway 99 was greatly improved with the new culvert. There was no evidence of salmon holding below the crossing as in previous years. Site surveys during the fall of 2002 documented adequate passage at flows as low as 10 cfs.
- Approximately half the run spawned and died in the historical spawning reach from Meise Road upstream to Michigan Bar. One quarter of the redds counted were above this reach and one quarter downstream.

CVPIA funded several projects that contributed to meeting ERP Goals in the Eastside Delta Tributaries EMZ:

- The *Mokelumne River Spawning Habitat Improvement Project* (**CVPIA-XX-V09**) provided additional Chinook salmon and steelhead spawning gravel within the preferred size range and improved inter-gravel water quality. To determine the success of the project, the sites enhanced in 1998, 1999 and 2000 were evaluated for salmonid spawning suitability prior to gravel enhancement and immediately after gravel enhancement. In addition, use of the sites by spawning salmonids was measured. Suitability parameters included channel configuration and gradient, substrate size, inter-gravel permeability, dissolved oxygen content (DO) and temperature, and benthic macroinvertebrate community structure. Use by spawning salmonids was measured by conducting redd surveys. These sites will be reevaluated every three years through 2009 (East Bay Municipal Utilities District 2000).
- The *Lower Calaveras River Chinook Salmon and Steelhead Life History Limiting Factors Analysis* (**CVPIA-01-F12** and **CVPIA-XX-V10**) project and the *Distribution and Relationship of Resident and Anadromous Central Valley Rainbow Trout* (**CVPIA-02-V01**) project are ongoing projects that are contributing to the goal to recover the at-risk species Chinook salmon and steelhead trout.
- The *Fish Screen Facilities in Calaveras River* (**CVPIA-XX-V11**) project has the goal of reducing fish passage and fish entrainment concerns associated with water diversions on the Calaveras River between the New Hogan Dam and Bellota (Same as **ERP-01-N59**).

Other programs and organizations that have contributed to meeting ERP Goals in the Eastside Delta Tributaries EMZ include:

- San Joaquin County Resource Conservation District (www.sjcrcd.org)
- Cosumnes River Preserve (www.cosumnes.org)
- Integrated Regional Water Management Plan for the Cosumnes, American, Bear, and Yuba Watersheds, California (2006) (http://caby.watershedportal.net).
- Sacramento Valley Conservancy (www.sacramentovalleyconservancy.org)
- Central Valley Joint Venture 2006 Implementation Plan (http://www.centralvalleyjointventure.org/plans/)

Planned Projects for Implementation

Planning projects completed during Stage 1 of ERP implementation have resulted in recommended actions that should be considered for funding during Stage 2. These projects include:

- Implementation of the construction phase of the Cosumnes and Mokelumne River Floodplain Integrated Resources Management Plan (*East Delta Corridor Habitat Studies: Cosumnes and Mokelumne Rivers Feasibility Study* (**ERP-99-C01/C02**) is expected to provide improved floodplain habitat on the Lower Cosumnes River within the Cosumnes River Preserve. Implementation of this project is supported by The Nature Conservancy.
- Continued implementation of projects that support the Lower Mokelumne River Watershed Stewardship Plan will also support riparian habitat targets.

Status of Area Today

Cosumnes River Ecological Management Unit

The focuses of ERP projects in the Cosumnes River EMU during Stage 1 were on acquisition, planning, and research/monitoring. Several acquisitions, primarily within the Cosumnes River Preserve, have been made that benefit ERP targets for ecological processes (natural floodplain and flood processes), habitat (riparian and riverine aquatic habitat), and species (fall-run Chinook salmon, Sacramento splittail, steelhead trout, giant garter snake, Swainson's hawk, Boggs Lake hedge hyssop, Colusa grass, western pond turtle, native resident fish species, native anuran amphibians, and Neotropical migratory birds). Implementation projects in the EMU have made progress toward ERP targets for ecological processes (natural floodplain and flood processes), habitats (riparian and shaded riverine aquatic habitat), stressors (dams and other structures and invasive riparian and marsh plants) and species (fall-run Chinook salmon and steelhead trout). Several planning projects have been completed that will help guide restoration projects on the Cosumnes River to meet ERP targets for ecological processes (Central Valley streamflows, coarse sediment supply, and natural floodplains and flood

processes), habitats (seasonal wetlands and riparian and riverine aquatic habitat), stressors (water diversions and dams and other structures), and species (fall-run Chinook salmon, Sacramento Splittail, spring-run Chinook salmon, winter-run Chinook salmon, giant garter snake, Swainson's hawk, native resident fish species, Neotropical migratory bird species, and waterfowl). Research/monitoring projects have been completed that contribute valuable knowledge toward future restoration efforts on the Cosumnes River for ecological processes (Central Valley streamflows and natural floodplain and flood processes), habitats (riparian and riverine aquatic habitat, freshwater and essential fish habitat) and stressors (invasive riparian and marsh plants, predation and competition, contaminants, fish and wildlife harvest, and artificial fish propagation) and species (fall-run Chinook salmon, Sacramento Splittail, spring-run Chinook salmon, steelhead trout, winter-run Chinook salmon, California yellow warbler, giant garter snake, Swainson's hawk, California red-legged frog, western pond turtle, native resident fish, Neotropical migratory bird species, and waterfowl).

Mokelumne River Ecological Management Unit

The focus of ERP projects in the Mokelumne River EMU during Stage 1 was planning. One implementation project has contributed toward the successful completion of the Mokelumne River ERP targets for ecological processes (natural floodplain and flood processes), habitats (riparian and shaded riverine aquatic habitats), and species (fall-run Chinook salmon, Sacramento Splittail, spring-run Chinook salmon, steelhead trout, winter-run Chinook salmon, giant garter snake, Swainson's hawk, native resident fish species, and Neotropical migratory bird species). Planning projects have been completed for the Mokelumne River that have the potential to meet ERP targets for ecological processes (natural floodplains and flood processes), habitats (seasonal wetland, riparian and riverine aquatic habitat, and freshwater fish and essential fish habitat), stressors (water diversions, dams and other structures, and invasive riparian and marsh plants) and species (fall-run Chinook salmon, Sacramento splittail, spring-run Chinook salmon, steelhead trout, winter-run Chinook salmon, giant garter snake, Swainson's hawk, native resident fish species, Neotropical migratory bird species, and waterfowl). In addition, research on the Mokelumne River has resulted in new information for ERP targets for habitats (freshwater fish habitat and essential fish habitat), stressors (contaminants), and species (California red-legged frog, western pond turtle, Neotropical migratory bird species, and waterfowl.)

Calaveras River Ecological Management Unit

As described in the previous section, ten projects have been funded by the ERP that would benefit the Calaveras River EMU. The majority of these projects have been focused on research and monitoring (seven projects). These projects should provide information to guide the future implementation projects in stage 2. The other projects were focused on planning (two projects) and education (one project). One project

evaluated diversion structures between Bellota and New Hogan Dam on the Calaveras River for the purpose of identifying opportunities to improve fish passage.

Impediments to Implementation

Attaining the vision for the Eastside Delta Tributaries Ecological Management Zone includes near-term and long-term funding and implementation of actions to achieve set targets. This includes managing water project operations, purchasing in-title or land easements from willing sellers, cooperatively developing and implementing a phased fish screening program, acquiring and placing gravel in the stream channel, and performing engineering feasibility and design studies to improve fish passage at diversion structures. All of these actions require cooperation and support of existing ecosystem and species restoration efforts and programs, as well as transparency to landowners and stakeholders (CALFED 2000b).

Cosumnes River Ecological Management Unit

The greatest impediment to restoration of the Cosumnes River is habitat loss and fragmentation as a result of continued urbanization and agricultural conversion. Other impediments include groundwater depletion, land conversion to more intensive agriculture, introduction of non-native species (especially invasive plants), alteration of the hydrologic regime, levees that prevent winter floods from reconnecting the river and floodplain, and altered disturbance regimes in vernal pool grasslands, chaparral, and oak woodland (Kleinschmidt 2007).

Mokelumne River Ecological Management Unit

Impediments to Mokelumne River restoration include flow fluctuations and insufficient flows for Chinook salmon and steelhead, water temperature, unscreened diversions, and gravel mining operations (AFRP 2001).

Calaveras River Ecological Management Unit

Preserving appropriate river flows and hold-over pools, reducing the effects of barriers and diversions, and promoting restoration actions to landowners and stakeholders are key to improving habitat for migrating fish species within the Calaveras River (CALFED 2000b).

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APPENDIX A

A.12. SAN JOAQUIN RIVER ECOLOGICAL MANAGEMENT ZONE

Introduction

The San Joaquin River Ecological Management Zone (EMZ) encompasses the strip of riparian and floodplain habitat along the lower San Joaquin River from Friant Dam to the confluence with the Stanislaus River near Vernalis, Stanislaus County. This riparian zone averages about four miles wide and extends approximately 185 river miles from Vernalis to Friant Dam. This amounts to a total area of approximately 740 square miles. This strip, although small in comparison to the entire San Joaquin River Basin, is a highly critical corridor for fish migration and contains some of the most significant riparian plant communities remaining in California's Central Valley.

The San Joaquin River EMZ has been divided into four reaches, each of which is an Ecological Management Unit (EMU) (Figure 1). Beginning at the northern, lower end of the river, the four reaches are:

- Vernalis to Merced River EMU - Vernalis to the confluence with the Merced River (about 43 river miles)
- Merced River to Mendota Pool EMU (about 87 river miles)
- Mendota Pool to Gravelly Ford EMU (about 24 river miles)
- Gravelly Ford to Friant Dam EMU (about 31 river miles)

The following descriptions of the EMUs begin at the lower end of the zone and proceed upstream to Friant Dam.

Vernalis to Merced River Ecological Management Unit

The Vernalis to Merced River EMU is the nontidal reach of the San Joaquin River and includes the confluences of the three major eastside tributaries: the Stanislaus, the Tuolumne, and the Merced. These three rivers flow from the west slope of the Sierra Nevada and provide most of the inflow to this reach of the mainstem San Joaquin River. On the west side of the mainstem, small intermittent streams drain the east side of the Coast Range. Flows from these streams only reach the river during winter storm events. Most of the flows entering from the west side are irrigation return flows. The levees along this lower reach of the San Joaquin are generally close to the river and restrict overflow during flood periods when nutrients could be provided to wetlands for aquatic food production. This portion of the river is never completely dry, but in late fall may have very low flow, mostly from irrigation drainage. The water is heavily laden

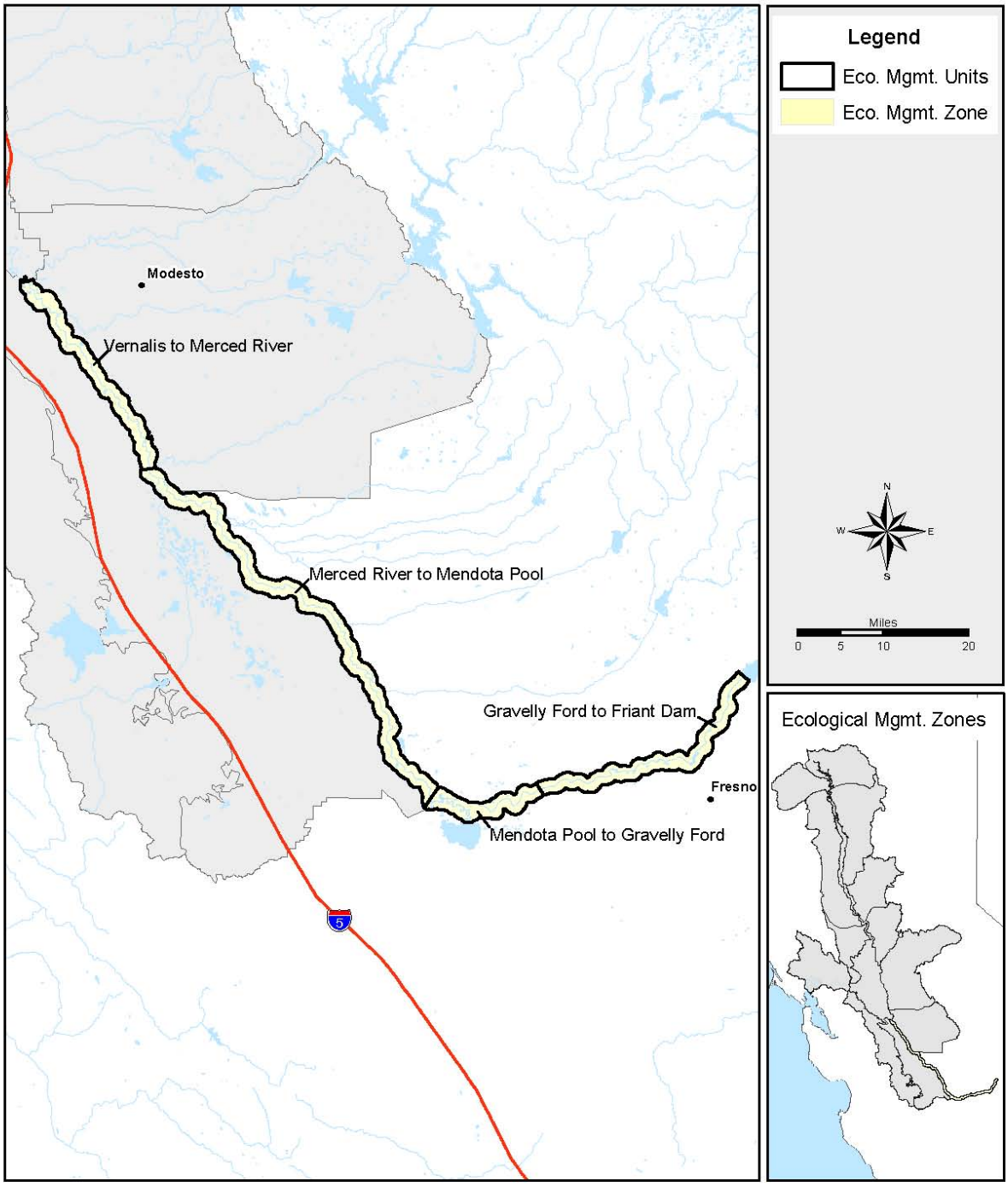

Figure 1. San Joaquin River Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. San Joaquin River EMZ Map

with sediment and agricultural chemicals, and is often too warm to support a stable anadromous fishery. Low dissolved oxygen year-round has also created a problem for aquatic life, especially below the confluence with the Stanislaus. This lower reach includes rare fragments of non-tidal marsh habitat.

Merced River to Mendota Pool Ecological Management Unit

This long reach (87 miles) extends above the confluence with the Merced River upstream to the large eastward bend in the San Joaquin River where Fresno Slough is tributary. It is at this point that historic overflows from the Kings River in extremely wet years have entered Fresno Slough and contributed flow to the San Joaquin. For most years, the Kings River, even under pristine conditions and before the completion of Pine Flat Dam, did not overflow into Fresno Slough and disappeared into the alluvial fan or ended up in the bed of ancient Buena Vista Lake.

A number of important tributary streams from the Sierra Nevada provide most of the flow in this reach. From north to south, beginning with Bear Creek which flows through Merced, the eastside tributaries to the mainstem in this reach are:

- Bear Creek
- Miles Creek
- Owens Creek
- Mariposa Creek
- Deadman Creek
- Chowchilla River
- Berenda Creek
- Dry Creek
- Fresno River
- Cottonwood Creek

All of these streams, including the two rivers, are intermittent and currently have virtually no flow in late summer in most years. This was the case even under pristine conditions. Cottonwood Creek, at the southern end of the zone, sinks into the alluvium at its lower end for most of the year and does not even reach the mainstem of the San Joaquin River as overland flow.

Nonetheless, these streams historically played a highly significant role in the fragile ecosystem of the San Joaquin and the Bay-Delta by providing large inflows during winter storm periods. This inflow helped wetlands along the mainstem and considerably augmented freshwater inflow to the Delta. Inflow to the mainstem from these streams is also important for extended periods during rare wet years. Flows to the mainstem of the San Joaquin in this reach have been greatly reduced from historic conditions because of the bypass system, artificial levee construction, and the many small storage reservoirs near the headwaters of these smaller tributaries.

After winter inflows have ceased in late spring, most of the overland flow to the river in this reach is from the Delta-Mendota Canal, which empties at its southern end into Mendota Pool. There is always some flow in all seasons in the Merced to Mendota Pool reach, albeit often of poor quality. During the dry season, much of this reach carries low flows that are generally heavily laden with agricultural contaminants and too warm to support stable anadromous or resident fish populations, except possibly invasive species.

Mendota Pool to Gravelly Ford Ecological Management Unit

This short reach of the river (24 miles) extends from the sharp eastward bend of the mainstem at the confluence with Fresno Slough to Gravelly Ford. Historically, Gravelly Ford was where the velocity of the current dropped sharply, active downcutting stopped, and much of the alluvial deposition began. It is also the approximate location where local inflow from side streams and local precipitation are no longer enough to maintain the San Joaquin River at the observed discharge. As is the case for most of the rivers on the floor of the Central Valley, these characteristics of the San Joaquin River below Gravelly Ford are clear indicators that this is a highly fragile aquatic riverine system.

There is no significant tributary inflow for this reach. Since the completion of Friant Dam, the reach is dry for much of the year. Gravel mining directly on the river bed has severely degraded the main channel, rendering these areas likely incapable of supporting salmon spawning and rearing even if adequate flows were available. The floodplain has been confined by levees, and vegetation has encroached into the abandoned channel. This is one of the most severely degraded river reaches in the entire state. It once supported a vibrant and robust anadromous fishery, but now it is dry much of the year and has not had a self-sustaining salmon run for nearly 60 years.

Gravelly Ford to Friant Dam Ecological Management Unit

This reach of the river extends 31 miles from immediately below Friant Dam, running along the Fresno-Madera County line just north of Fresno, and it historically supported an active anadromous fishery. Presently, except for rare periods during winter and spring high flows when Friant Dam is spilling, most of the reservoir releases are diverted either into the Friant-Kern Canal to the south or the Madera Canal to the north. Releases to support local riparian diversions below the dam range from 35 to 230 cfs, a tiny fraction of the flow needed to support an active fishery and to maintain the channel in a good condition for anadromous and resident fish habitat. During the dry season, little, if any, surface flow makes it the entire 31 miles to Gravelly Ford. However, the meager flow that occurs in this reach provides recreational value for the urban areas of nearby Fresno and its satellite communities. Even with the extirpation of the salmon runs in this reach, the river still has significant recreational value.

Applicable ERP Vision

The overall vision for the San Joaquin River Ecological Management Zone includes significant improvements in floodplain and stream–channel habitats consistent with flood control and urban and agricultural development plans in the San Joaquin Valley floodplain. It will also restore important fishery, wildlife, and plant communities and their associated ecological processes to stable, self-sustaining healthy conditions and reduce stressors that inhibit health and limit restoration. Much of the San Joaquin River system and its tributaries have been severely degraded. The stressors that have caused much of this degradation will have to be reduced to bring about significant recovery of habitats and species.

To initiate and promote recovery of aquatic habitat, streamflows must be augmented. Reactivation of stream meanders, installation of fish screens on diversions, and reduction in levee confinement on floodplains will also be required. The visions for the San Joaquin River EMZ also place high priority on: 1) connecting fragmented riparian and seasonal floodplain corridors; 2) restoring natural channel meanders and unconfined broad floodplains to promote self-sustaining riparian succession; 3) phasing out of instream sand and gravel mining and replacement with mines at locations which will not affect the main river channel or floodplains; 4) reducing fine sediment and contaminant inputs to tributaries; 5) augmenting streamflows to provide adequate temperatures for migrating salmonids and resident native fish; and 6) improving land management and grazing practices, especially in riparian zones.

Vernalis to Merced River Ecological Management Unit

The vision for this EMU is to restore the stream meander corridor to benefit upstream and downstream migration of fall-run Chinook salmon and steelhead, and to restore spawning and rearing habitat for American shad, striped bass, white and green sturgeon, and splittail. The vision also strives to reduce the loss of fish to water diversions, improve streamflows at critical times of year, re-establish a functional floodplain and a balanced sediment budget, and improve water quality by reducing input of contaminants to the river.

Merced River to Mendota Pool Ecological Management Unit

The vision for this EMU is to reduce the input of contaminants from Westside drainage and reduce straying of fall-run Chinook salmon upstream of the confluence with the Merced River. The vision for this reach is similar to that for the Vernalis to Merced River EMU. An important vision for these two reaches is to restore frequent flooding on expanded floodplains, which will provide much-needed food production, as well as critical spawning and rearing habitat

Mendota Pool to Gravelly Ford Ecological Management Unit

The vision for the heavily degraded reach of this EMU is to cease all gravel mining that is occurring directly in the river channel. More water will be released from upstream reservoirs to restore salmon and steelhead spawning and rearing habitat to the entire reach. Floodplains will be expanded with setback levees and removing confining vegetation, which has encroached into the abandoned river channel.

Gravelly Ford to Friant Dam Ecological Management Unit

The vision for this EMU focuses on maintaining native resident fishes and waterfowl and wildlife habitat by restoring minimum streamflows, stream-channel configuration, and the riparian corridor. The vision also proposes channel improvements to augment gravel and reduce fine sediment in spawning beds below Friant Dam. Riparian corridor vegetation would be re-established to provide shading and rearing habitat opportunities. The reach would benefit from increased flows during the salmon migration season, especially summer and late fall.

Stage 1 Expectations

Stage 1 expectations were not specifically addressed within the ERPP Volume II (CALFED 2000b) for the San Joaquin River EMZ or its associated EMUs. However, relevant expectations can be construed from the visions listed above.

Changes Attributable to ERP

The following is a brief evaluation of each of the projects that occurred within the San Joaquin River EMZ. Many of the projects affect other EMZs in addition to the San Joaquin River, most notably the three major tributary rivers (Stanislaus, Tuolumne and Merced) in the East San Joaquin Basin EMZ. Projects that affected more than one zone may be discussed in more detail within other EMZ sections of this report.

Much of the effort in the San Joaquin River area has concentrated on research, monitoring, and pilot studies to improve understanding of the alternative restoration strategies and their applicability, comparative effectiveness, cost, and impacts. Nearly all projects were completed with at least some limited degree of success. Some of the monitoring projects are ongoing and have been funded subsequently under other programs outside CALFED.

One research project, *San Joaquin River Drainage Fall-Run Chinook Salmon Genetic Baseline and Discrimination Evaluation* (**ERP-97-C09**), successfully developed analytical methods for determining genetic differences between spawning stocks on the

San Joaquin River and its tributaries and the stocks from other rivers in the Central Valley. The project will help to discriminate between the San Joaquin fall-run stock and other fall runs in the Central Valley.

The *San Joaquin Valley "Salmonids in the Classroom" Program Enhancement* (**ERP-98-B30**) project is an ongoing program that educates students about life cycles and issues concerning salmonids. Through CALFED funding, most of the classroom material was translated into non-English local languages. It is not easy to measure or observe changes brought about by educational projects, but this program has been well received by local school districts. Funding was modest for the project – this program should be evaluated for its effectiveness and expanded if the evaluation warrants it.

Two projects were implemented in the San Joaquin River EMZ during Stage 1 to improve instream water quality. The results of these water quality management programs should enable wetland managers and others to manage wetland landscapes with a better understanding of how their actions affect San Joaquin River water quality.

The *San Joaquin River Real Time Water Quality Management Program* (**ERP-97-C08**) project expanded the Department of Water Resources (DWR) water quality monitoring for the lower San Joaquin River and tributaries. The monitoring plan indicated that a key goal was to include 12 stations and to analyze samples for salinity, boron, electrical conductivity, and total suspended solids. This monitoring program was continued using other DWR funding after 2002. The final report has not been prepared as the monitoring is still in progress.

The *Biological Agricultural Systems in Cotton-BASIC-Reducing Synthetic Pesticides & Fertilizers in the Northern San Joaquin Valley* (**ERP-99-B14**) project is an agricultural pollution prevention program administered by the Sustainable Cotton Project (SCP). BASIC reduces pollution of ground and surface waters by assisting farmers seeking to reduce or eliminate their use of damaging chemicals, through a farmer-to-farmer mentoring program. BASIC is a voluntary, community-based program for cotton growers, which helps farmers to develop a set of tools that will allow them to not only reduce inputs, but save money. These tools include biological control systems, intensive regular crop monitoring, and alternative methods of weed control. The project is supported by grants from CALFED, State Water Resources Control Board, and private foundations. The project goal was to expand the existing farmer education and outreach program. This project will indirectly contribute to improved water quality in the San Joaquin River and tributary streams and canals. The project was completed and a final report prepared in May 2003. Local cotton growers indicated that the program helped them to significantly reduce their use of pesticides and fertilizers. The project proponent plans to further expand the program in the San Joaquin Basin using other funds.

Two projects addressed riparian vegetation recruitment in the San Joaquin Basin. The first project, *Pilot Project to Benefit Riparian Vegetation along the San Joaquin River* (**ERP-99-B29**), implemented a one-time augmentation of flows in the river below Friant Dam during the June to October period to promote dispersal and germination of riparian plants, primarily willow and cottonwood. The experimental increase in flows was done during the 1999 irrigation season. The study's final report claimed an increase in willow germination as a direct result of the flow augmentation. The second project, *A Mechanistic Approach to Riparian Restoration in the San Joaquin Basin* (**ERP-00-F04**), developed a model to identify mechanisms affecting establishment of riparian trees, and identified cost-effective restoration strategies. Tuolumne River sites were used in the study. The final report describes in detail the model developed to predict riparian growth.

A third, related, project, *Focused Action to Develop Ecologically-Based Hydrologic Models and Water Management Strategies in the San Joaquin Basin* (**ERP-00-B04**), developed a model for flows in the San Joaquin River. The model demonstrates a range of strategies for operating reservoirs to benefit fishery and riparian re-establishment. The model was completed as planned in August 2003, and could be used in the ongoing interagency San Joaquin River restoration effort.

Vernalis to Merced River Ecological Management Unit

The land acquisitions and easements projects were the ERP projects during Stage 1 that have brought about an immediate and observable change to the ecosystem in the San Joaquin Basin. Most of these acquisitions were for riparian, floodplain, or wetland protection and restoration.

The *San Joaquin River NWR Riparian Habitat Protection & Floodplain Restoration Project - Phase II* (**ERP-01-N08**) successfully acquired significant habitat for the riparian brush rabbit and associated species in the lower San Joaquin River. The project completed easements on about 400 acquired acres and restored 1,142 acres of riparian and wetlands habitat by December 2006. In a similar project, *Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River* (**ERP-02D-C11**), the goal is to restore riparian habitats at the San Joaquin River NWR and to reintroduce a new population of riparian brush rabbit near the Caswell State Park core population. This project is in progress for tasks that include the acquisition of land or easements, biological assessment and permitting, and riparian brush rabbit reintroduction.

The *San Joaquin River National Wildlife Refuge Riparian Habitat Protection and Floodplain Restoration Project - Phase I* (**ERP-97-B04**) project successfully acquired 3,230 acres of riparian and wetland habitat along the San Joaquin River for the benefit of the following species: fall-run Chinook salmon, splittail, Aleutian Canada goose, greater sandhill crane, western yellow-billed cuckoo, Swainson's hawk, bald eagle,

riparian brush rabbit, riparian wood rat, valley elderberry longhorn beetle, shorebirds, waterfowl, herons, and Neotropical songbirds. The *Lower San Joaquin River Floodplain Protection and Restoration Project* (**ERP-98-F21**) project acquired lands along the San Joaquin River floodplain for future enhancement of riparian and wetland habitats. The acquisitions were completed in 2002 as proposed. Restoration efforts may be done using Fish and Wildlife Service funds. The project was a valuable part of San Joaquin River floodplain restoration efforts.

The goal of *Acquisition of Floodplain Easements - Lower Tuolumne and San Joaquin Rivers* (**ERP-99-R01**) was to acquire and restore portions of floodplains, as well as monitor vegetation and wildlife changes. The acquisition was completed in March 2001. A total of 992 acres of flood-damaged lands were acquired on the Tuolumne and San Joaquin rivers. No restoration was done in this phase.

One on-going education project, *Educating Farmers and Landowners in Biological Resource Management* (**ERP-01-N42**), is continuing with the goal of educating San Joaquin Basin farmers and landowners about practices to reduce the use of chemicals. Implementing the management practices will improve water quality. One of two demonstration sites was on the Merced River. The initial phase was completed in 2005, but this educational program is continuing with other funding sources.

Two related projects, *Patterson Irrigation District Positive Barrier Fish Screen Study on San Joaquin River Diversion* (**ERP-01-N56**) and *Patterson Irrigation District Fish Screen Design and Environmental Review* (**ERP-02-P16**), provided planning and feasibility studies for the replacement of a fish screen barrier in conjunction with a re-design of the district's pumps and diversion works. The planning study was completed in December 2002. The follow-up effort included the preliminary and final design for a new diversion, pumping enclosure, and a fish screen for the district's intake. The goal of the re-design was to prevent entrainment of migrating fish into the intake facility. The design phase was completed successfully in February 2007. This phase also included an environmental assessment to meet the requirements of the Endangered Species Act. The design study was approved by the Interagency Fish Screen Advisory Committee and included in the 2007 project list for funding requests to Congress.

Three projects provided research and development for water temperature models. The *Stanislaus - Lower San Joaquin River Water Temperature Modeling and Analysis* (**ERP-02-P28**) project entailed a collaborative effort to develop a computer model to predict water temperature based on alternative reservoir operations. A model was completed in October 2006 for the San Joaquin River below its confluence with the Stanislaus. The *San Joaquin River Basin Water Temperature Modeling and Analysis* (**ERP-06D-S20**) project expanded and calibrated the Stanislaus River model developed under **ERP-02-P28** to include the Merced, Tuolumne, and San Joaquin rivers above the confluence with the Stanislaus. This is an ongoing project. A related project, *Data Collection for the San Joaquin Basin-wide Temperature Model* (**ERP-05D-S02**),

provides support for the development of the water temperature models for the San Joaquin River and tributaries. Water temperature data collected will be used for model calibration. The ongoing data collection effort is on schedule to date. The collection network includes 106 river thermographs, temperature profiles for reservoirs, and five meteorological stations.

A research project, *Health Monitoring of Hatchery and Natural Fall-run Chinook Juveniles in the San Joaquin River and Delta* (**ERP-99-B19**), characterized the health and condition of natural and hatchery Chinook salmon in the San Joaquin River and the Delta. Two sampling locations were on the San Joaquin River mainstem, one was on the Merced River, and a fourth location was in the Delta. All samples were collected and analyzed as planned. The study was completed in January 2001. Study results are to be published in a final report, which is undergoing agency review.

Merced River to Mendota Pool Ecological Management Unit

The *Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District* **(ERP-00-B05)** research project developed a pilot wetland drainage monitoring system, habitat and salinity management program, and a model to forecast salt loading. The management program was developed and implemented successfully by Grasslands Water District in June 2004. Water quality was improved after the management program was implemented. The Grassland Modified Hydrology effort/program is going into its third year and second evaluation. A final report will compare the baseline to one and two years of modification. The project is providing wetland managers with new information about soil salinity, vegetation, and avian response. The results of the project should enable wetland managers to manage wetland landscapes with a better understanding of how their actions affect San Joaquin water quality.

The goal of *Feasibility Analysis for the San Joaquin-Bear Creek Floodplain Restoration Project, San Luis National Wildlife Refuge, Merced County* (**ERP-97-B05**) was to restore unimpeded overflow at West Bear Creek Unit in the San Luis National Wildlife Refuge, as well as assess wildlife habitat benefits and potential impacts to adjacent lands managed by the refuge. The project showed that it was feasible to restore previously degraded riparian forest habitat, which provides direct benefit to fisheries and to the aquatic ecosystem along 10 miles of the lower San Joaquin River. The species to benefit from habitat restoration include: Sacramento splittail, anadromous salmonids, native resident fish, greater sandhill crane, Aleutian Canada goose, giant garter snake, western yellow-billed cuckoo, Swainson's hawk, tricolored blackbird, riparian brush rabbit, waterfowl, shorebirds, wading birds, and Neotropical migratory birds.

Mendota Pool to Gravelly Ford Ecological Management Unit

There were no ERP-funded projects that occurred exclusively within this EMU. However, several of the projects discussed under the San Joaquin River EMZ section were implemented within, or obtained results that are applicable to, this EMU as well as one or more other EMUs within the EMZ. Those projects were **ERP-00-B04**, **ERP-97-C09**, **ERP-98-B30**, **ERP-99-B14**, and **ERP-99-B29**. See the above discussion for more detail on these projects.

Gravelly Ford to Friant Dam Ecological Management Unit

The *River Studies Center Exhibits and Programs* (**ERP-99-B25**) educational project developed an exhibit at Riverview Ranch, which is located along the San Joaquin River below Friant Dam. The purpose was to further public awareness of the degraded and fragile nature of the San Joaquin River fishery and related riparian and floodplain ecosystems. Two exhibits were completed in the year 2000. A river ecology video was also prepared. The project as planned is complete and was well received by local residents in the Fresno area. The Riverview Ranch exhibits could be updated to reflect recent developments such as the September 2006 San Joaquin River Settlement between the Bureau of Reclamation and the Natural Resources Defense Council.

Project Summary Table

The following table summarizes general project information and lists all projects that were reviewed for evaluation in this Ecological Management Zone.

Table 1. San Joaquin River Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
San Joaquin River Ecological Management Zone				
ERP-00-B04	**Focused Action to Develop Ecologically-based Hydrologic Models and Water Management Strategies in the San Joaquin Basin** The project identified flow regimes that have a widespread effect on the entire length of the San Joaquin River tributaries, Delta and San Francisco Bay through analysis and modeling of hydro-biologic issues and water management.	3/30/2003	$295,925	Complete.
ERP-00-F04	**A Mechanistic Approach to Riparian Restoration in the San Joaquin Basin** Project identified the physical and biological mechanisms affecting establishment of riparian vegetation in the San Joaquin Basin in order to identify the most cost-effective strategies and sites for riparian protection and restoration.	3/31/2006	$293,532	Complete.

ERP-97-C08	**San Joaquin River Real Time Water Quality Management Program** This project expanded water quality monitoring activities in the San Joaquin River to enhance water resource management.	6/30/2002	$931,857	Complete.
ERP-97-C09	**San Joaquin River Drainage Fall-Run Chinook Salmon Genetic Baseline and Discrimination Evaluation** This project developed a genetic baseline for fall-run Chinook salmon in the San Joaquin River Basin.	6/30/2002	$387,003	Complete.
ERP-98-B30	**San Joaquin Valley "Salmonids in the Classroom" Program Enhancement** This project continued the existing classroom education program in the San Joaquin Basin regarding life cycles and issues for salmonids by translating the Salmonids in the Classroom curriculum into Spanish, Hmong, Lao and Khmer.	12/31/2001	$3,000	Complete.
ERP-99-B14	**Biological Agricultural Systems in Cotton-BASIC-Reducing Synthetic Pesticides & Fertilizers in the Northern San Joaquin Valley** The project provided funds for significant expansion of the BASIC program in the Northern San Joaquin Valley with the goal of reducing the dependence of farmers on chemical pesticide and fertilizer inputs, thereby helping to improve water quality in the area.	3/31/2003	$429,894	Complete.
ERP-99-B29	**Pilot Project to Benefit Riparian Vegetation Along the San Joaquin River** Monitored the downstream effects of the augmented flows at ten recommended cross sections, including the response of riparian seedlings and saplings on the San Joaquin River.	4/8/2002	$2,500,000	Complete.
Vernalis to Merced River Ecological Management Unit				
ERP-01-N08	**San Joaquin River NWR Riparian Habitat Protection & Floodplain Restoration Project - Phase II** Acquisition of an easement on 400 acres of habitat adjacent to the San Joaquin River NWR; restoration of 1,142 acres of riparian and wetlands habitat on refuge lands; a pilot re-introduction of riparian brush rabbits onto refuge lands; and biological monitoring and evaluation.	12/31/2006	$7,968,112	Complete. Project acquired 362 acres and restored 808 acres.
ERP-01-N42	**Educating Farmers and Landowners in Biological Resource Management** This project provided funding to continue the efforts of CAFF to educate farmers and landowners about reducing chemical use to improve water quality.	1/31/2005	$1,066,593	Complete.
ERP-01-N56	**Patterson Irrigation District Positive Barrier Fish Screen Study on San Joaquin River Diversion** Positive barrier fish screen on the San Joaquin River Pumping Plant will provide a reliable water supply for the irrigation district while protecting the San Joaquin River fishery.	12/31/2002	$175,000	Complete.
ERP-02-P16	**Patterson Irrigation District Fish Screen Design and Environmental Review** This project covered the tasks necessary to complete the preliminary and final engineering design for a new diversion and pumping enclosure facility adjacent to the existing diversion.	2/12/2007	$639,700	Complete.

ERP-02-P28	**Stanislaus - Lower San Joaquin River Water Temperature Modeling and Analysis** This project performed modeling and analysis of various alternatives for water management in the Stanislaus River Basin.	10/31/2006	$878,827	Complete.
ERP-02D-C11	**Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River** This project will restore riparian habitats along the lower Stanislaus and San Joaquin rivers adjacent to the Caswell State Park and the SJ river National Wildlife Refuge.	5/31/2011	$5,465,944	Ongoing. Project proposes to acquire 180+ acres and restore 50 acres.
ERP-05D-S02	**Data Collection for the San Joaquin Basin-wide Temperature Model** This directed action provides the funding needed by DFG to carry out the support activities related to collecting, storing, and managing water temperature and meteorological data in support of developing the San Joaquin River Basin-Wide Water Temperature Model.	6/30/2008	$781,000	Ongoing.
ERP-06D-S20	**San Joaquin River Basin Water Temperature Modeling and Analysis** Expands the existing Stanislaus-Lower San Joaquin River Water Temperature Model to include the Tuolumne and Merced Rivers, and the main-stem San Joaquin River from Stevenson to Mossdale.	12/31/2008	$716,052	Ongoing.
ERP-97-B04	**San Joaquin River National Wildlife Refuge Riparian Habitat Protection and Floodplain Restoration Project - Phase I** This project acquired lands for protection and eventual restoration of riparian and wetland habitats along the San Joaquin River.	3/31/2002	$10,947,000	Complete. Project acquired 3230 acres of land around the San Joaquin River NWR.
ERP-98-F21	**Lower San Joaquin River Floodplain Protection and Restoration Project** This project acquired property (fee title) adjacent to the San Joaquin River and eastside tributaries to preserve and for future enhancement of riparian and wetland habitats.	9/30/2002	$1,100,000	Complete. Project acquired 223 acres.
ERP-99-B19	**Health Monitoring of Hatchery and Natural Fall-run Chinook Juveniles in the San Joaquin River and Delta** This project characterized the health and physiological condition of both natural and hatchery juvenile Chinook salmon in the San Joaquin River and Delta.	1/1/2001	$37,860	Complete.
ERP-99-R01	**Acquisition of Floodplain Easements - Lower Tuolumne and San Joaquin Rivers** This project acquired and restored areas prone to flood damage, and monitored vegetation and wildlife populations.	3/31/2001	$1,412,108	Complete. Project acquired 992 acres.
Merced River to Mendota Pool Ecological Management Unit				
ERP-00-B05	**Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District** Provided monitoring, modeling and adaptive management of field operations to coordinate seasonal wetland drainage with the assimilative capacity of the San Joaquin River for salinity.	6/30/2004	$697,330	Complete.
ERP-97-B05	**Feasibility Analysis for the San Joaquin-Bear Creek Floodplain Restoration Project, San Luis National Wildlife Refuge, Merced County** Evaluated the benefits and impacts of allowing seasonal flooding onto lands adjacent to Bear Creek onto refuge lands.	9/30/2000	$334,000	Complete.

Gravelly Ford to Friant Dam Ecological Management Unit				
ERP-99-B25	**River Studies Center Exhibits and Programs** Developed environmental education program exhibits for Riverview Ranch to educate the public about natural resource issues of the San Joaquin river from it's head waters to the San Francisco Bay.	12/31/2002	$68,379	Complete.

Other Programs Contributing to ERP Vision

Two large-scale, comprehensive projects for the San Joaquin River have contributed to the ERP vision for the San Joaquin River EMZ:

- *Sacramento and San Joaquin River Basins Comprehensive Study*. This study was completed in 2002 and entailed a coordinated effort between the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the California Department of Water Resources, and others. The study goals were to develop a system-wide, comprehensive flood management plan for the Central Valley, which would reduce flood damage and provide ecosystem restoration. Numerous hydrological models were used to assess potential system-wide effects when the existing flood management system was modified. The models' results were then used as a basis for future project development.

- *San Joaquin River Restoration Program*. In September 2006, the U.S. Departments of Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority entered into a stipulated Settlement agreement to end an 18-year lawsuit. The agreement was approved in Federal Court in October 2006, and legislation to authorize Federal agencies to implement the terms of the Settlement was entered into Congress in January 2007. The Settlement has two goals: 1) restore and maintain fish populations in "good condition" in the mainstem of the San Joaquin River from Friant Dam to the Merced River confluence; and 2) to reduce or avoid adverse water supply impacts to all Friant long-term water contractors which may result from the interim and restoration flows provided for in the Settlement.

Planned Projects for Implementation

In Stage 1, most of the projects in the San Joaquin River EMZ involved research, monitoring, education, or pilot demonstrations. The objective was to establish a solid baseline of scientific and technical data and tools, which would serve as a guide for future implementation projects in Stage 2.

The projects *Patterson Irrigation District Positive Barrier Fish Screen Study on San Joaquin River Diversion* (**ERP-01-N56**) and *Patterson Irrigation District Fish Screen*

Design and Environmental Review (**ERP-02-P16**), which are two phases of the same project, provided planning and feasibility for the replacement of a fish screen barrier in conjunction with a re-design of the district's pumps and diversion works. The planning study was completed in December 2002. The follow-up effort included the preliminary and final design for a new diversion, pumping enclosure, and a fish screen for the district's intake. The goal of the re-design was to prevent entrainment of migrating fish into the intake facility. The design phase was completed successfully in February 2007. This phase also included an environmental assessment to meet the requirements of the Endangered Species Act. The design study was approved by the Interagency Fish Screen Advisory Committee and included in the 2007 project list for funding requests to Congress.

Status of the Area Today

As with other ecological management zones within the Central Valley, the San Joaquin River, since the inception of CALFED in 1995, has experienced only modest improvements in the overall health of the ecosystem. Continued declines in levels of key species such as the fall-run Chinook salmon have been observed. This continuing decline in the health of the ecosystem can be attributed, in part, to the fact that much of the emphasis on ecosystem restoration during the first years of CALFED in the San Joaquin River and its tributaries has been on research and studies which are directed toward the identification of specific limiting factors and stressors (such as stream temperature) for specific river reaches. Future efforts will be more productive if aimed at expansion of floodplains with setback levees, resulting in increased food production and habitat for juvenile salmonids.

Some of the completed projects have entailed pilot studies to determine effectiveness of altered release schedules or operational strategies and their effect on riparian, floodplain, and wetland habitats. Full benefit from these studies will not be realized until the strategies are implemented over time. For example, the Anadromous Fish Screen Program to reduce entrainment of anadromous salmonids into diversion structures has funded studies for feasibility and design, but has not constructed any new screens on the San Joaquin River.

Another reason for the continuing decline in the overall health of the San Joaquin River ecosystem, despite implementation of some ERP projects, is that other adverse factors affecting the health of the ecosystem had an overriding effect - factors which were not anticipated when CALFED was originally framed. These include accelerated urban and industrial growth in many parts of the San Joaquin Valley and adjacent foothills, and increased use of pesticides and fertilizers in expanding agricultural operations.

Urban and industrial growth in the area has further encroached on the already-degraded floodplain and wetland habitats along the river. This effect has likely more

than offset the modest benefits which have been achieved from the acquisition of the approximate 4,500 acres of riparian, floodplain, and wetland habitat which have, as a result of CALFED funding, come under improved management for the San Joaquin River area.

There is new information that affects the San Joaquin River EMZ and the East San Joaquin Basin EMZ. Through CALFED monitoring efforts and other associated federal and state program interests, a limiting factor analyses was conducted for all three tributaries (Mesick et al. 2007). This evaluation indicated that the survival of fry and out-migrating smolts are the most critical life history stages, and that the magnitude and duration of winter and spring flows are the primary factors that control the production of smolt out-migrants and adult fall-run salmon. The analyses also suggest that the critical period for juvenile rearing and outmigration occurs from March through about mid-June. There is evidence to suggest that high flows produce large numbers of adult fish by:

- Increasing the number of fry that survive to a smolt-size in the Tributaries from March through May;
- Increasing the survival of smolts migrating through the Delta from April through mid-June;
- Increasing the survival of smolts entering the ocean in June and July.

These conclusions are based on correlation analyses between fish abundance and survival, mean flow magnitude, and spawner abundance. Three estimates of fish abundance and survival were used:

- Adult recruitment, which is the combined number of fish in the escapement and ocean harvest that are segregated into cohorts of same-aged fish;
- Preliminary estimates of juvenile salmon abundance based on calibrated rotary screw trap catches (estimates are preliminary, because the trap efficiency models have not been finalized); and
- Coded-Wire-Tag smolt survival studies.

This new information will necessitate a reevaluation of the restoration program for the lower San Joaquin River EMZ including the tributaries, Stanislaus, Tuolumne, and Merced rivers. Emphasis should be placed on habitat for juvenile salmonids as well as adults.

Studies by the California Department of Fish and Game have demonstrated that survival and escapement of the San Joaquin River fall-run Chinook salmon are higher when spring flows on the mainstem were higher 2.5 years earlier. This would be the period when juveniles emigrated to the ocean. Salmon escapement is also observed to be

high, and population growth positive, when the discharge at Vernalis in March is maintained at a level of at least 5,000 cfs. This target, as set forth in the 1995 Bay-Delta Basin Plan, has been missed in most recent years on the lower San Joaquin River. Consequently, freshwater inflows from the San Joaquin Basin into the Delta have reached near record lows in several years since the year 2000. This has contributed, in part, to the continuing increase in salinity levels in the Delta and the continuing pelagic organism decline in that area (Delta Vision Blue Ribbon Task Force 2007).

Impediments to Implementation

Potential impediments to implementation of the strategies and criteria identified by studies in Stage 1 include institutional barriers, lack of funding toward project implementation and monitoring, lack of agreement in the scientific community as to limiting factors for ecosystem recovery, rapid turnover in expert scientific and administrative staff, lack of sound quality assurance plans, and lack of an effective monitoring and tracking system to assess progress made toward goals.

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APPENDIX A

A.13. EAST SAN JOAQUIN BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The East San Joaquin Basin Ecological Management Zone (EMZ) is located in the northern San Joaquin Valley and extends from the southern area of San Joaquin County south to Stanislaus and Merced Counties. It is one of three zones in the San Joaquin Valley Region. The zone is made up of three units that follow the watersheds of the lower Stanislaus, Tuolumne, and Merced rivers, which are the three main tributaries of the San Joaquin River (Figure 1).

- Stanislaus River Ecological Management Unit (EMU)
- Tuolumne River Ecological Management Unit
- Merced River Ecological Management Unit

These rivers contribute to the health of the Delta by supplying fresh water flows, nutrients, sediments, and native habitats (CALFED 2000a). The Delta is dependent on the quality of habitat within this zone to support the ecological function of that downstream system and the health of the plant, fish, and wildlife species located within this zone. Riparian and aquatic riverine habitats are especially important and contribute to adjacent wetland areas. Seasonally flooded wetlands found in the lower reaches are important for waterfowl species. Freshwater fish habitat and essential fish habitat are present throughout the zone and require specific management as special designation aquatic habitats.

Important habitats with extensive biological values include the grassland/vernal pool complexes in the eastern foothills, and large perennial and seasonal wetland preserves which include the San Joaquin and Merced National Wildlife refuges. The zone also includes Caswell Memorial State Park, one of the few remaining remnants of old growth Great Valley riparian habitat remaining in the San Joaquin Valley.

Important plant and wildlife species are found within these units, with a major focus on fall-run Chinook salmon, steelhead, riparian brush rabbit, and giant garter snake recovery efforts.

All three units share challenges to successful ecological restoration due to physical barriers and water usage issues that limit water flows, habitat suitability, species migration and reproduction, sediment transport, and other natural river functions.

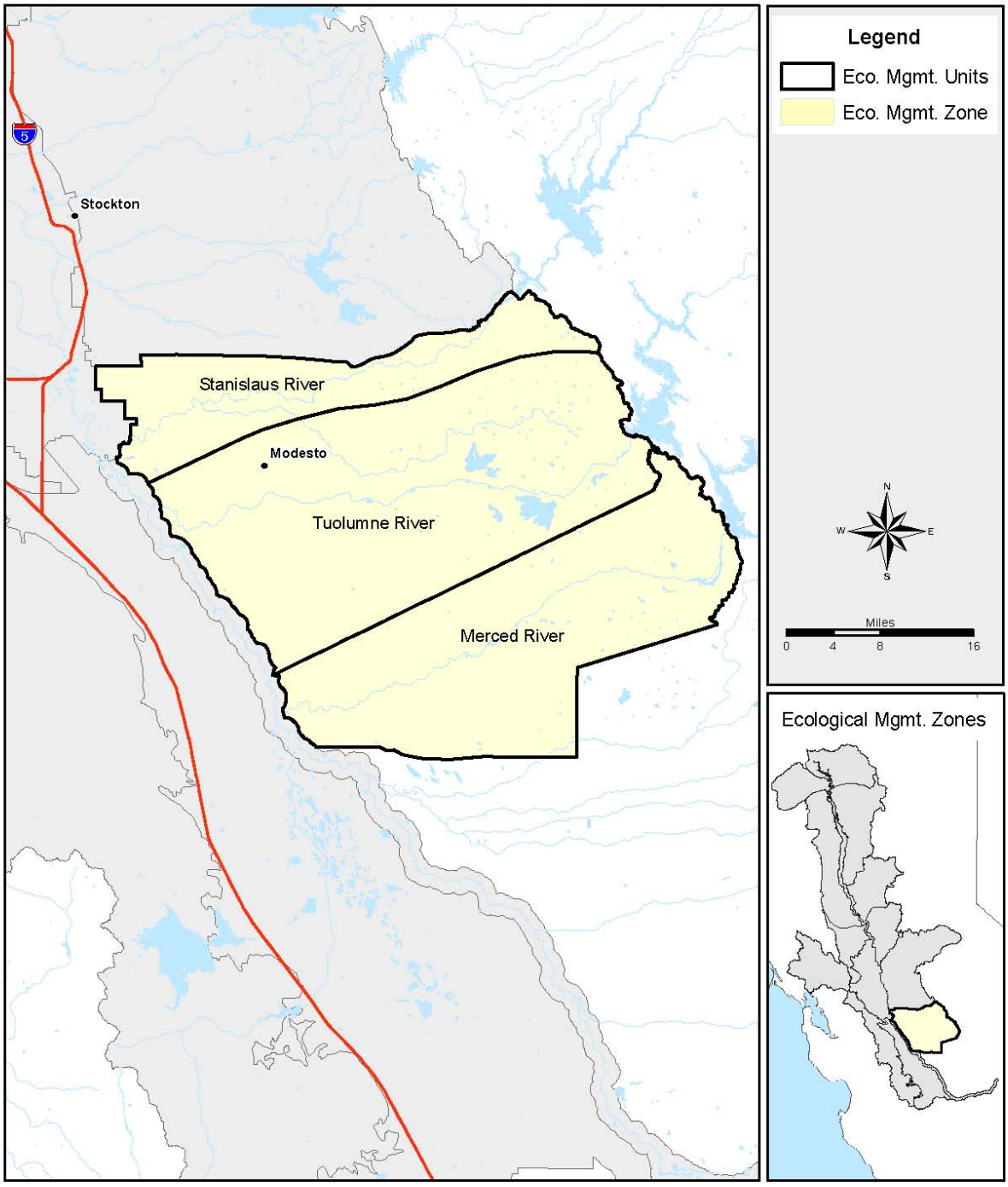

Figure 1. East San Joaquin Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. East San Joaquin Basin EMZ Map

Stanislaus River Ecological Management Unit

The most northern of the three East San Joaquin Basin tributaries is the Stanislaus River EMU. The river drainage area is approximately 1,100 square miles in size, flowing west from the crest of the Sierra Nevada Mountains down into the San Joaquin Valley through the towns of Knights Ferry, Oakdale, and Ripon. The average unimpaired runoff in the basin is about 1.2 million acre feet. New Melones Reservoir, approved for filling in 1981, is the largest storage reservoir in the Stanislaus watershed and has a gross capacity of 2.4 acre feet (af). It is operated by the U.S. Bureau of Reclamation as part of the Federal Central Valley Project. Downstream of New Melones Reservoir is Tulloch Reservoir, which has the capacity to regulate 68,400 af of water. Below Tulloch Reservoir is Goodwin Dam, which regulates water for power and irrigation to South San Joaquin and Oakdale Irrigation districts.

Tuolumne River Ecological Management Unit

The central drainage of the three main San Joaquin Basin tributaries in the East San Joaquin Basin EMZ, and the largest tributary of the basin, is the Tuolumne River EMU. The river has an average annual runoff of 1.95 million af and a drainage area approximately 1,900 square miles in size, including the northern half of Yosemite National Park. Each year, a portion of the water received from this drainage (220,000 af) is redirected from the Hetch Hetchy Reservoir and Cherry Lake to San Francisco. Don Pedro Reservoir, with a gross storage capacity of 2.03 million af, regulates the flows for the lower Tuolumne River in conjunction with the La Grange Dam, located a few miles downstream. It is managed jointly by Turlock and Modesto Irrigation districts for power, irrigation, and flood control, diverting approximately 900,000 af per year. Dams, agriculture, urban development, sand and gravel mining, and historic gold dredger mining have had major impacts to the river over the last century.

Merced River Ecological Management Unit

The Merced River EMU is the southern most watershed of the three main East San Joaquin Basin EMZ tributaries. The river drainage covers approximately 1,275 square miles of the Sierra Nevada Mountains and foothills, flowing west from the crest of Yosemite National Park down through the towns of Snelling, Merced, and Livingston. The average unimpaired runoff is just over 1 million af, similar to the Stanislaus River. The New Exchequer Dam on Lake McClure has a gross storage capacity of 1,024,000 af and regulates the releases to the lower Merced River. The dam is operated by Merced Irrigation and Turlock Irrigation districts for power production, irrigation, and flood control. McSwain Dam, an afterbay of the New Exchequer Dam, and the Merced Falls and Crocker-Huffman Diversion dams, are located downstream of Lake McClure. Approximately 500,000 af of water is diverted from the Merced River each year.

Applicable ERP Vision

The vision for the East San Joaquin Basin EMZ focuses on restoring wildlife, plant communities, and important fish species and associated habitats by restoring ecological processes and eliminating stressors. Priorities to accomplish the restoration of ecological processes target work that would improve the streamflows, increase coarse sediment supplies, lower water temperatures, and improve watershed health. This includes work that would increase overall system productivity and create or improve aquatic, riparian, wetland, and seasonally inundated floodplain habitats. Actions that would reduce stressors include limited wild fish harvests, eliminating entrainment at agricultural diversions, and restoring the effects of gravel mining.

Stanislaus River Ecological Management Unit

The vision for this EMU includes reactivating and maintaining important ecological processes by improving streamflow, water temperatures, gravel recruitment, stream channel and riparian habitat, and screening diversions to increase the survival of Chinook salmon, steelhead, and native resident fish and wildlife.

Tuolumne River Ecological Management Unit

The vision for this EMU includes restoring important ecological processes by maintaining suitable water temperatures, restoring streamflow, gravel recruitment, and stream channel and riparian habitat to improve habitat for Chinook salmon, steelhead, native resident fish, native amphibians and reptiles, and wildlife.

Merced River Ecological Management Unit

The vision for this EMU includes maintaining suitable water temperatures, restoring streamflow, coarse sediment recruitment, and stream and channel habitat to improve ecological functions and processes for fall- and late-fall-run Chinook salmon, steelhead, native amphibians and reptiles, riparian vegetation, and wildlife resources.

Stage 1 Expectations

Stage 1 expectations were not specifically addressed within the ERPP Volume II (CALFED 2000b) for most of the tributaries within the East San Joaquin Basin, with the exception of the Tuolumne River EMU demonstration project discussed below. However, relevant expectations can be construed from the visions listed above.

Tuolumne River Ecological Management Unit

The Tuolumne River watershed was selected as a demonstration watershed for Stage 1 implementation. During Stage 1 CALFED was to have supported ongoing efforts, and enhanced management and restoration efforts in the watershed. Success in Stage 1 was to have set the stage for subsequent implementation phases as the restoration and management information gained from the effort in the Tuolumne watershed. The effort was to have broad application in designing and implementing similar programs in similar watersheds in the San Joaquin Basin and elsewhere in the Central Valley.

Changes Attributable to ERP

Projects to support the education of ecological concepts and implementation strategies to benefit river habitats were funded throughout the East San Joaquin Basin EMZ. The focus of the *San Joaquin Valley "Salmonids in the Classroom" Program Enhancement* (**ERP-98-B30**) and *Conferences and Field Tours for Viable Solutions to the Agriculturally Impacted San Joaquin River Watershed Region* (**ERP-98-B32**) projects ranged from the support of classroom projects for young children that taught students about fisheries and associated habitats, to increasing the awareness of local growers, ranchers, agricultural advisors, and agriculture industry-related businesses about issues involved in maintaining a functional river system (CSA 2000).

The project *Focused Action to Develop Ecologically-based Hydrologic Models and Water Management Strategies in the San Joaquin Basin* (**ERP-00-B04**) developed models to demonstrate various water management strategies to benefit the restoration of riparian areas, as well as fisheries.

The *Data Collection for the San Joaquin Basin-wide Temperature Model* project (**ERP-05D-S02**) is collecting water temperature data to be used for the calibration of the models developed in **ERP-02-P28**. The *Stanislaus – Lower San Joaquin River Water Temperature Modeling and Analysis* project (**ERP-02-P28**) was a pilot temperature modeling study that is now being expanded to include the Tuolumne and Merced rivers through the project *San Joaquin River Basin Water Temperature Modeling and Analysis* (**ERP-06D-S20**), with a focus on streamflow relationships. The modeling effort for the Stanislaus and Lower San Joaquin rivers concentrated on characterizing the flow-temperature relationships that are critical to anadromous fish management and restoration. A key component of the work on the Stanislaus River has been the incorporation of biological science to develop salmon thermal criteria as an integral part of the flow and temperature modeling and the assessment of the results. With increasing environmental demands and water quality regulation of water resources throughout the San Joaquin River Basin and in the Sacramento-San Joaquin Delta, the need for a single basin-wide model provides the most responsive and effective approach to evaluating impacts of competing water demands and showing the costs and results of a number of options to improve conditions at critical periods.

Non-native plant species, many of which are invasive to native riparian vegetation communities, are an issue on all three tributaries in the East San Joaquin Basin EMZ and have been targeted by ERP projects as well as other agency programs and private efforts for eradication and control. The project *Purple Loosestrife Prevention, Detection & Control in the Sac/SJ Delta & Associated Hydrologic Units* (**ERP-99-F08**), implemented by the California Department of Food and Agriculture, developed a program to detect, control and prevent the species influence on the system that included the lower area of this EMZ and parts of the delta and northern watersheds.

Stanislaus River Ecological Management Unit

Substantial progress was made on two of the three actions and associated targets listed in ERPP Vol. II for the Stanislaus River EMU (CALFED 2000b). These actions include a cooperative approach to coordinate flow releases and an evaluation of the benefits of restoring aquatic and riparian habitats.

Two projects contributed to the first action to coordinate flows along the Stanislaus River. One of these, the *Stanislaus - Lower San Joaquin River Water Temperature Modeling and Analysis* (**ERP-02-P28**) project, identified alternatives that included additional flow possibilities to show opportunities to decrease water temperatures critical to salmonid populations. The other project, *Agreement for the Acquisition of Water Between the United States and the Oakdale and South San Joaquin Irrigation Districts* (**ERP-99-B30**), collaborated with two local irrigation districts to increase flows critical to salmonid spawning and rearing activities in the year of 1999.

The action to evaluate the benefits of restoring aquatic and riparian habitats was addressed specifically by two ERP projects. Both the *Knights Ferry Gravel Replenishment* (**ERP-97-N21**) and its associated monitoring project (**CVPIA-XX-V01**) contributed important information to the benefits of restoring aquatic and riparian habitats, monitored pre- and post- project conditions, and analyzed survey data that impacted the benefits yielded by the project in regards to salmon spawning selection and reproductive success (Mesick 2002a, 2002b, 2001). The *Stanislaus - Lower San Joaquin River Water Temperature Modeling and Analysis* (**ERP-02-P28**) project evaluated specific alternatives to benefit critical temperature regimes for salmonids and associated ecological biota which influences the improvement of aquatic and riverine habitats.

Support for the reintroduction of riparian brush rabbit populations and expansion of suitable riparian brush rabbit and riparian woodrat habitat on property near Caswell State Park and the San Luis National Wildlife Refuge (NWR) Complex has been a combined effort between U.S. Fish and Wildlife Service, Natural Resource Conservation Service, Army Corps of Engineers, U.S. Bureau of Reclamation, California Department of Water Resources, California Department of Fish and Game, and California Department of Parks and Recreation (Caswell Memorial State Park). The project *Habitat Acquisition*

for Riparian Brush Rabbit and Riparian Woodrat (**ERP-01-N11**) acquired 371 acres of riparian habitat to provide secure sites for release of captive-bred riparian brush rabbits (USFWS 2002). The project *Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River* (**ERP-02D-C11**) will restore riparian habitats within the San Joaquin River NWR to reintroduce a new population of riparian brush rabbit near the Caswell State Park population.

Tuolumne River Ecological Management Unit

Targets for central valley streamflows and stream meander were identified under ecological processes that needed attention for the Tuolumne River. Tasks included the development of a cooperative approach to coordinate flow releases and maintain base flows below Don Pedro Dam, restoration of 6-9 miles of the natural channel configuration by isolating gravel pits and reconfiguring dredger mining tailings, and isolation of 15-30 dredger mining ponds between river miles 25 and 51.

Restoration planning efforts along the Tuolumne River EMU have been substantial. The Tuolumne Irrigation District, in conjunction with the Modesto Irrigation District, as well as a large group of public and private partners, have engaged in a number of planning and implementation projects to contribute to habitat restoration by realigning stream meander, repairing in-stream dredger mining ponds, adding spawning gravel, and increasing floodplain area. Large amounts of acreage along the Tuolumne River were protected by conservation easements or title fee acquisition, each with a managing entity identified for long-term management toward ERP objectives and goals. The ambitious goal of restoring 6-9 miles of the natural channel configuration had some progress, although more projects were funded through the planning phase but not implemented due to various issues. Several dredger mining ponds were also filled through the projects *Tuolumne River Channel Restoration (Pool 9)* (**ERP-97-M08**), *Tuolumne River Setback: Dikes and Channel Restoration, Mining Reach 7/11 Segment* (**ERP-97-M09**), *Tuolumne River Floodway Emergency Repair and Long-term Habitat Restoration Project (7/11)* (**ERP-98-F06**), *Tuolumne River Special Run Pool 10 Restoration* (**ERP-99-F01**), and *Tuolumne River Mining Reach Restoration (MJ Ruddy)* (**ERP-99-F02**). Predators were identified as a critical stressor to salmonids early in the beginning phases of the ERP. Studies conducted along the Special Run Pool 9 and 10 project area of the Mining Reach show that predators were not a critical impact on salmonid juveniles and that the feared habitats of these warm water predators, the instream dredger ponds, may actually serve as a replacement floodplain for foraging habitat where none exist. According to the surveys and analysis conducted on predation within the Mining Reach, both warm and cold water predator species had very little impact to fry and out-migrating smolts.

Gravel addition projects by various agencies continue on the Tuolumne River. The project *Spawning Gravel Introduction, Tuolumne River, La Grange* (**ERP-97-C11**) was successfully completed. This restoration enhancement was also originally thought to be

a critical element for an abundant salmonid population and many on-going gravel projects continue to support the enhancement of spawning habitat. However, salmon populations have not responded as anticipated, pointing to another critical element that has more influence on the returning spawning adults. Other studies suggest that there is a major factor that either affects the success of the juveniles beyond the confluence of the San Joaquin River or is a barrier to the returning adult spawners.

The successful implementation of the *Tuolumne River Bobcat Flat Floodplain Acquisition Project* (**ERP-00-F01**) and *Grayson River Ranch Perpetual Conservation Easement and Restoration* (**ERP-98-F07**) projects, both managed by Friends of the Tuolumne, are well established and functioning as planned. The projects provided a perpetual conservation easement on 140 acres near the Tuolumne River's confluence with the San Joaquin River. Restoration activities included returning historic floodplain to the river channel, restoring critical riparian habitat, and providing greater flexibility with flood management. Nearly 7000 native trees and native grasses were planted to restore the oak and willow forest on degraded habitat areas of the ranch. Approximately 40 experimental acres were seeded with creeping wild rye, a native grass species. Two backwater areas were created to improve floodwater interface with the project area and increase the potential area of self-sustaining riparian vegetation.

Merced River Ecological Management Unit

The Merced River identifies the same targets listed for the Tuolumne River for streamflows and stream meander, with only 5-7 miles of disturbed channel identified as a restoration task (CALFED 2000b). In addition, three stressors are identified as targets for improvement for water diversions, dams and other structures, and potential impacts from the artificial propagation of fish. They include the reduction of entrainment of fish and other aquatic organisms into diversions to a level that will not impair salmon and steelhead restoration by screening 50% of the water volume diverted in the basin, improving existing diversion screens on the Merced River, eliminating the loss of adult fall-run Chinook salmon that stray into the San Joaquin River upstream of the Merced confluence, developing a cooperative program to eliminate blockage of upstream-migrating fall-run Chinook salmon and steelhead at temporary irrigation diversion dams erected during the irrigation season, continuing annual installation of a temporary weir on the San Joaquin River immediately upstream of the confluence with the Merced River to block adult salmon migration, minimizing the likelihood that hatchery reared salmon and steelhead could stray into adjacent non-natal rivers and streams to protect naturally produced salmon and steelhead, and cooperatively evaluating the benefits of limiting stocking of hatchery-reared salmon and steelhead to the Merced River.

Substantial progress was made toward a watershed management plan for the Merced River. The Merced River Stakeholders Watershed Group and Technical Advisory Group (TAC) spearheaded the effort to develop a watershed plan with the technical expertise of Stillwater Science. The three projects funded extensive studies along the gravel

mining reaches of the Lower Merced River on social, geomorphic, and biological topics. The projects were the *Merced River Corridor Restoration Plan – Phase II* (**ERP-98-E09**), *Merced River Corridor Restoration Project - Phase III* (**ERP-00-E05**), and *Merced River Corridor Restoration Plan Phase IV: Dredger Tailings Reach (Merced River Ranch)* (**ERP-02-P12-D**). These projects produced reports based on technical studies of channel, floodplain, spawning gravel, and riparian vegetation with recommendations on ecological design and restoration needs. One project focused on the restoration of the dredger mining reach of the Merced River. The goal was to design pilot floodplain and channel restoration experiments intended to initiate the restoration of natural ecosystem function, and set in place monitoring and evaluation schemes designed to contribute to increased scientific understanding in restoration design.

ERP contributed substantial funding to the Merced River Salmon Habitat Enhancement Project (MRSHEP). The project consisted of four phases of stream channel and floodplain restoration, and associated revegetation of native riparian habitat. The projects reconfigured the channel through disturbed instream dredger mining pits and tailings, recreated floodplains and isolated ponds too large to fill. Phase I of MRSHEP, *Merced River Salmon Habitat Enhancement Project Phase II- Ratzlaff Reach Construction)* (**ERP-99-B05**), restored the river channel and isolated a dredger mining pond of the Ratzlaff Reach portion of the project. Phases II & III funded design and implementation of the Robinson Reach portion through the project *Revised Phase II - Merced River Salmon Habitat Enhancement River Miles 42 to 44 (Robinson Reach and Permit #307 sites)* (**ERP-01-C03**). Phase IV funded design work for the Western Stone project reach through the project *Preliminary Design and Engineering of Lower Western Stone Site, Merced River Salmon Habitat Enhancement Project (Phase IV)* (**ERP-99-B04**). All but the final phase has been implemented, with the exception of Western Stone, which needed to go through a redesign due to one private property owner removing their support of the lower section of the reach. The Upper Western Stone portion of the reach has been redesigned using a low riparian vegetation impact strategy and is in the final approval stages. Over time, the natural channel and floodplain function, with the assistance of periodic high precipitation years, will allow the aquatic and riparian habitats and associated species to rebound naturally.

Project Summary Table

The following table summarizes general project information and lists all projects that were reviewed for evaluation in this Ecological Management Zone.

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
East San Joaquin Basin Ecological Management Zone				
ERP-00-B04	**Focused Action to Develop Ecologically-based Hydrologic Models and Water Management Strategies in the San Joaquin Basin** Model developed to be used to demonstrate range of reservoir operating strategies to benefit fishery and riparian re-establishment.	3/30/2003	$295,925	Models were successfully developed as specified in the contract. Results are theoretical & inconclusive as to ecosystem benefits to be derived from re-creation of historic flow regime.
ERP-00-F04	**A Mechanistic Approach to Riparian Restoration in the San Joaquin Basin** Project identified the physical and biological mechanisms affecting establishment of riparian vegetation, in particular Fremont cottonwood and willow communities in the San Joaquin Basin, in order to identify the most cost-effective strategies and sites.	3/31/2006	$293,532	Project completed and identified suitable contour elevations in relation to the river channel for three most common riparian plant species in the San Joaquin Basin.
ERP-02D-P63	**Monitoring and Investigations of the San Joaquin River and Tributaries Related to Dissolved Oxygen** This study will provide a comprehensive understanding of the sources and fate of oxygen-consuming materials in the San Joaquin River watershed between Channel Point and Lander Avenue.	6/30/2008	$6,807,428	Study in progress with consistent review and has adapted modified design strategies as the project develops.
ERP-05D-S02	**Data Collection for the San Joaquin Basin-wide Temperature Model** Support the development of the water temperature models for the San Joaquin Basin rivers. Water temperature data collected to be used for model calibration. Assisting the modeling and analysis being developed in ERP-02-P28 & ERP-06D-S20.	6/30/2008	$781,000	Data collection effort in progress. Network includes 106 river thermographs, temperature profiles for reservoirs and five met stations. Data to Modeling Team Aug 06 for calibration runs.
ERP-06D-S20	**San Joaquin River Basin Water Temperature Modeling and Analysis** This project is in the process of expanding the Stanislaus River temperature model developed under ERP-02-P28 to the Merced, Tuolumne & San Joaquin above Stanislaus R. confluence.	12/31/2008	$716,052	Project is in progress and assisted by DFG by a directed action that collects water temperatures (ERP-05D-S02)

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-C09	**San Joaquin River Drainage Fall-Run Chinook Salmon Genetic Baseline and Discrimination Evaluation** Helped characterized the genetic makeup of San Joaquin River fall-run Chinook salmon. Included extensive data collection, database development, and several analysis focuses.	6/30/2002	$387,003	Project data collection completed but final genetic study needs to be analyzed. Tissue samples were collected and entered into a database. Oct 2001, DFG reports on results for the Stanislaus, Tuolumne and Merced Rivers.
ERP-98-B30	**San Joaquin Valley "Salmonids in the Classroom" Program Enhancement** Goal was to educate students about life cycles and issues concerning salmonids, and translate material into other languages.	12/31/2001	$3,000	Complete. Education program implemented. Continued an existing program.
ERP-98-B32	**Conferences and Field Tours for Viable Solutions to the Agriculturally Impacted San Joaquin River Watershed Region** The Committee for Sustainable Agriculture developed and implemented this project to increase local growers, ranchers, agriculture advisors and agriculture industry-related business's awareness of issues involved in maintaining a functional river system.	12/31/2001	$28,000	Complete. Final report submitted for two conferences presented in 1999 - the Modesto Soil Fertility & Pest Management Conference and the Modesto Livestock & Dairy Conference.
ERP-99-B14	**Biological Agricultural Systems in Cotton-BASIC-Reducing Synthetic Pesticides & Fertilizers in the Northern San Joaquin Valley** Expanded existing program which seeks to provide cotton farmers means for reducing use of pesticides and fertilizers & thereby improve water quality.	3/31/2003	$429,894	Status and level of completion cannot be assessed. No final report on file, however all funds were expended.
ERP-99-F08	**Purple Loosestrife Prevention, Detection & Control in the Sac/SJ Delta & Associated Hydrologic Units** Over a three year period, the Integrated Pest Control Branch of the CA Dept of Food & Ag carried out a series of tasks which resulted in an exhaustive survey of the Sacramento-San Joaquin Delta and local eradication of loosestrife in Phase I and II.	9/30/2002	$221,306	Complete. Eradication element extended with other funding.
Stanislaus River Ecological Management Unit				
ERP-01-N11	**Habitat Acquisition for Riparian Brush Rabbit and Riparian Woodrat** Acquired a fee title/easement on 371 acres of riparian habitat to provide secure sites for release of captive-bred riparian brush rabbits along the Lower Stanislaus River adjacent to the Caswell State Park.	12/31/2006	$2,720,085	Complete.
ERP-02D-C11	**Recovery Implementation for Riparian Brush Rabbit and Riparian Woodrat on the Lower Stanislaus River** This project will restore riparian habitats at the SJ River National Wildlife Refuge and reintroduce a new population of riparian brush rabbit near the Caswell State Park core population.	11/30/2008	$5,465,944	In progress for work tasks that include the acquisition of land or easements, biological assessment and permitting, and RBR reintroduction

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P28	**Stanislaus - Lower San Joaquin River Water Temperature Modeling and Analysis** This project performed modeling and analysis of various alternatives for water management in the Stanislaus River.	10/31/2006	$878,827	Complete. Extended in another ERP project (ERP-06D-S20) to include the Tuolumne, Merced, and Lower San Joaquin Rivers.
ERP-97-N21	**Knights Ferry Gravel Replenishment** The project developed a gravel implementation design for 18 sites in the Lower Stanislaus River between Goodwin Dam and Willms Pond. Pre-project assessment with follow up post-monitoring from project CVPIA-XX-V01 yielded results that are influencing future designs.	3/15/2002	$561,406	Complete. Followed by a 3 year monitoring effort funded through AFRP project CVPIA-XX-V01
ERP-99-B30	**Agreement for the Acquisition of Water Between the United States and the Oakdale and South San Joaquin Irrigation Districts** During water year 1999, US Bureau of Reclamation acquired up to 50,000 acre-feet of surplus water from the Oakdale Irrigation District and the South San Joaquin Irrigation District to benefit juvenile salmonids during spring out migration	9/30/1999	$3,000,000	Complete.
Tuolumne River Ecological Management Unit				
ERP-00-F01	**Tuolumne River Bobcat Flat Floodplain Acquisition Project** This project is comprised of 3 parcels (300 acres) offered to Friends of the Tuolumne (FOT) by 2 willing sellers. The owners wish that the parcels be managed for friendly environmental use. FOT will hold fee title until restoration is complete.	11/1/2006	$1,984,320	Complete. Project spawning habitat enhancement, side channel development and riparian restoration planting successfully implemented.
ERP-01-N03	**Tuolumne River Restoration: Special Run Pool 10** The project proposed to fill the in-channel mining pits, preventing future connections between the river and the off-channel mining pit. Work would include improving salmon spawning and rearing habitats, reducing predator habitat (bass) in a 0.5 mile section of the Tuolumne River, and restoring native riparian habitats.	6/30/2006	$652,030	Incomplete. Actual channel restoration has not occurred due to lack of funding. Permitting tasks & associated funding were removed by an amendment.
ERP-01-N09	**Tuolumne River Fine Sediment Management (Gasburg Creek)** Plans are to reduce the supply of fine sediment to increase substrate permeability for Chinook salmon, as well as revegetate riparian and floodplain habitat.	12/31/2007	$995,119	Ongoing.
ERP-02-P29	**Tuolumne River Sediment Acquisition and Spawning Gravel Transfusion Project** The Tuolumne River restoration project proposed to secure a long-term source of sediment necessary to implement present and future restoration projects, and add a large quantity of clean spawning gravel into the river for restoration.	12/31/2008	$4,350,000	Pending. Project amendment not approved because of a substantial change in the scope of work from the original project proposal that would remove the acquisition and on-site gravel work.

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-97-C11	**Spawning Gravel Introduction, Tuolumne River, La Grange** The project added 11,000 tons of gravel between the Old La Grange Bridge and Basso Bridge in the lower Tuolumne River in 1999 to increase and improve Chinook salmon spawning habitat.	12/31/2001	$250,975	Complete. Spawning gravel augmentation successfully implemented and monitored annually.
ERP-97-M08	**Tuolumne River Channel Restoration (Pool 9)** This project filled mining pits and constructed setback levees in the Tuolumne River at river mile 25.9 to remove predator habitat and enhance riverine processes and salmonid habitats.	2/28/1999	$2,253,100	Complete. Levee work and monitoring tasks completed.
ERP-97-M09	**Tuolumne River Setback: Dikes and Channel Restoration, Mining Reach 7/11 Segment** This project filled mining pits, removed dredger tailings, constructed setback levees, and restored the channel and floodplain in a 2.6 mile section of the Tuolumne River extensively mined for aggregate material.	12/31/2004	$2,801,000	Complete.
ERP-98-B40	**Increase Public Awareness of the Riparian Habitat and Ecosystems of the Tuolumne River** This project implemented educational programs to increase public knowledge and awareness of ecological issues and opportunities in Modesto, adjacent to the Tuolumne River.	12/31/2001	$29,004	Complete. All but one phase of the project proposal was implemented.
ERP-98-C04/C05	**Basso Bridge Ecological Reserve and Merced River Ranch Land Acquisitions** This project acquired 40 acres along the Tuolumne River, near La Grange, for the protection of riparian, wetland and riverine habitats to protect spawning riffles, and protect and enhance riparian species.	12/31/2000	$830,500	Complete. Parcels were successfully acquired.
ERP-98-F06	**Tuolumne River Floodway Emergency Repair and Long-term Habitat Restoration Project (7/11)** Phase II of ERP-92-M09 revegetated riparian habitat and conducted emergency repair of a failed levee.	6/30/2004	$1,358,845	Complete.
ERP-98-F07	**Grayson River Ranch Perpetual Conservation Easement and Restoration** Project provided a perpetual conservation easement on 140 acres, returning historic floodplain to the river, restoring critical riparian habitat, and providing greater flexibility with flood management.	10/31/2007	$582,000	Complete. Acquisition and restoration planting successful.
ERP-99-F01	**Tuolumne River Special Run Pool 10 Restoration** Repaired a dike at an off-channel mine pit in the lower Tuolumne River to reduce predation on juvenile Chinook salmon and monitor 1 year.	3/31/2006	$164,800	Complete. Dike successfully repaired and monitoring completed.

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-F02	**Tuolumne River Mining Reach Restoration (MJ Ruddy)** Project proposed to Reconstruct 1.1 miles of the lower Tuolumne River channel and floodplain that was previously diked for gravel mining and then destroyed by the January 1997 floods for the primary benefit of San Joaquin fall-run Chinook salmon.	3/31/2006	$168,813	Project has closed, but level of completion has yet to be determined. ERP is awaiting final report.
Merced River Ecological Management Unit				
ERP-00-E05	**Merced River Corridor Restoration Project - Phase III** Developed a publicly supported, technically sound, and implementable restoration plan for the Merced River corridor from Crocker-Huffman Dam downstream to the San Joaquin River.	11/1/2002	$341,271	Complete. Coordination and planning tasks successful.
ERP-01-C03	**Revised Phase II - Merced River Salmon Habitat Enhancement River Miles 42 to 44 (Robinson Reach and Permit #307 sites)** This was the second phase to restore a reach of the Merced river: channel reconfiguration, creation of a large floodplain with native vegetation, and berm reconstruction to reduce predation of non-native fish on native species (was ERP-01-N06)	6/30/2004	$1,699,101	Low success due to drought and lack of irrigation.
ERP-01-N42	**Educating Farmers and Landowners in Biological Resource Management** Educated farmers and landowners about practices to reduce use of chemicals and improve water quality.	1/31/2005	$1,066,593	Complete. One of two demonstration sites on the Merced River.
ERP-02-P12-D	**Merced River Corridor Restoration Plan Phase IV: Dredger Tailings Reach (Merced River Ranch)** The goal of this project is to design pilot floodplain and channel restoration experiments, in their watershed context, intended to initiate the restoration of natural ecosystem function to the Dredger Tailing Reach of the Merced River.	1/31/2007	$2,497,877	Complete. Channel design and riparian restoration plans successful.
ERP-98-C04/C05	**Basso Bridge Ecological Reserve and Merced River Ranch Land Acquisitions** This project acquired 318 acres along the Merced River near Snelling, for the protection of riparian, wetland and riverine habitats.	12/31/2000	$830,500	Complete. Parcel successfully acquired and planning effort has moved forward in ERP-02-P12-D.
ERP-98-E09	**Merced River Corridor Restoration Plan – Phase II** Analyzed and quantified current in-channel, riparian, and floodplain conditions in the Merced River Corridor.	5/23/2001	$345,443	Complete. Assessment activities for baseline restoration plan completed.
ERP-98-F11	**Merced River Salmon Habitat Enhancement - Phase III (Robinson Reach)** This project restored natural conditions to Merced River habitat at river miles 42 to 43.5. Restoration included filling/isolating deep pools, reconfiguring channel and floodplain characteristics, and increasing riparian habitat.	9/30/2002	$2,433,000	Complete. Channel restoration, dredger mining pit filled, and expansive floodplain created.

Table 1. East San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-99-B04	**Preliminary Design and Engineering of Lower Western Stone Site, Merced River Salmon Habitat Enhancement Project (Phase IV)** Reduced entrainment of outmigrating fish, improved river and floodplain dynamics, and enhanced the riparian corridor.	4/30/2003	$125,000	Design successfully completed but one landowner pulled their support from the project. Other funding now is redesigning the upper reach.
ERP-99-B05	**Merced River Salmon Habitat Enhancement Project Phase II- Ratzlaff Reach Construction)** Reduced entrainment and predation of out migrating fish. Isolated 45 acres of unnatural predator habitat from the river channel. Improved river and floodplains dynamics and enhance the riparian corridor. Increased the quantity and quality of in-stream spawning.	3/30/2000	$1,584,002	Complete. Pond isolation, channel restoration, and riparian habitat revegetation successfully implemented.
ERP-99-B19	**Health Monitoring of Hatchery and Natural Fall-run Chinook in SJ River** Characterized the health and condition of natural and hatchery Chinook by sampling in the San Joaquin River, Merced River and the Delta.	1/31/2001	$37,860	Complete.

Other Programs Contributing to ERP Vision

Several Central Valley Project Improvement Act (CVPIA) projects were funded that helped contribute to meeting targets for the East San Joaquin Basin:

- *Health Monitoring of Hatchery and Natural Fall-Run Chinook Juveniles* (**CVPIA-01-F10**) characterized the health & condition of hatchery juvenile Chinook salmon from Merced River hatchery and natural stocks collected at four points on the rivers.
- *San Joaquin River Chinook Salmon Age Determinations: Phase II* (**CVPIA-01-F09**) processed and analyzed the existing scale samples for the San Joaquin Basin to determine age structure of returning adult fall-run Chinook salmon.

AFRP and BOR, with associated CVPIA project funding, have contributed to acquisition of riparian and aquatic habitats, spawning gravel additions, and various other restoration activities. Other key programs and organizations include CSU Stanislaus Endangered Species Recovery Program, Sacramento River Partners, Point Reyes Bird Observatory, and the Audubon Society.

Other programs that have substantially contributed to the ERP goals and objectives, and are partners on many of the projects discussed in this chapter include:

- USFWS - Anadromous Fish Restoration Program
  http://www.delta.dfg.ca.gov/afrp

- US Bureau of Reclamation – CVPIA programs http://www.usbr.gov/mp/search/listsrvc.cfm?vCategory=CVPIA
- Delta Pumping Plant Fish Protection Agreement (Four Pumps) DWR http://www.des.water.ca.gov/mitigation_restoration_branch/fourpumps

Other major agencies that contribute regulatory influence include:

- Federal Energy Regulatory Committee http://www.ferc.gov
- Regional Water Quality Control Board CEQA, CESA, CWA http://www.waterboards.ca.gov/centralvalley
- US Army Corps of Engineers NEPA, FESA, CWA http://www.spk.usace.army.mil
- USFWS – FESA
- NMFS – FESA
- CDFG – CEQA

The San Joaquin Basin website, sponsored by Fishbio Environmental, Inc., links tributary stakeholders and environmental information within the San Joaquin Basin, which includes the Eastern tributaries (Fishbio 2007). ERP project documents will soon be available at http://www.delta.dfg.ca.gov/erp/reports_docs_proj_specific.asp.

Project and other associated information can also be found at many of the agency and stakeholder web sites, which are included in the following list for the East San Joaquin Basin EMZ:

- U.S. Fish and Wildlife Service – Anadromous Fish Program http://www.delta.dfg.ca.gov/afrp/projects.asp
- National Marine Fisheries Service - http://swr.nmfs.noaa.gov/sac/index.htm
- Bureau of Reclamation – Central and Southern Regions http://www.usbr.gov/mp/nepa/index.cfm
- Department of Water Resources – San Joaquin District http://www.sjd.water.ca.gov/rivermanagement/index.cfm
- Merced River Stakeholders http://www.emrcd.org/stakeholders/index.html
- Tuolumne River Trust http://www.tuolumne.org/content/index.php?topic=programs_bayarea
- Friends of the Tuolumne http://www.friendsofthetuolumne.org
- Stanislaus River Fish Group http://www.delta.dfg.ca.gov/srfg/index.asp
- Stanislaus River Website http://stanislausriver.com
- Stillwater Sciences http://www.stillwatersci.com/whatwedo/projectdesc
- Fishbio Environmental http://www.fishbio.com

Stanislaus River Ecological Management Unit

A group working on the Stanislaus River that deserves merit is the Stanislaus River Fish Group, whose efforts have been the most successful of all three tributaries to effectively

coordinate stakeholders in sharing information and moving forward with ecological research, analyses, and restoration planning. Their website offers detailed information, data, and serves as an effective communication tool for most activity that occurs along the Stanislaus River. The website can be found at http://www.stanislausriver.com/index.htm., with a direct group link located at http://www.delta.dfg.ca.gov/srfg/.

CVPIA funded several restoration and habitat improvement projects on the Stanislaus River:

- *Spawning Habitat & Floodplain Restoration in the Stanislaus River, Phase I* (**CVPIA-01-F02**) restored spawning and rearing habitat for salmonids in the Reach of the Lower Stanislaus River (AFRP 2007, KDH 2000).
- *Continual monitoring for the Knight's Ferry gravel replenishment, Phase 2* (**CVPIA-XX-V01**) conducted monitoring for ERP-97-N21 to evaluate the effects of adding different sizes and sources of gravel on the utilization of spawning habitat by fall-run Chinook salmon and the quality and success of incubation habitat at 18 project sites within the Stanislaus River.
- *Test and Demonstrate a Portable Alaskan Weir to Count and Characterize Runs of Anadromous Salmonids in the Stanislaus River* (**CVPIA-XX-V12**) will install a portable resistance board weir on the Stanislaus River to measure escapement of fall-run Chinook Salmon and Steelhead. The weir will use the VAKI infrared monitoring system to provide species identification, length, and passage timing and direction data.
- *Stanislaus River Restoration Plan Development and Outreach* (**CVPIA-XX-V13**) is pulling together critical data from various projects to prioritize project needs, guide restoration methods, and organize efforts for all stakeholders within the Stanislaus River EMU. Pre- and post-project monitoring will contribute baseline data from the Spawning Habitat & Floodplain Restoration in the Stanislaus River Project, below the Lover's Leap landmark east of Oakdale.

Tuolumne River Ecological Management Unit

Stakeholders and other programs contributing to restoration efforts for the Tuolumne River include AFRP, DWR, Tuolumne River Trust, and others. The Tuolumne River Technical Advisory Committee, which is a group composed of a variety of members from all river stakeholders, has been very active in reviewing and advising technical issues for restoration planning efforts for ERP funded projects and other activities along the river.

CVPIA funded outreach and restoration projects on the Tuolumne River:

- *Tuolumne River Watershed Outreach and Stewardship* (**CVPIA-01-F04**) fostered local watershed stewardship through involvement and participation in implementation of the Tuolumne River Restoration Plan.
- *Non-Structural Alternative at the San Joaquin River National Wildlife Refuge: Refinement for Habitat Enhancement* (**CVPIA-01-F03**) conducted an engineering and hydraulic analysis of three levee breach scenarios to provide intermittent inundation for newly acquired land at San Joaquin NWR.
- *Tuolumne River Mining Reach Restoration No 3 - Warner-Deardorff Segment* (**CVPIA-01-F14**) completed the design engineering started under the MJ Ruddy Project, engineering for the ROW acquisition, and the pre-project monitoring for the Warner-Deardorff segment of the Tuolumne River Mining Reach project.

Merced River Ecological Management Unit

CVPIA funded several modeling and research projects on the Merced River:

- *Merced River Water Temperature Management Feasibility Study* (**CVPIA-01-F07**) compiled existing information as a first step in development of a potential comprehensive water temperature management plan for the lower Merced River.
- *Evaluate Use of a Two-Dimensional Hydraulic and Habitat Simulation Model to Assess Benefits of Channel Restoration* (**CVPIA-01-F11**) quantified features of fall-run Chinook salmon spawning and rearing habitat, before and after restoration, in the Robinson restoration project, located at river mile 42.0 to 43.5 on the lower Merced River using a two-dimensional hydraulic habitat model.
- *Tag & clip 125k smolts with full tags at CDFG Merced Fish Hatchery* (**CVPIA-XX-V17**) tagged (coded wire tags) and clipped adipose fins of salmon smolts for use in survival tests on the Merced River using rotary screw traps.

Planned Projects for Implementation

Two CVPIA projects are in the final planning stages of implementation within the Stanislaus EMU. The first is Phase I of the Spawning Habitat and Floodplain Restoration in the Stanislaus River Project, which has removed the floodplain restoration element from its project description and will focus on enhancing spawning habitat in existing and created riffles between Goodwin Dam and Willms Pond. Project approval for the permits and final environmental documents appears to have been stalled for several years, according to information on the AFRP project website.

The second project, which has been requesting comments, is the Stanislaus River Restoration Plan and Development Outreach Project. The plan is focused on directing long-term ecological research and the implementation of prioritized habitat restoration below Goodwin Dam. Plan elements have been added each year from 2003 to 2007 and are available for review at http://www.delta.dfg.ca.gov/srfg/restplan.asp.

Status of the Area Today

Studies throughout the basin have slowly sorted out the critical needs of the East San Joaquin Basin EMZ. Although the addition of spawning gravels and the filling of dredger mining ponds to restore the river channel function are important and need to continue, the priority needs that have not been adequately addressed include developing a plan to provide adequate water flows at critical times for salmonid reproduction stages, and increasing the area of channel floodplains for juvenile rearing and foraging habitats (Mesick 2007). Increased flows at other critical times, with continued enhancement of riparian habitats, need to continue to lower river temperatures and provide higher quality habitats for the entire food web to support associated fish and wildlife species. Water quality, habitat fragmentation, and fish passage issues in the lower reaches of the San Joaquin River system may also contribute greatly to the health of the entire system and the upper tributaries specifically.

Planning and coordination efforts need to continue to explore avenues of continued restoration of the highly impacted units of this EMZ, especially between local, state, and federal agencies. Identifying the critical issues, prioritizing planning and project implementation efforts, and systematically working to improve the entire watershed is the goal of the CALFED ERP program.

For the Stanislaus River EMU, as with all of the tributaries within the East San Joaquin Basin EMZ, the two critical ecological elements that have surfaced after evaluating the results of the implemented projects are the need for increased streamflows, especially at critical times when juvenile salmonids are outmigrating, and for expanding floodplains along the river channel for rearing and spawning habitat. This conclusion is based on a number of factors, using the salmon population as the indicator critical link to monitor the overall health of the entire system. Population numbers have continued to drop over the last ten years despite of a steady influx of spawning gravel, spring VAMP flows, the filling of instream dredger mining ponds, and revegetation efforts.

The area of riparian and riverine aquatic habitats, as well as seasonal wetlands, has been highly reduced along the Stanislaus River due to increased urban and agricultural development. Floodplains near Oakdale, Riverbank, and Ripon have been modified to prevent flooding, which in turn has developed a more channelized river channel which limits function and therefore lower ecological productivity. As all the projects were cancelled or terminated that had been approved to address this identified task for the EMU, it is one of the main identified missing elements needed. ERP project analyses and results, in addition to the other work being conducted on this river, point to the need for rearing and foraging habitat for juvenile salmonids as critical to expanding the population. One mechanism that can be evaluated is to partner the effort with flood

control concerns throughout the County. Target opportunities for creating floodplains that can be used for flood relief to densely populated areas, and allow them to create seasonal rearing habitats during late winter and early spring flows. Additionally, studies are needed to identify opportunities to set back levees and allow wider floodplains wherever open land is still available. Future Valley growth will only increase the pressure to narrow the river corridor. Geographic Information System technology could assist in the evaluation of lands available and target best priority locations that have the potential to allow opportunities for restoration.

Fall-run salmon populations have become so low in the tributaries of the San Joaquin River that native populations may have dropped below sustainable levels. Recommendations by both federal and state biologists have identified studies required to assess and analyze limiting factors to rapidly declining fall-run reproduction on all three tributaries. The Tuolumne River is especially vulnerable, where the low return of spawners may have dropped below recovery. At the very least, monitoring is required to accurately assess the status of the fish population, critical environmental factors, and changes that may contribute to either increases or decreases in the population.

Extreme measures may be required, such as implementing hatcheries on rivers where populations have dropped below sustainable to supplement the rivers with stocked fish. That type of action would require a specific management plan to allow the recovery of wild fish, and ensure genetic homogeneity, with provisions established to offset any impacts that could occur to prevent the recovery of the wild populations.

Additional questions will need to be addressed in regards to the impacts of the restoration of the Upper San Joaquin River below Friant Dam, and effects it may have on the lower San Joaquin River habitats and spawning tributaries. Current plans to restore spring-run Chinook salmon present clear conflicts for the management of flows for fall-run Chinook salmon in terms of the timing of required environmental streamflows, habitat availability, and water quality issues.

Spawning gravel, while currently not considered the critical link to increase salmon success, still is considered an essential requirement that needs consistent infusion to keep quality habitat available for maximum use. Disagreements about the composition of the gravel have stalled projects from adding material to the spawning riffles, although there is evidence that shows that finer cobble is required for success in some areas but not in others. More studies are needed to confirm the thresholds of tolerance for gravel sizes, locations, riffle size and structure, and other preferred elements for successful spawning use. It is important that the spawning material is more readily available, or the cost factor severely limits the ability to enhance spawning habitats to the degree that is necessary.

Impediments to Implementation

The challenges and setbacks were varied. Scientific research methods continually needed to be modified as new information became available and often the data collection of earlier projects could not be directly used for long-term analyses due to inconsistent variables. Many older projects had inconsistent reporting documents and missing deliverables on file when the projects were transferred from CBDA to CDFG. Costs for the restoration work often inflated substantially between the project proposal and the time when it was ready to go to construction. Contractors that subcontracted all of the work created inflated costs due to double or triple overhead costs. The lack of direct guidance and minimal communication from ERP managers to the contractor often delayed contract funding and the amendment processes. Reluctance to modify scopes of work for improved scientific methods for work plans met resistance from contractors also caused delays.

Other questions have been raised concerning the river channel and floodplain designs for the Merced River Salmon Habitat Enhancement Project (MRSHEP) restoration segments. The high impact engineering strategy used for the Robinson segment created a large barren floodplain that has taken years to establish the most minimal vegetation coverage, and the canal shaped channel, which did create excellent fish passage in an area that was limited, has been criticized as a one-dimensional design that did not create a channel modeled after the natural narrow deep pool and wide riffle channel variation found in natural systems. According to project engineers, the design was to allow the natural function of the river to create a natural type of channel over time, which has begun to slowly occur. Unfortunately, substantial vegetation removal and rigid channel characteristics will take many years to establish into a fully functioning system. Criticism that the impacts were greater than anticipated, difficult for local property owners from an aesthetic standpoint, and unknown impacts to the surrounding ecosystem due to extended impacts by the construction has caused considerable debate in the professional habitat restoration community. New strategies from the most innovative and experienced environmental engineers have focused on the use of two-dimensional modeling and pre-project biological assessments to incorporate into the design. Regulatory agencies have also been emphasizing the need for low impact to existing riparian vegetation to maintain some ecosystem connectivity for riparian and aquatic riverine habitats during restoration activities, especially in areas designated as critical and essential fish habitats.

Although the planning effort on most of the projects on the Tuolumne River has been successful, the implementation of a number of them has been difficult to achieve. Obstacles including failure to acquire properties due to short grant time frames, higher than expected construction costs, high overhead costs due to subcontracting, difficulties with construction and monitoring designs meeting ERP scientific criteria, and communication issues have delayed many of the projects from being completed.

Progress to develop a cooperative approach to coordinate flow releases has not been successful, although VAMP flows and agreed minimum seasonal flows have been maintained. Recent studies produced by the USFWS AFRP program have identified the lack of sufficient stream flow at the time of the earliest salmonid juvenile out-migration time period (February – March) to be the number one critical factor influencing the populations on the Tuolumne and the other rivers within the San Joaquin Valley Region (Mesick, 2007).

Although there were numerous challenges to implement these projects, which included agency and landowner communication issues, inflated construction costs, high flow floodplain design limitations, and poor success with revegetation efforts, the benefits of the project still outweigh the slow recovery progress of the ecosystem function.

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APPENDIX A

A.14. WEST SAN JOAQUIN BASIN ECOLOGICAL MANAGEMENT ZONE

Introduction

The approximately seven-million acre San Joaquin River Basin extends from the Delta, south to the upper San Joaquin River, west to the Coast Range, and east to the Sierra Nevada. The West San Joaquin Basin Ecological Management Zone (EMZ) includes the eastern slope of the Coast Range and portions of the southwestern Central Valley. The West San Joaquin Basin EMZ is bounded on the north by the San Joaquin Delta, on the east by the west bank of the San Joaquin River from the Stanislaus River to the Mendota Pool, on the south by Panoche Creek, and on the west by the eastern slope of the Interior Coast Range (Figure 1).

All watersheds in the West San Joaquin Basin EMZ flow east toward the San Joaquin River. Many of the smaller creeks have been ditched and diverted into drainage canals, while others, after emerging from the Coast Ranges to the west, lose identity as they enter the irrigated flat lands to the east and only reach the San Joaquin River as sheet flow or irrigation return flow.

The West San Joaquin Basin EMZ has two distinct landform areas: the hilly west side arid watersheds, and the valley floodplain on the eastern side adjacent to the San Joaquin River. The Delta-Mendota Canal of the Central Valley Project (CVP) and the California Aqueduct of the State Water Project (SWP) are dominant features of the zone from north to south, separating the hills from the valley.

Agriculture is the pre-dominant land use in the area lying to the east of the California Aqueduct and extending to the west bank of the San Joaquin River. To the west of the aqueduct the land is mostly grazed. Plant communities are largely grassland, oak savannah, and sage scrub. Despite its barren and bleak appearance, this portion of the basin is home to some of the most sensitive special status species in California.

The climate of the zone is the driest of California's Great Valley. Annual precipitation is generally less than 15 inches, and in some years is less than five inches. Mostly because of the rain shadow effect of the higher South Coast Ranges which lie southwest of the zone, this area has the only true deserts found anywhere in the Great Valley.

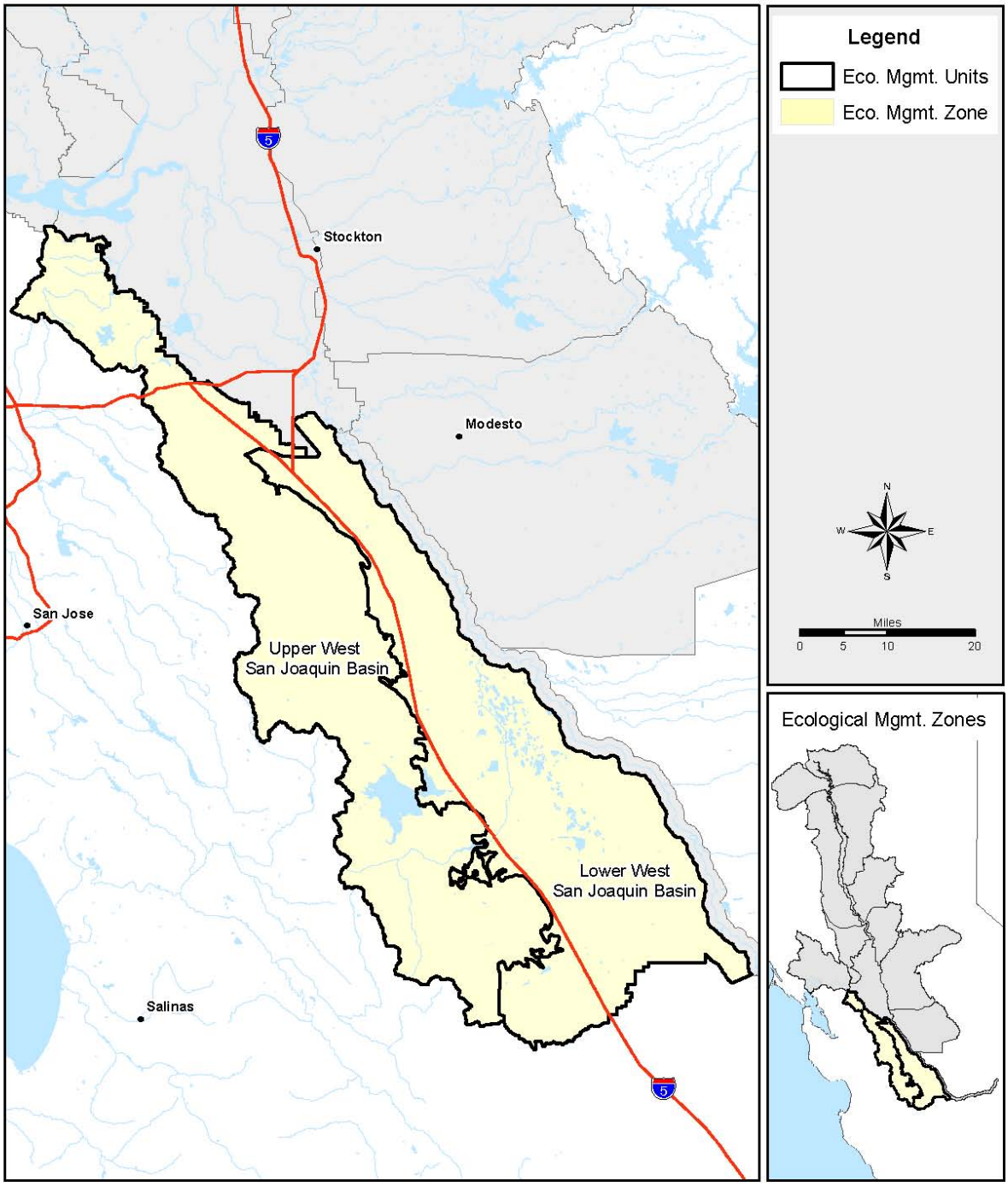

Figure 1. West San Joaquin Basin Ecological Management Zone

CALFED BAY-DELTA PROGRAM

California Department of Fish and Game
Ecosystem Restoration Program

Figure 1. West San Joaquin Basin EMZ Map

The West San Joaquin Basin EMZ includes various habitat types including agriculture, wetlands, coastal scrub, chaparral, oak woodland, oak savanna, grassland, riparian forest, seasonal wetlands, and sycamore alluvial woodlands. The EMZ includes approximately 33% of the remaining wetland acres in the Central Valley. The 180,000-acre Grassland Ecological Area constitutes the largest contiguous wetlands remaining in California. It is a significant waterfowl wintering area, supporting peak waterfowl populations in excess of one million birds, as well as an important fall and spring migration stopover site for shorebirds. Wetlands in the San Joaquin Valley are intensively managed to produce standing crops of moist soil food plants and invertebrates with high value to wildlife, particularly waterfowl. Approximately one-quarter of the Central California Sycamore Alluvial Woodland natural community is located in the zone's Los Banos area. The largest stand (426 acres) is located at the proposed State Water Project Los Banos Grandes Reservoir site, while all other stands in Central California are less than 250 acres. This stand of sycamore woodland is one of the oldest and most pristine in the State. In addition, the Arburua Ranch jewelflower (*Streptanthus insignis spp. Iyonii*) is known only from the Los Banos Grandes area and locations nearby (CALFED 2000a).

Currently, the most notable stressor affecting the West San Joaquin Basin EMZ is the agricultural drainage problem in the San Joaquin valley. A drainage export facility (the San Luis Drain) was never completed and some soils and shallow ground water on the west side have gradually built up salts due to the lack of a drainage outlet. This has led to changes in cropping patterns, more intensive irrigation management, and decreased agricultural profitability (some lands have gone out of production). The buildup of salt also creates the potential for ground water contamination and impairment of its beneficial uses. The key constituents of concern are total dissolved solids (salts), selenium, and boron.

Further problems developed when drainage water from the partially completed San Luis Drain (Drain) was ponded at Kesterson Reservoir near Gustine. Few realized selenium was toxic when agricultural water was first pumped into Kesterson, which is part of the 26,609-acre San Luis National Wildlife Refuge, about 80 miles northwest of Fresno. Kesterson Reservoir was intended to be a regulating reservoir on the Drain prior to discharge in the Delta, but became a terminal storage facility with no outlet. Beginning in 1981, approximately 7,000 acre-feet of subsurface drainage were discharged per year to this facility until problems with wildlife were observed in 1983 and traced to selenium in the drain water. This led to the State Water Resources Control Board (SWRCB) issuing a Cleanup and Abatement Order for Kesterson, and the eventual closure of both the San Luis Drain and Kesterson Reservoir.

An interagency San Joaquin Valley Drainage Program (SJVDP) was formed in 1984 to study the drainage problems and make appropriate recommendations. The investigation was limited to the evaluation of in-valley drainage management options with a goal of permitting the present level of agricultural development in the valley to

continue, while protecting and restoring fish and wildlife and their habitats. In 1990, the SJVDP presented its final report "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley" (commonly known as the Rainbow Report).

In 1991 the interagency San Joaquin Valley Drainage Implementation Program (SJVDIP), successor to the SJVDP, was formed to implement the recommendations of the Rainbow Report. The SJVDIP conducted a re-evaluation of the recommended plan to address the changes that have taken place since 1990 including scientific advances, availability of new data, and institutional changes. Significant progress was made in some areas, but full implementation has not been achieved.

The West San Joaquin Basin EMZ includes the Grassland Resource Conservation District (GRCD), which comprises more than 74,700 acres within the Grassland area. Located within the GRCD is the Grassland Water District (GWD), a Central Valley Project contractor that delivers water to private lands and to the three public wildlife areas within its boundaries: San Luis National Wildlife Refuge, Los Banos Wildlife Management Area, and the North Grassland Wildlife Management Area. Land within the GWD is used primarily for duck hunting clubs and seasonal grazing of livestock. Although the properties within GWD are managed separately, the overall management objective is to enhance natural food plant production and to protect wetland habitat for migratory and resident waterfowl. Until 1985, agricultural drainage and operational spills from upslope irrigators provided up to 148 thousand acre feet (TAF) annually of additional water for the Grassland wetlands. Concerns regarding the quality of the drainage water caused the GWD to cease accepting drainage water in 1985. Interim supplies were then obtained through a series of temporary contracts with the CVP. The passage of the CVPIA in 1992 provided the GWD with firm water supplies. The CVPIA requires the Secretary of the Interior to immediately provide firm water supplies of suitable quality to specified wetland habitat areas. The GWD, the state's wildlife management areas, and the federal wildlife refuges presently receive approximately 168 TAF under the CVPIA, and deliveries were to be increased to 250 TAF by the year 2002 (SWRCB 1999).

A 2003 briefing book was developed by a coalition of environmental groups and local agencies downstream of the San Joaquin Valley entitled “Drainage Without a Drain: Toward a Permanent, Responsible Solution to the Agricultural Drainage Problem in the San Joaquin Valley”. The problem for the farmer is the threat of waterlogged, nonproductive fields. Semi-permeable layers of clay underlie several hundred thousand acres of intensively irrigated land on the arid west side of the San Joaquin Valley. Irrigation water not absorbed by plants seeps down through the soil until it reaches the clay layers. After years of intensive irrigation, this shallow ground water can raise to the level of the crop root zone, water-logging the roots, over-exposing plants to salts, and crippling productivity. Many farms on the Westside have underground tile drains and pump systems to remove the problem groundwater from their property before it

reaches damaging levels; others do not have tile drains now, but want to have them installed. The largely unanswered question is: Where should the water go once it is pumped from the ground?

For the environment, the problem is that agricultural drainage contains an array of substances harmful to people, fish, and wildlife. Soils in the Westside contain high concentrations of selenium, a naturally occurring element toxic to humans and wildlife at trace concentrations. When these soils are irrigated, selenium and other elements are concentrated in the drainage water. Selenium concentrations as high as 7400 parts per billion (ppb) have been measured in subsurface drainage from the Westside.

Since December 31, 2002, discharges for irrigated agriculture must be monitored, placing much uncertainty over the future of runoff from these activities. Along with urban runoff, the US Environmental Protection Agency identified agricultural runoff as the most serious threat to water quality in the country. Municipal and industrial wastewater, as well as some urban runoff, is already formally managed. However, agricultural runoff, application of biosolids to farms, and agricultural drainage, especially in the Central Valley, will remain significant and potentially expensive challenges, with no obvious or simple solutions.

Ecological Management Units

Unlike the other CALFED Ecosystem Restoration Program Ecological Management Zones which were further divided into Ecological Management Units (EMUs), the West San Joaquin Basin EMZ was not divided into EMUs.

Applicable ERP Vision

For Stage 1, ERP Strategic Goals provided a basis for the vision of restoring ecological health for the zone. The vision for the West San Joaquin Basin EMZ includes improved water quantity and quality in the watersheds, wetlands, and San Joaquin River. The vision also includes a range of sustainable aquatic, wetland, riparian, and upland habitats that support abundant natural production of resident fish and wildlife, as well as waterfowl and other migrant birds that use the Pacific Flyway each winter. The vision includes enlarging remaining native habitats and connecting those areas.

The vision focuses on improving watershed, stream channel, and floodplain processes. The result would be increased seasonal flows of quality water to the San Joaquin River and area wetlands, and reduced input of agricultural waste runoff and associated contaminants into zone watersheds, wetlands, and the San Joaquin River.

Stage 1 Expectations

The San Joaquin River and its tributaries are an important component of the Bay-Delta ecosystem. During Stage 1, factors that most influenced the ecological health of the west side tributaries in the San Joaquin River Basin were identified and a number of actions were implemented to address these factors.

The CALFED ERP Strategic Plan identified actions for the San Joaquin Basin that included acquiring at least 100,000 acre feet of water from willing sellers for environmental uses in the Sacramento Basin, the San Joaquin Basin, and the Delta. This 100 TAF is not part of CVPIA flows; rather, it is to be additional water necessary to meet the broader objectives of the CALFED Ecosystem Restoration Program and will be coordinated with the Environmental Water Account.

The vision for restoration targets and actions formed the following Stage 1 expectations/objectives:

- *Improve ecological processes for Central Valley streamflows and natural floodplain processes* - Natural streamflow patterns are important in maintaining the geomorphology of watersheds, as well as riparian and floodplain vegetation along stream banks. Streamflow is also essential for the well being of valley wetlands and contributes to the flow of the San Joaquin River and to Delta inflow. Restoring natural stream channels and floodplain processes will help restore natural habitat and vegetation. This expectation can be met through agreements and/or easements with willing landowners and irrigation districts to provide return flows of high quality water from irrigated agriculture and seasonal wetlands to the San Joaquin River. Limiting diversion of natural flows from streams to improve streamflows and construct setback levees and allow floodplain processes such as stream meander belts will also contribute. In addition, expanding existing floodplain overflow basins and reducing or eliminating gravel mining and stream bed altering from active stream channels will help to accomplish restoration.
- *Restore wetland, riparian, and adjacent upland habitat in association with aquatic habitat* – This is an essential element of the restoration strategy for the EMZ. Eliminating fragmentation and restoring connectivity will enhance habitat conditions. Aquatic habitats provide valuable foraging and resting habitat for waterfowl, as well as habitat for a variety of special status species. This objective could be accomplished through cooperative programs to acquire conservation easements or by purchasing land from willing sellers to restore and protect various habitats such as nontidal and perennial aquatic habitat, perennial grassland, and riparian and riverine aquatic habitat, as well as for creating wildlife-friendly agricultural habitat. Improvements can be made to seasonal wetland habitat for waterfowl by managing wetlands so that they maintain 40% open water and 60% vegetation. Actions described for ecological processes,

stressor reduction, and riparian and riverine aquatic habitat should suffice to maintain and restore freshwater fish habitats.

- *Reduce contaminants into the waterways from the lands with the greatest inputs to improve water quality in streams and wetlands, as well as in the San Joaquin River and Bay-Delta* - This objective could be accomplished by acquiring land from willing sellers in areas with demonstrated subsurface agricultural drainage problems and elevated levels of selenium and then returning these lands to native alkaline scrub habitat, or by using conservation easements to modify agricultural practices to reduce loads and concentrations of contaminants.

Changes Attributable to ERP

The Statewide Drainage Management Program/SJVDIP role was expanded to cooperate with CALFED. The CALFED Record of Decision made reference to implementation of the 1990 Rainbow Report recommendations to improve water quality for both drinking water quality and ecosystem restoration goals. In October 2000, the SJVDIP Management Group adopted a Drainage Management Strategy (Strategy) outlining a process to pursue implementation of the recommended in-valley solutions. To implement the Strategy, SJVDIP formed a committee to seek input from stakeholders on priority drainage management actions. The SJVDIP Management Group then developed a list of drainage management actions recommended for each drainage management option.

In keeping with these recommendations to find cost-effective ways to manage irrigation drainage water efficiently without harming agricultural production, projects were funded to reduce drainage water at the source - the farm - while maintaining a salt balance in the root zone sufficient to maintain productivity. Farmers and water districts within the Valley have adopted various irrigation improvements and drainage reduction measures to manage salts and trace elements in response to regulatory requirements to protect environmental resources. The irrigation and drainage management measures, fallowing, and land retirement have been the primary mechanisms for water conservation and reduction of contaminant loads to water bodies in the region. These actions have resulted in significant reduction in the volume of drainage water discharged to the San Joaquin River (from 57 TAF in 1990 to about 30 TAF in 2000). These measures, coupled with separation and future safe disposition of salts from the root zone and groundwater aquifer, could result in sustainable soil and water quality (SJVDIP 2002).

Six of the seven ERP projects implemented in the West San Joaquin Basin EMZ were demonstration projects or studies to evaluate methods, management practices, and modified hydrology, as well as to reduce selenium, salinity, and pesticides associated with those drainage management actions. The projects demonstrated favorable results and progressive solutions toward solving a portion of the drainage problem.

The goals of the *Irrigation Drainage Water Treatment for Selenium Removal: Panoche Drainage District Demonstration Facility* (**ERP-98-B14**) project were to fund the continued operation, and demonstrate the effectiveness, of the algal-bacterial selenium removal (ABSR) technology used at the Panoche Drainage District selenium removal facility. The goal was also to investigate potential wildlife exposure to selenium at full-scale facilities, and to develop an operational plant configuration that would minimize the life-cycle cost for each pound of selenium removed. The ABSR Facility demonstration focused on providing affordable reduction of the selenium load that is discharged to the San Joaquin River. The project indicated that during 1997 and 1998, the best-performing ABSR plant configuration reduced nitrate by more than 95 percent and reduced total soluble selenium mass by 80 percent. Ongoing investigations focus on optimizing operational parameters and determining operational costs and scale-up engineering requirements. Potential wildlife exposure is still a concern. Concentration of selenium can occur in shallow ponded areas, and residual organic selenium in the ABSR Facility final effluent is a concern. Studies in progress will indicate what level of final clarification will be required to minimize this readily bioaccumulated form of selenium in the effluent.

The long-term project goal is to further increase the flow rates through the ABSR Facility to achieve the greatest selenium mass reduction at the lowest cost. A real-time, telemetered flow and water quality monitoring and control system has been installed at the facility to improve the efficiency of feedstock use and to maximize throughput without sacrificing selenium removal efficiency. Once this transfer of technology to the district is complete, a cost evaluation based on a full-scale facility design will be finalized. This will allow drainage district managers to make informed decisions on future investments in agricultural drainage treatment using the ABSR technology (Quinn et al. 2000).

The *Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District* (**ERP-00-B05**) project focused on improved understanding of current salinity mass loading from private duck clubs and cattle ranches in the northern half of the Grassland Water District's (GWD) 51,500 acre drainage area. Management of salts from private wetlands is more complex than from agricultural water districts because of the diversity of the system, the dearth of information relating soil salinity and moisture stress to weed propagation, and the lack of any decision support system to assist wetland managers in selecting best management practices. A GIS-based salinity accounting model has been developed to improve the tracking of salt loads in wetland areas, within Northern GWD, that receive water from the same supply canals to remove one of the impediments to real-time salinity management. This software will also help GWD assess potential future costs of more intensive water and salinity management.

The Grasslands project laid the theoretical ground work for the application of real-time water quality management to seasonal wetlands, developed a network of real-time water quality monitoring stations, and enhanced the capability of remote sensing technologies for moist soil plant recognition and for the assessment of the long-term impact of salinity management actions. This research will compare traditional management practices with a delayed seasonal drawdown timed such that it provides benefits to San Joaquin River water quality. The project is providing wetland managers access to information related to soil salinity, vegetation, and avian response. The results of the project should enable wetland managers to take a pro-active approach in the management of wetlands drain water through the installation of a real-time monitoring system designed to help improve water quality in the San Joaquin River.

The project *Wetland Response to Modified Hydrology with Respect to Salinity Management* (**ERP-05D-S10**) applied the information generated in the *Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District* (**ERP-00-B05**) project and enhanced the capability of remote sensing technologies for moist soil plant recognition and for the assessment of the long-term impact of salinity management actions. The project provided wetland managers with information related to soil salinity, vegetation, and avian responses that they traditionally did not have access to. The results will enable wetland managers, such as at the state and federal refuges, to manage wetland landscapes and better understand how their actions may or may not affect San Joaquin River water quality.

The *Panoche/Silver Creek Watershed Management and Action Plan* (**ERP-00-E02**) project expanded on the completed Panoche Creek Watershed Assessment and recommended Best Management Practices (BMPs) for test sites in the watershed. The test sites were monitored for effectiveness of the BMPs to reduce loading of sediment, selenium, and other contaminants during high-flow events. The Panoche/Silver Creek watershed is approximately 300,000 acres and has some of the most dramatic resource concerns in the state. There have been assessments completed in other parts of this watershed, but because of the size of this watershed, (approximately 300,000 acres), the assessments have had to been completed in sections, not one entire assessment. It is believed that the Silver Creek Drainage is a primary source of selenium and water quality problems. This proposed project helped enable the participants to implement a collaborative, comprehensive piece of their watershed management plan. The monitoring data was used to develop the Action Plan component of the Panoche Creek/Silver Creek Coordinated Resources Plan. The Action Plan is being implemented for both drainages with some water quality improvement discernible in the early phase.

Education outreach was implemented successfully for reducing sediment and the several demonstration projects completed in Stage 1 have shown conclusively that substantial reductions in sediment and other contaminant discharges to Westside tributaries can be achieved. These reductions in contaminants are not only technically feasible on a large scale but are cost-effective as well, in that significant water quality

improvement is possible at comparatively modest costs. These demonstrated technologies and practices have gained wide acceptance among local land managers and farmers in the West Basin, mostly as a result of the excellent educational outreach in Stage 1.

The *Full-Scale Demonstration of Agricultural Drainage Water Recycling Process Using Membrane Technology* (**ERP-02-P44**) project entailed demonstration of reverse osmosis membrane treatment to remove salts from recycled agricultural runoff in the Grassland Drainage Area. The goal of Phase I of this project was to demonstrate the technical, economic, and environmental feasibility of implementing desalination/recycling solution for the purpose of eliminating the selenium, boron, and other contaminants contained in agricultural drainage flows originating in the West San Joaquin Basin EMZ from the Bay-Delta ecosystem. This pilot-scale demonstration was accomplished through field testing of a new agricultural drainage membrane desalination process, Double Pass Preferential Precipitation Reverse Osmosis or DP3RO™, in the Panoche Drainage. Previously, the best result with membrane technology was a 50% recovery rate, but this left a large brine volume containing high levels of selenium. Using the DP3RO™ process, recovery rates over 90% were achieved in the pilot system tests. By operating individual farms as closed loop water systems in which their drainwater is desalinated and recycled as prime irrigation water, no selenium, boron, or other salts will be discharged from the farm property.

At present, reverse osmosis (RO) is the most promising technology for complete treatment of drainage water, i.e., removal of dissolved salts and selenium. Advances in membrane technology have increased the efficacy of RO treatment. The technology is available, but implementation of RO treatments can be driven by economic considerations. RO is an energy intensive operation and the costs are greatly affected by energy costs. The two major obstacles to extensive RO technology implementation are the costs of operation and the current limitations on brine disposal. Treatment of drainage water to remove only selenium would still leave very saline water requiring reuse or disposal. Nevertheless, the removal of selenium would increase the options for reusing or disposing of the drainage water without biological impact.

The *Biological Agricultural Systems in Cotton – BASIC - Reducing Synthetic Pesticides & Fertilizers in the Northern San Joaquin Valley* (**ERP-99-B14**) project was an expansion of an existing program being administered by the Sustainable Cotton Project group, a grower-sponsored organization. The project goal was to provide cotton farmers the means for reducing the use of pesticides and fertilizers, thereby improving the quality of agricultural runoff. The project funded outreach to cotton farmers in the Firebaugh area, and continued research and demonstration of cotton growing methods which would reduce the need for pesticides and fertilizer. The project was supported by grants from CALFED, SWRCB, and private foundations.

This program, which was voluntary and community based, helped farmers develop a set of tools to reduce pesticide and fertilizer use. These tools include biological control systems, crop monitoring, and alternate methods of weed control. The Final Project Report indicated widespread willingness on the part of farmers to use the new techniques. Sampling from agricultural plots indicated that growers who relied on technical advice supplied by the program were able to reduce significantly their use of chemical pesticides.

Most of the growers in the pilot program opted to remain in the program for more than one year. Growers who participated indicated a level of satisfaction and the desire to learn more about farming with less pesticides and fertilizers. In general, the program showed great promise for reducing chemicals in agricultural runoff, with resulting improvement in water quality of west side tributary streams to the San Joaquin River.

The Stage 1 expectation of protecting and preserving important riparian and wetland habitats and recovery of associated sensitive species, such as the riparian brush rabbit, was accomplished through the *San Joaquin River NWR Riparian Habitat Protection & Floodplain Restoration Project - Phase II* (**ERP-01-N08**) project. The project, which funded the easement and acquisition of approximately 400 acres of habitat adjacent to the 11,000 acres of refuge land, provides long-term preservation and protection. The project also provides restoration of 1,142 acres of riparian and wetlands habitat on refuge lands, a pilot re-introduction of riparian brush rabbits onto refuge lands, and biological monitoring and evaluation. This project also included the completion of flood management evaluation and resolution of issues, the creation and integration of a technical oversight committee, and complements the recovery efforts for the riparian brush rabbit and the riparian wood rat, two of the most critically endangered species in the Central Valley of California. A captive breeding effort for the rabbit has been launched by Department of Interior agencies. Acquisition and restoration of riparian habitat provided by this project was needed to provide secure sites for release of captive bred rabbits in the future.

In Stage 1, expectations were made toward restoring wetland, riparian, and adjacent upland habitat in association with aquatic habitat, which was noted as an essential element of the restoration strategy for the EMZ. Acquisition and partnering with the USFWS San Joaquin Refuge eliminated or reduced fragmentation and restored connectivity to a large contiguous riparian and riverine habitat, benefiting multiple species. Funded projects demonstrated management techniques to improve water quality and management of wetlands and seasonal wetland habitat for waterfowl. Improvement toward stressor reduction such as the water quality concerns for the San Joaquin River and Delta, and increases in riparian and riverine aquatic habitat, assist with maintaining and restoring freshwater fish habitats.

Project Summary Table

The following table is a summary of the seven CALFED projects which significantly affect the West San Joaquin Basin EMZ. Most of the projects also affect other Ecological Management Zones in addition to the West San Joaquin Basin, most notably the lower San Joaquin River. Projects of this sort which affect more than one zone are discussed in more detail under the San Joaquin River EMZ chapter of this report. Where this is the case, it is so noted in the table. Projects in the table denoted with an asterisk are those entirely contained within the West San Joaquin Basin EMZ and are therefore only evaluated in this chapter.

Table 1. West San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-98-B14*	**Irrigation Drainage Water Treatment for Selenium Removal: Panoche Drainage District Demonstration Facility** The purpose of this project is to demonstrate the effectiveness of micro-algae for nitrate and selenium reduction in agricultural runoff.	9/30/2002	$1,171,956	Completed as proposed. Project demonstrated selenium removal rates as high as 80%. Showed need for deeper reduction ponds. Next phase funded by DWR and CALFED Drinking Water Program.
ERP-99-B14	**Biological Agricultural Systems in Cotton – BASIC - Reducing Synthetic Pesticides & Fertilizers in the Northern San Joaquin Valley** Project expanded existing program to provide cotton farmers the means to reduce use of pesticides and fertilizers and thereby improve water quality.	3/31/2003	$429,894	Project complete. Final report (May 2003) states that growers in the program significantly reduced use of pesticides and fertilizers.
ERP-00-B05	**Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District** Project goal was to develop a wetland drainage monitoring system, a habitat and salinity management program, and a model to forecast salt loading.	6/30/2004	$697,330	Contract completed as required. Developed salinity data network, management program, water quality model, and habitat assessment methodology.
ERP-00-E02*	**Panoche/Silver Creek Watershed Management and Action Plan** Project implemented and monitored the effectiveness of Best Management Practices at test locations to reduce sediment, selenium & other contaminants during high flows.	6/30/2005	$868,600	Project completed as proposed. Data gathered in this phase used to develop Panoche-Silver Creek Coordinated Resource Action Plan.
ERP-01-N08	**San Joaquin River NWR Riparian Habitat Restoration Phase II** This phase funds easement acquisition of about 400 acres and restoration of 1,142 acres of riparian and wetlands habitat near the San Joaquin NWR.	12/31/2006	$7,968,112	Proposed acquisitions complete. For details as to implementation success, see East San Joaquin Basin EMZ chapter of this report.

Table 1. West San Joaquin Basin Ecological Management Zone Project Summary

ERP Project Number	Project Name and Description	End Date	Total Funding	Project Status
ERP-02-P44*	**Full-Scale Demonstration of Agricultural Drainage Water Recycling Process Using Membrane Technology** Project entailed demonstration of reverse osmosis membrane treatment to remove salts from recycled agricultural runoff in the Grassland Drainage Area between Mendota and I-5, Fresno County.	9/30/2004	$319,993	Project complete. Results in final report. Pilot tests indicated thin-film membranes did not perform adequately to remove dissolved salts. Recommendation was to retest w/ new membrane.
ERP-05D-S10*	**Wetland Response to Modified Hydrology with Respect to Salinity Management** Internal Dept of Fish & Game research project to improve water quality for wetlands by altering timing of flooding and drawdown regimes.	6/30/2009	$260,000	Ongoing. Two quarterly status reports received to date.

* = Projects are contained solely within the West San Joaquin Basin EMZ.

Other Programs Contributing to ERP Vision

State Water Resources Control Board/Regional Water Quality Control Board

The Watershed Management Initiative (WMI) was developed to help the California Water Boards in meeting the goal of providing water resource protection, enhancement, and restoration while balancing economic and environmental impacts. The WMI provides a framework that overlies numerous separate and competing program priorities established by federal and state mandates. The California Water Boards have been implementing the WMI since 1997 to better coordinate and focus limited public and private resources to address both point and nonpoint source water quality problems, especially in high priority targeted watersheds. By looking at entire watersheds rather than focusing on specific pollutants or polluters, the California Water Boards can develop unique solutions that consider all local conditions and pollution sources for each watershed. These solutions rely on the input and involvement of local stakeholders.

The Regional Water Boards have developed WMI Chapters that describe the Regional Water Board strategies for addressing water quality concerns on a watershed basis. These strategies rely on close coordination with other state, federal, and local agencies in using limited fiscal and technical resources. The WMI Chapters identify priorities, and describe the Regional Board watersheds and watershed-related activities, as well as program activities. Even though the chapters are meant to be long-term strategies, priorities can change quickly. Hence, the WMI Chapters are meant to be living documents so that relevant sections can be updated when new information on changing priorities is received. The WMI Chapters identify priority tasks and projects to be funded

by existing resources, as well as those that are currently unfunded, including potential projects for grant applications. The California Water Boards can use the chapters in making informed decisions on which activities will be funded by specific work plans. The WMI Chapters are dynamic and represent the best information and strategies at the time they are written.

Central Valley Project Improvement Act (CVPIA)

According to the CVPIA ROD, approximately $15 million of CVPIA restoration funds will be used for the purpose of protecting, restoring, and enhancing special status species and their habitats in areas directly or indirectly affected by the Central Valley Project. CVPIA programs that contribute to ERP goals and objectives include: Anadromous Fish Restoration Program, Dedicated Project Yield, Restoration of Riparian Habitat and Spawning Gravel, Clear Creek Restoration, Anadromous Fish Screen Program, & Water Acquisition programs.

Natural Resource Conservation Service (NRCS)

The NRCS Environmental Quality Incentives Program (EQIP) provides a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality. EQIP offers financial and technical help to assist participants with the installation or implementation of structural and management practices on eligible agricultural land. Funded projects are implemented according to an environmental quality incentives program plan of operations that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards and adapted for local conditions. The NRCS Wetland Reserve Program (WRP) is also a voluntary program that provides technical and financial support to landowners who want to protect, restore, and/or enhance wetlands on their property. The goal of the program is to achieve the greatest wetland value and function, as well as wildlife habitat, on all acres enrolled.

Status of the Area Today

A study by the U.S. Geological Survey of the impacts of the proposed San Luis Drain predicts substantial harm to the food web from increased discharge of selenium to the Bay-Delta. The study also predicts degradation even when selenium concentrations are well below existing legal standards, a prediction that is substantiated by current monitoring. Several species of birds in the estuary are already impaired by selenium, though refineries are the only significant source at present and ambient selenium concentrations are low relative to the nationwide water quality standard.

The major water quality problems of the San Joaquin River basin are a result of depleted freshwater flows, municipal and industrial wastewater discharges, salt loads in

agricultural drainage and runoff, and other pollutants associated with agricultural irrigation and production, including nutrients, selenium, boron, organophosphate pesticides (such as diazinon and chlorpyrifos), and toxicity of unknown origin. The Central Valley--which covers the San Joaquin River, as well as the Sacramento River and Tulare Lake basins--has 40 water bodies impaired due to agriculture, including 800 miles of waterways, and 40,000 acres in the Delta. In its most recent triennial review of its basin plan, the Central Valley Water Board identified as high priorities salinity and boron discharges to the San Joaquin River, low dissolved oxygen problems in the lower San Joaquin, organophosphorous pesticide control generally, and a policy for protecting Delta drinking water quality (DWR 2004).

Water released from New Melones Reservoir on the Stanislaus River is currently used to help meet the salinity and dissolved oxygen requirements at Vernalis on the San Joaquin River. Agricultural drainage and discharges from managed wetlands are already formally managed under permit in the 370,000-acre Grasslands watershed, which contributes high levels of salts, selenium, boron, and nutrients to Mud and Salt sloughs, which in turn are the primary contributors of selenium to the San Joaquin River. Dairies, stockyards, and poultry ranches are also a concern in the region for their loadings of pathogens, nutrients, salts, and emerging contaminants (such as antibiotics) to water bodies. Some dairies and other agricultural operations are already subject to regulatory review. Water releases from managed wetlands, part of the State and federal wildlife refuge system, also discharge salts and nutrients. Erosion of Westside streams is the primary source of organochlorine pesticides in the San Joaquin River (DWR 2004).

The area has experienced continuing declines in levels of key species such as fall-run Chinook salmon and steelhead. The emphasis on ecosystem restoration during ERP Stage 1 for the West San Joaquin Basin has been on research and pilot demonstration studies which are directed toward the identification of specific limiting factors and stressors.

Most of the intermittent tributary streams which empty into the San Joaquin River from the West Basin are still heavily laden with sediment and agricultural runoff contaminants, especially during high flows. A significant proportion of the returning Chinook salmon population are known to stray into the drainage ditches and diversion structures on the west side where no spawning habitat exists. With full-scale implementation of water quality monitoring and management plans developed under the pilot demonstrations in Stage 1, there should be significant improvements to instream habitat for this zone and major downstream benefits to the San Joaquin EMZ and Bay-Delta as well.

The State of California should expand and intensify its program of on-farm water conservation to focus especially on demonstrating alternative source control measures for drainage-problem lands, and should encourage implementation of the 1990

"Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley", or "Rainbow Report".

Some of the Rainbow Report's recommendations have been funded and implemented through ERP. Throughout the west side of the San Joaquin Valley, many farms and irrigation districts already rely on recommended actions from the Rainbow Report to reduce and manage their drainage problem. Some farmers have even advanced drainage management technology beyond the Rainbow Report, adding refinements and developing new and innovative techniques.

Several of the targets identified for the West San Joaquin Basin EMZ (CALFED 2000b) will require additional time and project funding to reach the goals set forth in the ERP Program Plan. Some of the pilot demonstration projects in the West Basin have resulted in new knowledge which can be used to guide future full-scale implementation projects. One good example is the *Irrigation Drainage Water Treatment for Selenium Removal: Panoche Drainage District Demonstration Facility* (**ERP-98-B14**). With the successful demonstration that selenium removal can be as high as 80 percent during the main irrigation season, the new knowledge can be used to fund full-scale implementation of microalgae units as a substrate for removal of selenium and nitrate for a large number of irrigation return flow conduits along the lower San Joaquin River. This new knowledge will also facilitate further research into more efficient and less costly selenium removal technologies.

A second project which has provided new knowledge is the *Panoche Creek/Silver Creek Watershed Management and Action Plan (ERP-00-E02)*. Several Best Management Practices (BMP's) for enhancement of water quality were tested for their effectiveness in this pilot demonstration project. The BMP's were monitored and results indicated that fencing streambanks and the provision for dedicated stockwatering troughs significantly reduced sediment and other contaminant contributions from grazing land to overland flow.

Planned Projects for Implementation

A funded SWRCB project, directed by the Grassland Water District, will move into implementation of the concepts presented in the *Adaptive Real-Time Water Quality Management of Seasonal Wetlands in the Grassland Water District* (**ERP-00-B05**) project on paired seasonal wetland units within the Grassland Ecological Area. Adoption of wetland best management practices for real-time water quality management is constrained by lack of information and lack of highly visible exemplars as to how this technology might be applied cost-effectively and with measurable impact on water quality in the San Joaquin River. This hypothesis will be tested by implementing real-time water quality management on two well- managed and highly visible duck clubs in the Grassland Water District. One club will be located in the Southern Division of the

District, which in the past was the recipient of selenium tainted agricultural subsurface drainage water and where land is uniformly salt-affected, and another club in the Northern Division of the Grassland Water District, which has received and continues to receive better quality agricultural return flows and which does not have the same history of salinization. State–of-the-art technologies will be installed. Improvements to system hydraulics will be made at each duck club to allow the first scientifically defensible water and salt balances to be developed as part of this next research and implementation project.

Monitoring is a key component to each of the drainage management actions. Currently, rigorous monitoring of surface waters receiving drainage water is occurring. Most of this monitoring is driven by discharge permit requirements issued by the Regional Water Quality Control Board. The Grasslands Bypass project is monitored for selenium discharge into the San Joaquin River and penalties are levied against the dischargers if drainage water exceeds the maximum allowable limit for selenium. Dischargers to surface evaporation basins are also required to monitor drainage water for selenium. Surface water monitoring is required to protect fish and wildlife and their habitats. In addition, temporal response of surface water to management practices are rapid and changes can be seen on time scales as small as weekly. Monitoring of soil and ground water has received less attention due to funding limitations and temporal changes occurring over time periods of years and even decades. Evaluation of management actions on the long-term sustainability will require salinity, selenium, and boron monitoring to determine salt balance in the drainage-impaired areas of the Valley. Presently there are questions as to where or if salinity is accumulating in the Valley. In the future, surface water monitoring will continue or increase from present levels due to regulatory requirements. However, without sustained monitoring of soil and ground water, proposed benefits of management actions will not be quantifiable. Continuous funding of existing baseline monitoring and performance monitoring should be provided. Additionally, performance measure monitoring of new projects, particularly agency funded projects, should be required in any project solicitation packet (SJVDIP 2002).

Immediate action is needed to quickly address the bulk of the water quality problem for the basin and concurrent research toward the development of long-term strategies. Support is needed for more rapid implementation of drainage reduction and drainage reuse management tools. While these techniques may not eliminate the drainage problem entirely, the Rainbow Report predicts they are sufficient to control the entire drainage problem for at least fifty years.

Impediments to Implementation

Any decision the Bureau makes on land retirement, runoff treatment, or even drain construction will have to be funded by Congress. Due to environmental constraints,

providing drainage has become significantly more challenging and costly, making the original drainage disposal strategies difficult. Researchers have identified several potential drainage service strategies including treatment of agricultural drainage water, deepwell injection and use of evaporation ponds; however, all are costly and their long-term effectiveness and impacts to the environment are unknown.

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