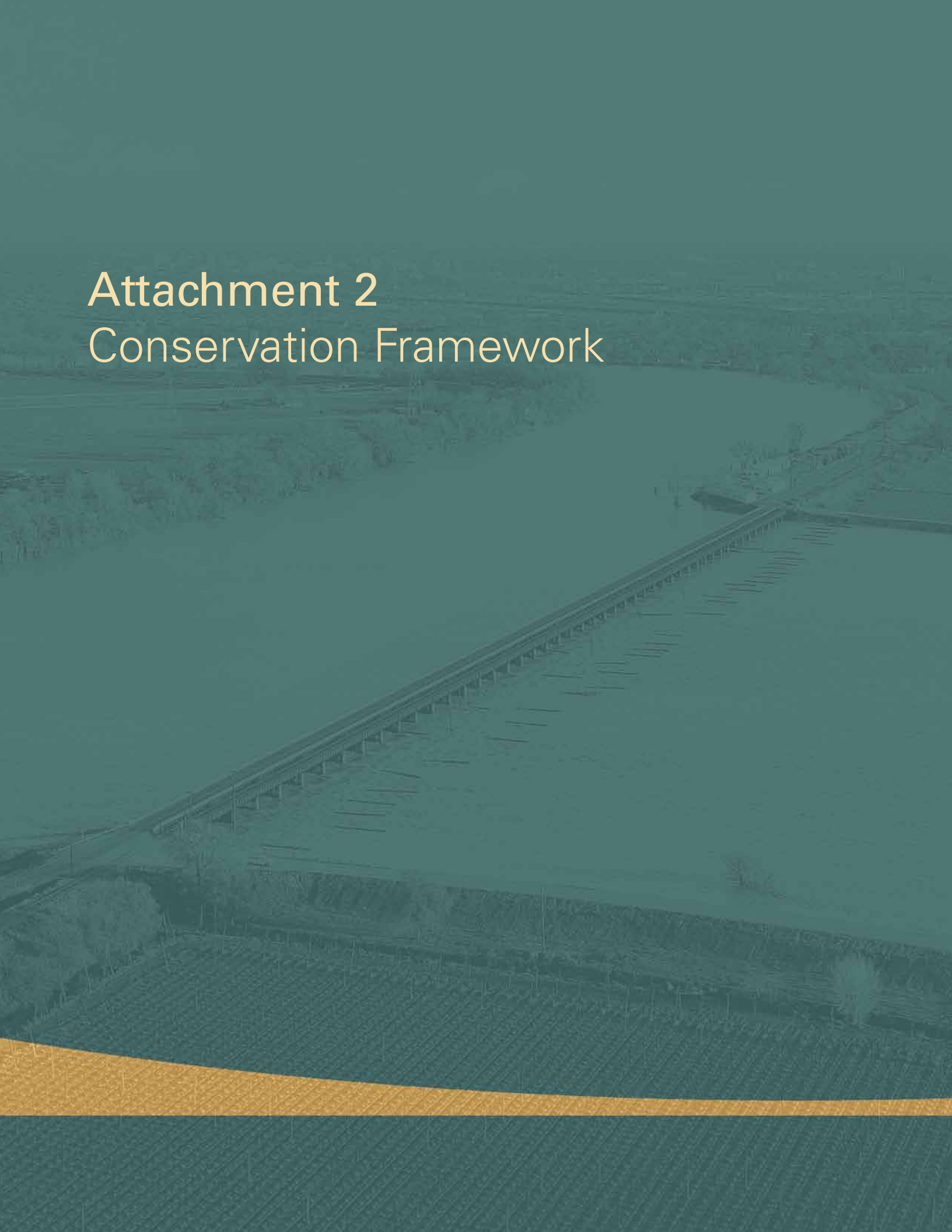
Attachment 2
Conservation Framework



CENTRAL VALLEY
FLOOD MANAGEMENT
PLANNING PROGRAM

FloodSAFE
CALIFORNIA

Public Draft

2012 Central Valley Flood Protection Plan

Attachment 2: Conservation Framework

December 2011

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

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1.0 Introduction

The Conservation Framework is an integral part of the State of California's (State's) preferred approach to flood management in the Central Valley. To help meet the required objectives of the Central Valley Flood Protection Act of 2008 and the goals of the Central Valley Flood Protection Plan (CVFPP) (with the primary goal regarding public safety), this Conservation Framework outlines the State's intent to accomplish the following:

White pelicans along the Sacramento River

- Improve and enhance natural dynamic hydrologic (flow) and geomorphic processes in the flood management system
- Increase and improve the quantity, diversity, quality, and connectivity of riverine habitats in the flood management system, including the agricultural and ecological values of these lands
- Contribute to the recovery and stability of native species populations and overall biotic community diversity associated with the flood management system

Successful achievement of these goals, as part of achieving other CVFPP goals, is expected to provide multiple benefits, including the following:

- A more sustainable and resilient flood management system, capable of long-term adaptability to changing hydrological and climatic conditions and providing greater long-term viability for ecosystems and agriculture
- Improved public safety from catastrophic flooding
- Faster delivery of flood risk reduction projects and more efficient and effective environmental permitting

Conservation is the maintenance, enhancement, and restoration of populations, communities, and ecosystem functions to sustain the services, benefits, and values of public trust resources.

The Conservation Framework is the first phase of more comprehensive and integrated planning within the flood management system, leading to a longer term Central Valley Flood System Conservation Strategy (Conservation Strategy). This Conservation Framework provides direction for conservation planning in the context of flood management. It also provides interested organizations (local

governments, State and federal agencies, flood managers, conservation organizations, and agricultural interests) with important planning information and approaches that can, and should be, integrated into flood project planning and implementation. This Conservation Framework describes how the 2012 CVFPP integrates the relevant environmental policies and conservation elements contained in the Conservation Framework with CVFPP implementation. The integration will help minimize impacts on the ecosystem, mitigate for environmental effects, and improve ecosystem functions.

This Conservation Framework will be replaced by a longer term Conservation Strategy, as part of the 2017 CVFPP update, and it will complement the federal Central Valley Integrated Flood Management Study (CVIFMS). The Conservation Strategy will be consistent with this Framework and provide more specifics about integrating flood and conservation actions. This Conservation Strategy may include regional permitting plans (such as Natural Community Conservation Plans (NCCP), Habitat Conservation Plans (HCP), or programmatic Section 7 consultations, for example).

This section of the Conservation Framework describes the broader CVFPP context for Central Valley flood management planning, explains the State's interest in integrated flood and ecosystem management, describes the purpose and development of the Conservation Framework, and outlines the organization of this document.

1.1 Background and CVFPP Context

As authorized by Senate Bill 5, also known as the Central Valley Flood Protection Act of 2008, the California Department of Water Resources (DWR) has prepared a sustainable, integrated flood management plan called the CVFPP, for adoption by the Central Valley Flood Protection Board (Board). The 2012 CVFPP provides a systemwide approach to protecting lands currently protected from flooding by existing facilities of the State Plan of Flood Control (SPFC), and will be updated every 5 years.

1.1.1 CVFPP Planning Areas

For planning and analysis purposes, and consistent with legislative direction, two geographical planning areas were important for CVFPP development (Figure 1-1):

- **SPFC Planning Area** – This area is defined by the lands currently receiving flood protection from facilities of the SPFC (see *State Plan of Flood Control Descriptive Document* (DWR, 2010)). The State of California's (State) flood management responsibility is limited to this area.

- **Systemwide Planning Area** – This area includes the lands that are subject to flooding under the current facilities and operation of the Sacramento-San Joaquin River Flood Management System (California Water Code Section 9611). The SPFC Planning Area is completely contained within the Systemwide Planning Area which includes the Sacramento River Basin, San Joaquin River Basin, and Sacramento-San Joaquin Delta (Delta) regions.

Planning and development for the CVFPP occurs differently in these planning areas. The CVFPP focused on SPFC facilities; therefore, evaluations and analyses were conducted at a greater level of detail within the SPFC Planning Area than in the Systemwide Planning Area.

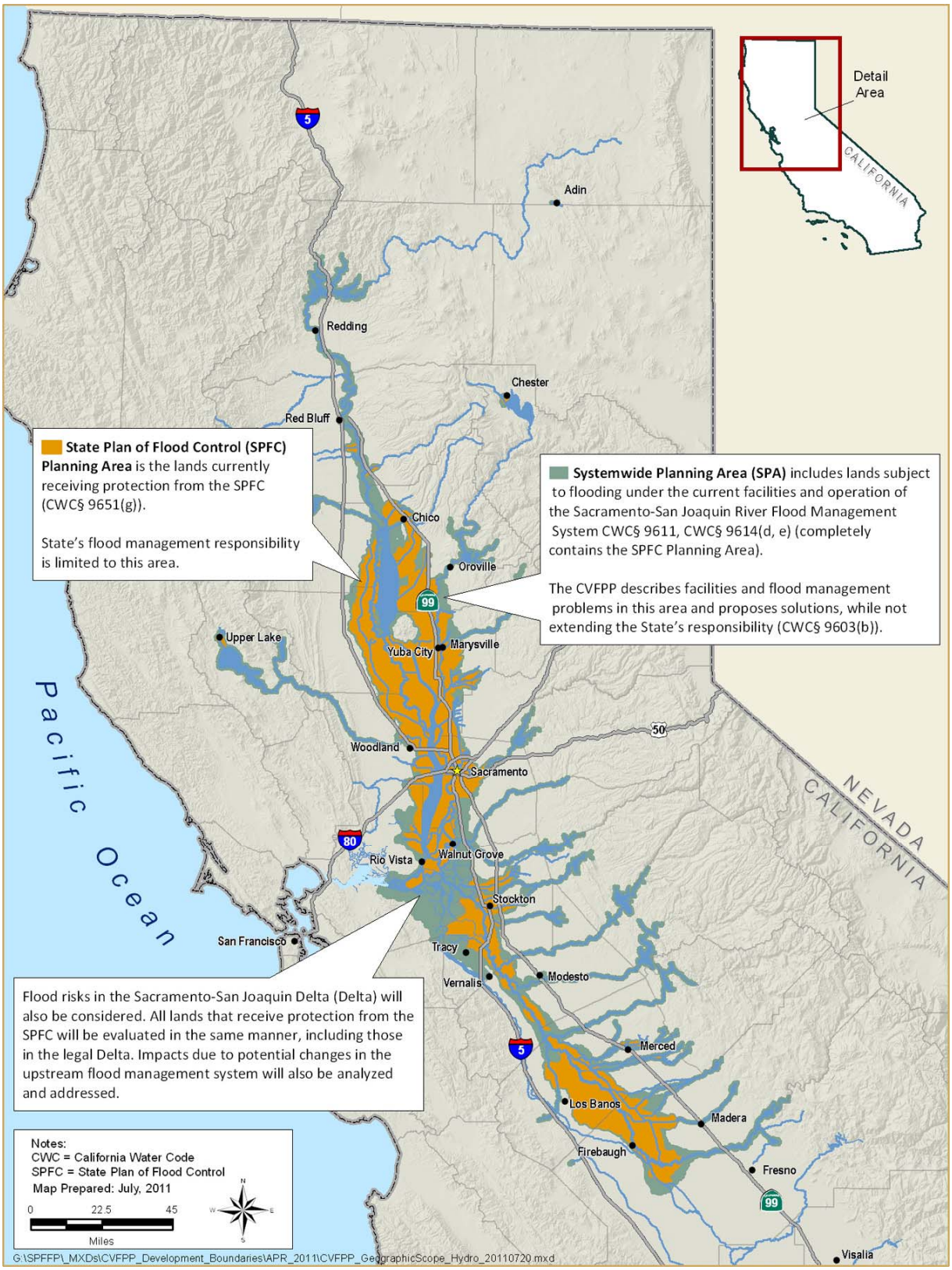

Figure 1-1. Central Valley Flood Protection Plan Planning Areas

1.1.2 2012 CVFPP Planning Goals

As explained in the CVFPP itself, this plan is a critical document to guide California's participation (and influence federal and local participation) in managing flood risk along the Sacramento and San Joaquin rivers. The CVFPP proposes a systemwide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the SPFC. DWR recognizes that many other planning efforts are also underway within the CVFPP planning area (see Attachment 9E: Existing Conservation Objectives from Other Plans) and that it will need to identify opportunities to coordinate, collaborate, and reduce potential conflicts with these efforts. The CVFPP will be updated every 5 years, with each update providing support for subsequent policy, program, and project implementation.

To help direct CVFPP development to meet legislative requirements and address identified flood-management-related problems and opportunities, a primary and four supporting goals were developed:

- **Primary Goal** – Improve Flood Risk Management
- Supporting Goals:
  - Improve Operations and Maintenance
  - Promote Ecosystem Functions
  - Improve Institutional Support
  - Promote Multi-Benefit Projects

The Conservation Framework is an integral part of the CVFPP in support of all of these goals. In particular, the Conservation Framework focuses on promoting ecosystem functions and multi-benefit projects. All levels of CVFPP project planning and development will consider opportunities to integrate ecosystem enhancements with flood damage reduction projects.

Incorporating the environmental principles and conservation actions identified in the Conservation Framework can improve flood risk management and O&M.

1.1.3 2012 CVFPP Planning Approaches

In addition to the **No Project** approach, three fundamentally different approaches to flood management were initially compared to explore potential improvements in the Central Valley. These approaches are not alternatives; rather, they bracket a range of potential actions and help

explore trade-offs in costs, benefits, and other factors important in decision making. The approaches are as follows:

- **Achieve SPFC Design Flow Capacity** – Address capacity inadequacies and other adverse conditions associated with existing SPFC facilities, without making major changes to the footprint or operation of those facilities.
- **Protect High Risk Communities** – Focus on protecting life safety for populations at highest risk, including urban areas and small communities.
- **Enhance Flood System Capacity** – Seek various opportunities to achieve multiple benefits through enhancing flood system storage and conveyance capacity.

Comparing these approaches helped identify the advantages and disadvantages of different combinations of management actions, and demonstrated opportunities to address the CVFPP goals to different degrees.

Based on this evaluation, a **State Systemwide Investment Approach** was developed that encompasses aspects of each of the approaches to balance achievement of the goals from a systemwide perspective, and includes integrated conservation elements. Figure 1-2 illustrates this plan formulation process.

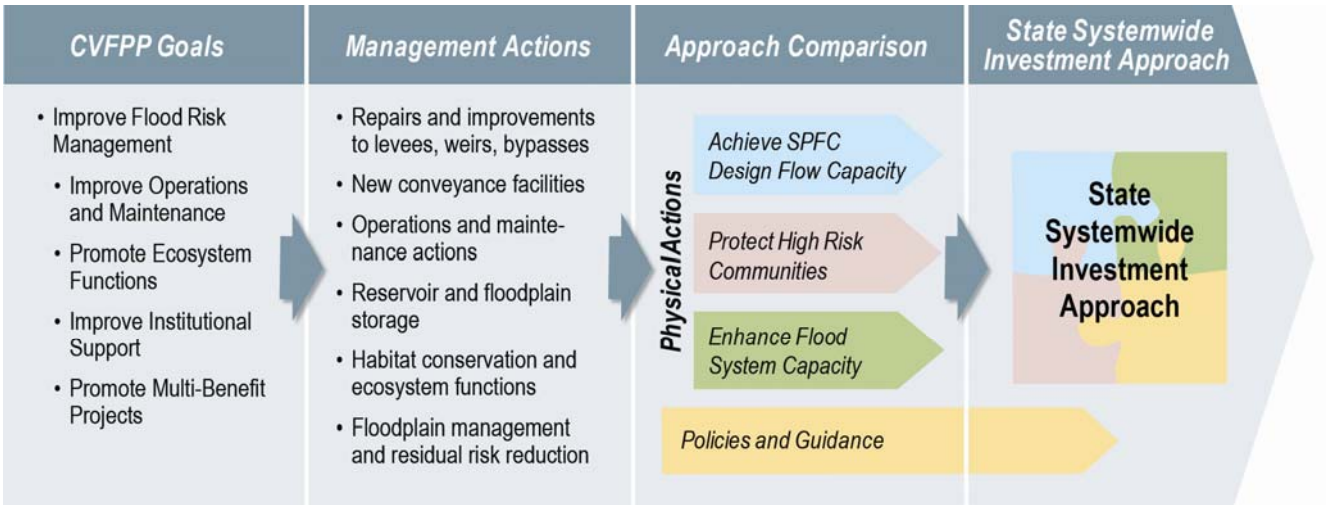

Figure 1-2. Formulation Process for State Systemwide Investment Approach

1.2 Integration of Flood and Ecosystem Improvements

The State is committed to protecting public safety while improving the status and trends of biological resources within the Central Valley flood management system. This commitment is consistent with and supportive of legislative, administrative, and interagency direction. Legislative direction is based in the ecological objectives of the Central Valley Flood Protection Act of 2008. Administrative direction comes from the ecosystem goals of CVFPP and FloodSAFE California Initiative (FloodSAFE), as well as the DWR Environmental Stewardship Policy (2010a) and other related DWR policies. The February 27, 2009, *California Central Valley Flood System Improvement Framework* developed by the California Levees Roundtable contains some interagency direction. Environmental stewardship can reduce flood project regulatory delays, lower long-term operation and repair costs, provide greater public benefits, and strengthen public support.

> Environmental stewardship is a concept of, and commitment to, responsibly manage and protect natural resources (water, air, land, plants, and animals) and ecosystems in a sustainable manner that ensures they are available for future generations.

For the CVFPP, the State's preferred approach is to improve both flood management and ecological conditions on a systemwide basis, using integrated policies, programs, and projects. This approach builds on recent efforts and successes to incorporate environmental benefits into flood management projects, and improves on these efforts by considering systemwide measures that can be taken to improve and recover ecosystem processes that are key to environmental health. These recent efforts and successes are described in greater detail in Section 4.1. Further, by integrating environmental stewardship early into policy and project planning, development, funding, and implementation, this approach will move beyond traditional project-by-project compensatory mitigation. This approach also creates the opportunity to develop flood management projects that may be more sustainable and cost effective and can provide ecological benefits while protecting water supply and public safety.

In addition to pursuing an approach that integrates flood protection and ecological improvements, the State recognizes that efforts to improve flood protection and associated ecological conditions will take place on, near, or affect Central Valley farmland and rural communities. The State acknowledges that jointly developed solutions deliver a variety of benefits to agricultural, flood protection, and conservation interests. The State is as committed to working with stakeholders from each of these sectors to further develop and implement the Conservation Framework and develop

the long-term Conservation Strategy, as it has in the development of the primary document, the CVFPP.

1.3 Conservation Framework Purpose and Phasing

This Conservation Framework serves two purposes. The first purpose of the Conservation Framework is to be an environmental guide for flood project planning in the 2012 CVFPP. The second purpose is to present a broad outline and preview of a longer term Conservation Strategy to be completed by 2017.

The Conservation Framework describes how environmental stewardship is integrated into flood management activities, directs the reader to relevant environmental elements in the CVFPP, and gives additional detail on environmental planning elements, including regulatory compliance. Supporting documentation for the Conservation Framework includes detailed technical attachments containing further information on the following: regional advance mitigation planning (RAMP), status and trends of environmental resources, an assessment of fish passage needs, vegetation mapping, conservation objectives from other plans, restoration opportunities analysis, and regional environmental permitting.

The longer term Conservation Strategy will provide a comprehensive approach for the State, consistent with the Conservation Framework, to (1) achieve the environmental goals and objectives of the Central Valley Flood Protection Act, FloodSAFE, and the CVFPP, and (2) implement the DWR environmental stewardship policy within the flood management system. The long-term vision of this Conservation Strategy is a sustainable system of managing Central Valley floodways that includes multiple environmental objectives during project planning and design and that achieves the following:

- Embodies environmental and agricultural stewardship as an integral part of flood management
- Results in a healthy and robust ecosystem
- Reduces long-term maintenance and management costs
- Uses solid scientific foundations, local expertise, and broad-based contexts for informing decisions

- Nurtures productive partnerships, both within State agencies and with external groups

- Promotes local agency and public support for sustainable practices that further the goals and objectives of this framework

- Promotes development and implementation of projects that provide multiple benefits, including recreation, conservation, agriculture, water supply, and other values

The Conservation Strategy is being developed in several phases, with this Conservation Framework representing the first phase. Concurrent with development of this document, conservation activities have been initiated that will continue during implementation of the 2012 CVFPP. In the second phase, the Conservation Strategy will be completed as part of the 2017 CVFPP update and will inform both the State feasibility studies and the federal U.S. Army Corps of Engineers (USACE) CVIFMS feasibility studies. The Conservation Strategy will refine this long-term vision and Conservation Framework goals, contain more information about key factors that influence achievement of those goals, describe how applying specific management actions can work effectively at achieving those goals, and set conservation priorities among management actions and regions. The Conservation Strategy will expand on and replace the current Conservation Framework, and it will be updated along with the CVFPP every 5 years. A timeline for the next steps in Conservation Strategy development is shown in Section 7, Next Steps.

The Conservation Framework supports the content of the CVFPP through the following:

- Describing the broad flood ecosystem; its various components, stressors, and management responses to these stressors; the importance of ecosystem processes to sustaining habitat and species, and the historical, current, and expected future status and trends of this ecosystem

- Providing conservation goals (see Section 3, Conservation Goals) based on environmental supporting goals in the Central Valley Flood Protection Act related to ecosystem processes, habitats, and species

- Giving greater detail about key planning principles that helps the State achieve conservation goals more efficiently and effectively

- Describing how flood managers have integrated environmental stewardship into past projects and how DWR can work with ongoing planning efforts to continue and expand on these approaches
- Showing how the CVFPP's integrated flood management actions and policies support achieving conservation goals

1.4 Conservation Framework Development

The Conservation Framework was developed iteratively in conjunction with the CVFPP. In addition to the directives of the Central Valley Flood Protection Act of 2008, a primary driving element in the development of the Conservation Framework is the DWR Environmental Stewardship Policy. Environmental stewardship is a concept of and commitment to responsibly manage and protect natural resources (water, air, land, plants, and animals) and ecosystems in a sustainable manner that ensures they are available for future generations. In September 2010, DWR formally adopted its Environmental Stewardship Policy, which applies to water and flood management projects and activities throughout DWR.

The Conservation Framework incorporates this Environmental Stewardship Policy as a State preferred policy in the CVFPP. However, subject to various technical, economic, and policy constraints, implementation of conservation-related policies will be influenced by the following factors:

- Opportunities present during flood project planning
- Specific mitigation measures required by regulatory agencies before project approval
- Opportunities for development of large-scale advance mitigation programs
- Opportunities for specific projects that target ecosystem benefits
- Opportunities for integration with other conservation and land-use planning efforts
- Opportunities for integration with agricultural land-use and production systems
- Needs for achieving other CVFPP goals

- Plan for onsite environmental education and public access for recreation

Early in the CVFPP development process an Environmental Stewardship Scope Definition Work Group (ESSDWG) was chartered to provide input on the scope of environmental stewardship to be addressed in the 2012 CVFPP. Comprising members representing a broad range of interests and perspectives, ESSDWG provided the following input:

- Description of the major environmental challenges, categorized into priority groups, that the CVFPP should address
- Description of major opportunities that the CVFPP should consider for addressing the major challenges, including recommendations for improving upon past efforts and coordinating with current efforts
- List of the key principles for guiding the development, integration, and implementation of environmental stewardship features of the CVFPP
- List of the major environmental goals that should be included in the CVFPP

DWR Environmental Stewardship Policy Highlights

DWR shall work towards the sustainability of public trust resources related to water resources projects and the environment. The goal of an environmental stewardship ethic is to create human systems consistent with natural systems, where each is ultimately sustainable. Systems of water supply and flood protection are more successful when they accommodate and sustain ecosystem functions. Sustainable systems are also more economical over time. DWR fosters the environmental stewardship ethic by embracing broad concepts of impact avoidance and protection of natural resources, minimization, mitigation and restoration, and enhancement of natural functions and values.

DWR will incorporate ecosystem restoration as an objective in water and flood management projects, including partnering with restoration efforts of others, to achieve net environmental benefit. Ecosystem restoration is the process of reestablishing, to the extent possible, the structure, function, and composition of the natural environment.

DWR will use science to understand the functions of natural biological and physical systems, so as to help plan and design water supply storage and conveyance systems and flood control systems that also benefit native plants, and fish and wildlife resources.

DWR managers will embrace environmental stewardship as part of their responsibilities. As managers develop and deliver reliable water supplies and provide for flood protection for the State's residents, they can incorporate environmental stewardship in several ways:

- Integrate ecosystem protection and restoration into water storage and conveyance and flood control/management planning
- Include environmental stewardship and ecosystem protection and restoration as criteria in project funding decisions for all DWR programs
- Plan for conservation, restoration, and maintenance of the biological diversity and natural physical processes of aquatic and related terrestrial ecosystems.
- Plan and implement projects that contribute to the recovery of aquatic and riparian species listed under the federal and State Endangered Species Acts and other laws, as well as other at-risk species.

- Description of approaches or measures to evaluate the CVFPP's effective integration and implementation of environmental stewardship elements

- Recommendations for important documents that should be used as reference materials related to environmental stewardship. These references were used in developing both the CVFPP and Conservation Framework

The ESSDWG prepared a summary to record the outcome of the group's efforts, The *Environmental Stewardship Scope Definition Work Group Summary Report* (DWR, 2009).

An Agricultural Stewardship Scope Definition Joint Subcommittee was also chartered during Phase 1 of the CVFPP planning process. The role of this group was to describe major agricultural contributions, challenges, and opportunities and receive input from the agricultural community. Subcommittee members and observers composed a geographically broad group that included perspectives from local municipalities, conservation, and different levels of agriculture.

The subcommittee provided the following input:

- Definition of key goals by region and priority group, providing additional details about existing conditions and future challenges specific to agriculture

- Key principles for guiding the development and implementation of agricultural stewardship features into the CVFPP and description of approaches for evaluating the effective integration of those elements

- List of agriculturally focused problems and opportunities and criteria for assessing the incorporation of agricultural interests into the CVFPP

- Goals for the development of tiered design standards that recognize the differences among urban, rural, and agricultural levees and provide equitable funding for urban and rural flood protection systems

- List of suggested actions, with both general statements addressing policy and public safety issues and specific recommendations for proposed funding, State programs, and pre-identified flood relief areas

- Process Guide Checklist to help ensure that agricultural concerns are addressed throughout the development of the 2012 CVFPP

The subcommittee developed a framework, included in the draft report, *Important Considerations for the Central Valley Flood Protection Plan Related to Sacramento-San Joaquin Valley Agriculture* (DWR, 2010), that (1) aims to balance habitat and ecosystem goals with agricultural preservation, and (2) identifies agricultural stewardship opportunities consistent with the goals of the CVFPP. The report highlights the need to ensure understanding of how flood system improvements may affect potential financing opportunities, and identifies principles for promoting crop diversity, sustainable farm operation and production, and continued growth. Although the report identified a variety of issues related to flooding in an agricultural landscape (e.g., finance/insurance, consequences of flooding, post-flood recovery, and emergency communication), this Conservation Framework focuses on those agricultural issues related to environmental stewardship on agricultural land.

The items from the ESSDWG and Agricultural Stewardship Scope Definition Subcommittee were integral in providing guidance and content for much of the Conservation Framework. As the Conservation Strategy is developed, DWR will pursue opportunities to integrate ecosystem and agricultural interests.

1.5 Report Organization

Organization of this document is as follows:

- Section 1 introduces and describes the purpose of this report.
- Section 2 summarizes floodway ecosystem conditions and trends.
- Section 3 contains conservation goals of the Conservation Framework.
- Section 4 describes the integration of conservation elements into the CVFPP.
- Section 5 summarizes implementation actions.
- Section 6 reviews indicators of success for integrating conservation elements into the CVFPP.
- Section 7 describes next steps for the Conservation Strategy.
- Section 8 contains references for the sources cited in this document.
- Section 9 lists abbreviations and acronyms used in this document.

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2.0 Floodway Ecosystem Conditions and Trends

The Systemwide Planning Area contains most river channels and floodplains of the Sacramento and San Joaquin rivers and their major tributaries. The riverine and riparian ecosystems of these river channels and floodplains are among the most important natural resources of the Sacramento and San Joaquin valleys, and provide habitats of critical importance to numerous native aquatic and terrestrial species.

This section describes key fluvial, geomorphic, and ecological interactions in the flood management system; historical pressures and changes to ecological processes and habitats; current conditions and trends; conservation improvements and progress; and continuing stressors.

> The riverine and riparian ecosystems in the river channels and floodplains of the Systemwide Planning Area are among the most important natural resources of the Sacramento and San Joaquin valleys.

A preliminary analysis of the status and trends of hydrologic and geomorphic processes, habitats, and key wildlife and fish species was performed and is provided in Attachment 9B: Status and Trends of the Riparian and Riverine Ecosystems of the Systemwide Planning Area. This section is based on that analysis, which shows that modification of hydrologic and geomorphic processes has reduced their ability to support important ecosystem functions.

2.1 Fluvial, Geomorphic, and Ecological Interactions

In a general sense, the ecological systems of the Central Valley consist of uplands, riverine environments, and lower lying adjacent flood basins. Uplands are generally located around the rim of the valley and in areas between waterways that are elevated above river levels. These areas, along with the broader watershed, capture precipitation and provide runoff to the riverine and flood basin areas. The Conservation Framework does not focus on these areas, but recognizes their important influence on the other parts of the system.

The flow of water through the system, and the associated hydrologic, geomorphic, and ecological processes, are influenced by a variety of natural factors (such as topography and soils) and human influences. The diagram in Figure 2-1 shows the major natural and human factors

influencing the ecological processes and condition of riverine ecosystems in the Sacramento and San Joaquin valleys.

This figure diagrams several major premises underlying much of the Conservation Framework:

- Species, particularly endangered species, within the riverine system depend on the quality, quantity, and dynamic nature of habitat along waterways. These habitat features, in turn, depend upon functional hydrologic and geomorphic processes, such as sediment erosion, transport, and deposition. Thus, maintaining and improving these processes is critical to maintaining and recovering river-dependent species.

- Human activities (including flood management activities) have been adversely affecting these ecological processes.

- Reducing the adverse influences of human activities on these ecological processes is necessary for effective conservation of riverine and riparian ecosystems in the Sacramento and San Joaquin valleys.

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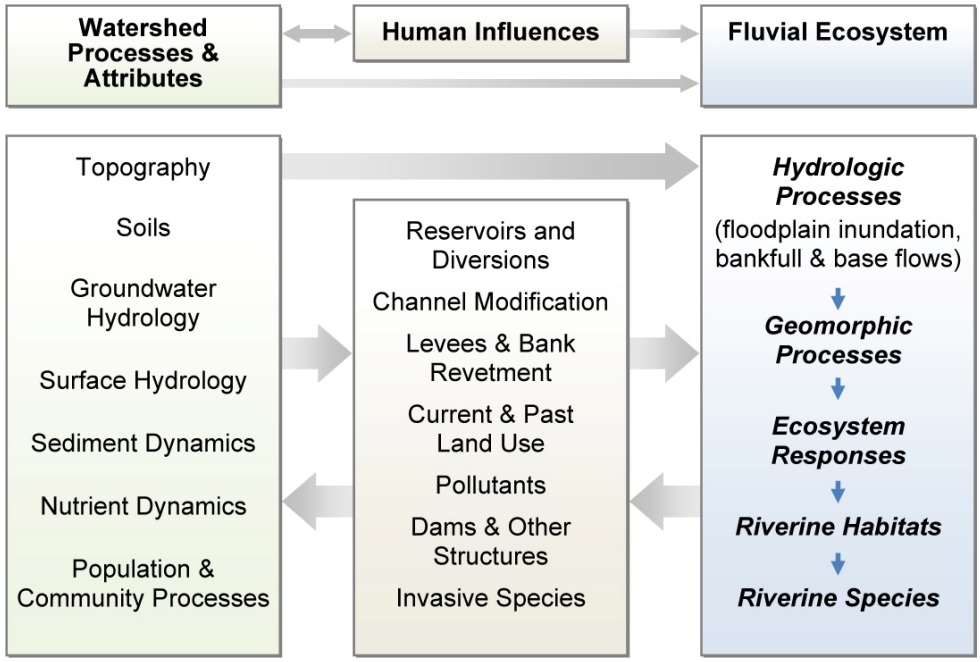


Figure 2-1. General Relationships of Natural Processes, Human Influences, and the Fluvial Ecosystem

2.1.1 Riverine ecosystem

The riverine ecosystem depends on a variety of different flow levels, each providing unique hydrological, geomorphic, and ecological processes. Three ecologically significant categories of river flows are:

- **Floodplain inundation flows** typically occur less frequently than once every 2 years. These flows are responsible for sediment deposition onto a floodplain, provide seasonal floodplain habitat for aquatic species, supply nutrients to floodplain vegetation, and disperse seeds onto the floodplain.

- **Bankfull flows**, occurring on average once every 1.5 to 2 years, represent the maximum flow that can be contained within the active river channel. These flows are responsible for most of the force that alters the channel and bed of a river.

- **Base flows** are typically the annual minimum flows that occur in summer and fall.

Floodplain inundation flows and bankfull flows are particularly important in initiating geomorphic processes that sustain habitat and species. Along alluvial floodplain rivers, the erosion, transport (both suspended in the water column and along the river bed (i.e., bedload)), and deposition of sediment causes channels to migrate, be cut off, and split and rejoin downstream.

These fundamental geomorphic processes influence the formation of floodplain topography, soils, and other floodplain dynamics to create a diverse mosaic of floodplain landforms of different ages that support different age classes of riparian vegetation. These geomorphic processes also are important drivers of in-stream habitat quality for fish and other aquatic life, and form off-channel habitats such as side channels and oxbow lakes that provide important fish and wildlife habitat. Figure 2-2 provides an example of a constrained river reach on the upper Sacramento River downstream from Colusa, and Figure 2-3 depicts a river reach (upper Sacramento River, upstream from Colusa) with an active floodplain.

Figure 2-2. Constrained Reach of Sacramento River Upstream from Colusa

Figure 2-3. River – Active Floodplain

Each of the three categories of flows (floodplain inundation, bankfull, and base flows) drives different geomorphic and ecological processes, which collectively maintain a healthy ecosystem and a diversity of habitat types. These effects are summarized in Table 2-1.

Table 2-1. Effects of Different Categories of Flows on Geomorphic and Ecological Processes and Species

	Floodplain Inundation Flow	Bankfull Flow	Base Flow
Geomorphic processes	• Causes major changes in channel morphology (scouring, erosion, channel cutoffs, new side channels) • Mobilizes coarse to fine sediments	• Causes ongoing scouring and erosion of banks, formation of point bars, lateral channel migration, and mosaic of different-aged floodplain surfaces • Mobilizes moderate to fine sediments	• Causes deposition in channel • Mobilizes fine sediments only
Ecosystem processes	• Increases large woody material in river • Increases dissolved oxygen in water • Increases aquatic structural diversity and exposes gravels for spawning • Enables establishment of early successional vegetation (willows and cottonwoods) • Provides nutrients, sediment, and plant seeds to floodplain from upstream • Increases primary aquatic productivity	• Increases large woody material in river • Increases dissolved oxygen in water • Increases aquatic structural diversity and exposes gravels for spawning • Creates mosaic of riparian vegetation (pioneer to mature) with time • Provides nutrients, sediment, and plant seeds to riverbank from upstream • No major effect	• Provides perennial flow for fish, birds, and other species and maintains vegetation growth • Reduces dissolved oxygen in water • Decreases aquatic structural diversity • Allows mature vegetation to outcompete early successional species if base flow is prolonged • No major effect • Allows accumulation of organic materials, as well as contaminants
Species	• Provides floodplain habitat to outmigrating salmonids and spawning splittail and increases early successional habitat for plants and animals, potential to strand or isolate fish species	• Provides instream fish habitat to channel and maintains diversity of early to late successional habitat for plants and animals	• Provides summer channel habitat for fish; causes silts to cover spawning gravels; and facilitates invasion of less- flood-tolerant species, including nonriparian and nonnative species

The riverine and riparian ecosystem historically supported a wide variety of fish and wildlife. Many of these species evolved life history strategies that allowed them to exploit the temporal and spatial variability associated with the region's Mediterranean climate and variable hydrologic and geomorphic processes.

2.1.2 Flood Basins

Lower reaches of the Sacramento and San Joaquin valleys are elevated above lower-lying adjacent lands known as flood basins. These include, for example, the Yolo Basin, the American River Basin, and Sutter Basin. This reverse topography is due to geological changes over millennia. The most

highly subsided lands, extending below sea level in places, are found in the Delta "islands," where human-induced subsidence is a more recent development. Before the development of the flood management system, these flood basins regularly flooded during winter storms and historically were collectively called the 'inland sea" during major flood events. These lands supported extensive tule marshes, seasonal wetlands and grasslands.

In the flood basins of the Sacramento and San Joaquin valleys, geomorphic processes, such as sediment erosion and transport, played a less significant role in habitat maintenance, as compared to the riverine environment. The role of these processes in maintaining habitats and species gradually decreases as distance from river channels increases. However, species such as migratory salmonids depend on periodic and shallow inundation of these basins to replenish soil and food web productivity.

Although flood basins in the Central Valley have been converted to agricultural uses, these agricultural lands provide habitat for several wildlife species. For example, rice fields and canals provide habitat for giant garter snakes (*Thamnophis gigas*) and resident and migratory birds; irrigated pastures and field crops provide forage for songbirds, raptors, small rodents, and waterfowl; orchards can provide roosting habitat for bats; and row crops provide foraging habitat for raptors.

2.2 Historical Pressures and Changes

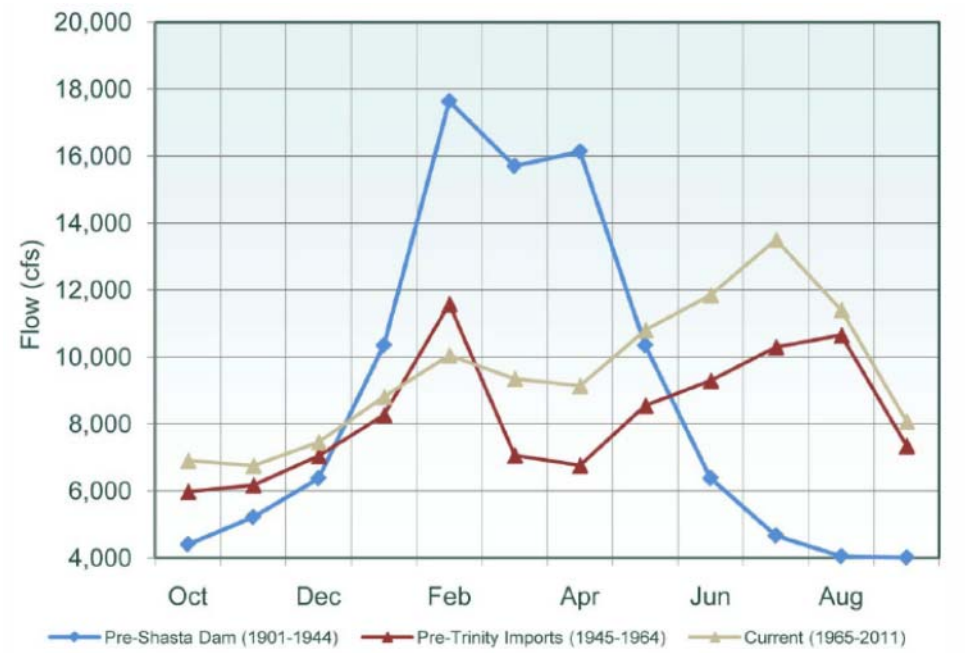
Relative to historic conditions, riverine ecosystems and flood basins have been adversely affected by a variety of stressors, including human settlement, historic and current land use, construction O&M of the SPFC, species invasions, water diversions, and other modifications to the landscape that characterized the watersheds of the Sacramento and San Joaquin valleys before widespread European settlement. The combined effect of these stressors has eliminated extensive areas of wetland and riparian habitat; reduced the diversity, abundance, and distribution of numerous plant and animal species (many to the endangered level); and increased stressors such as invasive species and pollutants that are degrading the remaining habitat, driving many species to the point of being critically endangered.

2.2.1 Changes to Flows and Hydrologic Processes

Central Valley river flows and hydrologic processes have been substantially altered in the past 100 years. Analysis of hydrologic data collected downstream from Shasta Dam on the Sacramento River and downstream from Friant Dam on the San Joaquin River shows that the presence of the dams has substantially changed annual median flows.

In the Sacramento River, Shasta Dam has reduced monthly median flows in winter and spring, and summer and fall flows have been increased, even after importing water from the Trinity River (Figure 2-4), and the variability in median spring flows has been greatly reduced.

In the San Joaquin River, Friant Dam has had an even greater effect on hydrology. Before the recent implementation of the San Joaquin River Restoration Program (SJRRP), most San Joaquin River flows from above Friant Dam, were diverted at the dam into two major irrigation canals (Madera and Friant-Kern canals), and thus did not continue downstream in the river. The magnitude of the effect of these diversions is indicated by the change in median monthly flows (Figure 2-5). Larger events that would inundate floodplains are also reduced by Friant Dam and downstream by routing into the flood bypass system.



Source: Prepared by AECOM in 2011 based on USGS gauge data

Figure 2-4. Monthly Median Flows in Sacramento River at Bend Bridge (USGS Gage 11377100)

Figure 2-5. Monthly Median Flows in San Joaquin River at Friant (USGS Gage 11251000)

Beyond monthly median flows, the frequency and duration of ecologically significant flows has also changed. The frequency of floodplain inundation flows (2 to 10 years) and the average duration of these flows have increased in the Sacramento River Basin since construction of reservoirs for flood control. This increase in duration reflects typical flood control operations under which larger flood event peaks are stored and subsequently released at lower flow rates following the peak of a flood event. In the San Joaquin River Basin, the frequency and average duration of floodplain inundation flows have greatly decreased because of retention of flows behind dams and diversion of flows into the bypass system.

The frequency of bankfull flows has been greatly reduced in both the Sacramento and San Joaquin rivers, and the duration of these flows has been increased as a result of reservoir operations.

With the current system of reservoirs and water diversions in the Sacramento and San Joaquin valleys, base flows are elevated for irrigation purposes above historical conditions on the Sacramento River and its tributaries and greatly reduced on major portions of the San Joaquin River and its tributaries. Consequently, riparian tree seedlings may drown during the summer along the Sacramento River, but they may desiccate along portions of the San Joaquin River.

2.2.2 Changes in Geomorphic Processes and Channel and Floodplain Dynamics

In the Sacramento River, Shasta Dam has interrupted and greatly reduced sediment transport, and dams on major tributaries (e.g., the Feather River) also have disrupted sediment transport. The geomorphic processes along the Sacramento River between Red Bluff and Colusa, a reach where the river still actively meanders, have been affected by these changes in hydrology and sediment transport, and they have also been affected by land-use changes (loss of riparian forest), increased bank revetment, and construction of levees. The result has been that total river length, area of floodplain reworked by the river, and variability of the age of floodplain surfaces have all been reduced.

Active floodplain at the confluence of Thomes Creek and Sacramento River

In the San Joaquin River, Friant Dam, the Delta-Mendota Canal, and dams on all major tributaries have greatly modified the hydrology of the river. The geomorphic consequences of these modifications have not been studied as extensively for the San Joaquin River as they have for the Sacramento River. The San Joaquin River upstream from the confluence with the Merced River is part of a multi-channeled system, where channel positions have not changed much over time. Some reaches of the river (e.g., upstream from the Mendota Pool, upstream from its confluence with the Merced River) historically were meandering. However, Friant Dam has greatly reduced the frequency of scouring flows, resulting in less bank erosion, reduced area of river wash (gravel and sand bars), and less input of large woody material into the river channel. These effects of Friant Dam and the effects of bank revetment and levee construction have generally stopped the meandering that historically occurred. In the foothill portions of the San Joaquin River and its major tributaries, pits created by aggregate mining have been captured by the streams, causing major changes in channel form and degradation of aquatic habitats.

2.2.3 Reductions in Habitats and Species

The riverine and flood basin habitats of today have been greatly modified from pre-1850 conditions. The flood basins have been largely converted to agricultural or urban uses. Wide bypasses in the Sacramento Valley still provide seasonal habitat for native fish species (Sommer et al., 2003);

however, the extent, frequency, and duration of inundation important for juvenile fish rearing is substantially less, compared to conditions before 1850.

Approximately 95 percent of historical wetlands and riparian areas no longer exist in the Central Valley, based on an analysis by The Bay Institute (1998) using 1993 California Department of Fish and Game (DFG) vegetation data (Figure 2-6). Most of the remaining wetlands are seasonal wetlands managed as waterfowl habitat and are located in federal and State wildlife areas and on private duck clubs; they are not directly connected to rivers. Much of remaining 56,000 acres of riparian habitat is highly fragmented or occurs as narrow strips along waterways.

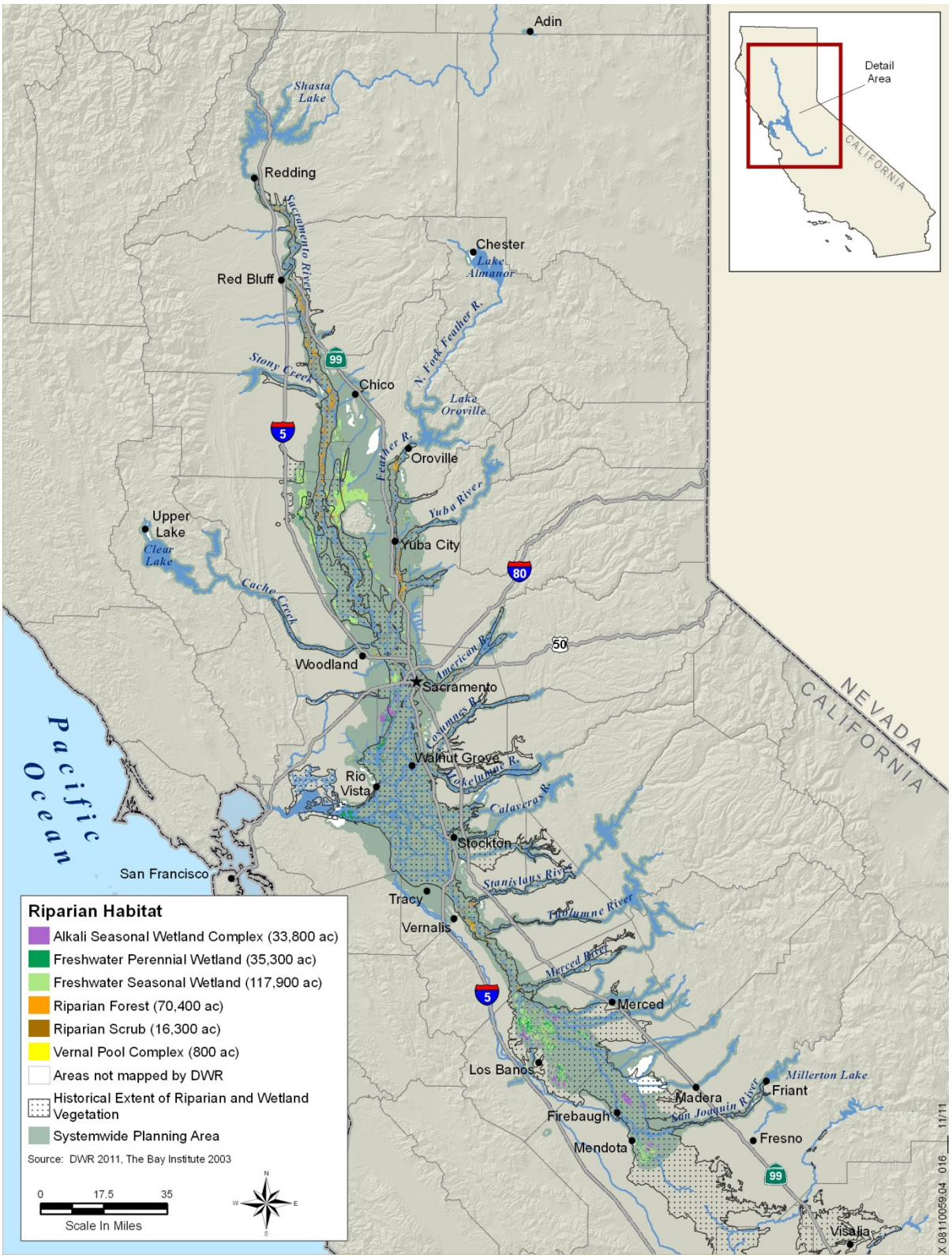


Figure 2-6. Riparian and Wetland Vegetation Potential/Historical and Current Distribution

The reduction in overall area of wetlands and riparian forest has reduced the abundance of terrestrial wildlife species supported by these habitats. Although many of these species still occur today, their population sizes and spatial distributions have generally been greatly reduced, relative to historical conditions. Tables 2-2 and 2-3 identify 20 species that are currently listed under either the California Endangered Species Act (CESA) or the federal ESA, as well as 33 other species that are considered sensitive species.

Aquatic habitats for salmonids and other native fishes have been greatly reduced or degraded by changes in hydrologic and geomorphic processes. These changes are due to many factors, including dams, diversions, revetment, and levees. Dams have prevented upstream passage of salmonids, many miles of spawning habitat no longer accessible to Chinook salmon (Figure 2-7) and steelhead. Isolation of rivers from their once-extensive floodplains has cut off frequent flooding, reducing the cyclical replenishing of food web productivity in important rearing habitat.

The natural fluvial disturbance patterns that maintain the complex mosaic of riverine habitats and that support native species abundance and diversity have been altered due to less frequent overbank and bankfull flows and longer durations of base flows. River channels have been straightened in many areas, and 150 miles of the Sacramento River bank are lined with riprap (The Bay Institute, 1998). River water tends to be deeper and of more uniform depth than it was before 1850, when aquatic habitats were much more diverse.

Table 2-2. Representative Sensitive Plant Species of Riverine, Wetland, and Riparian Habitats in Sacramento and San Joaquin Valleys and Delta

Species		Status			Habitat		
Common Name	**Scientific Name**	**Federal[a]**	**State[b]**	**CRPR[c]**	**Riverine-Lacustrine**	**Wetland**	**Riparian Forest-Scrub**
Bristly sedge	*Carex comosa*	–	–	2.1		•	
Bolander's water-hemlock	*Cicuta maculata var. bolanderi*	–	–	2.1		•	
Slough thistle	*Cirsium crassicaule*	–	–	1B.1		•	•
Silky cryptantha	*Cryptantha crinita*	–	–	1B.2			•
Delta button-celery	*Eryngium racemosum*	–	E	1B.1			•
Bogg's Lake hedge-hyssop	*Gratiola heterosepala*	–	E	1B.2		•	
Woolly rose-mallow	*Hibiscus lasiocarpus var. occidentalis*	–	–	2.2		•	
California satintail	*Imperata brevifolia*	–	–	2.1			
Delta tule pea	*Lathyrus jepsonii var. jepsonii*	–	–	1B.2		•	•
Mason's lilaeopsis	*Lilaeopsis masonii*	–	R	1B.1		•	
Delta mudwort	*Limosella subulata*	–	–	2.1		•	
Slender-leaved pondweed	*Potamogeton filiformis*	–	–	2.2	•		
Eel-grass pondweed	*Potamogeton zosteriformis*	–	–	2.2	•		
Sanford's arrowhead	*Sagittaria sanfordii*	–	–	1B.2		•	
Marsh skullcap	*Scutellaria galericulata*	–	–	2.2		•	
Side-flowering skullcap	*Scutellaria lateriflora*	–	–	2.2		•	
Suisun Marsh aster	*Symphyotrichum lentum*	–	–	1B.2		•	•
Wright's trichocoronis	*Trichocoronis wrightii var. wrightii*	–	–	2.1		•	•

Table 2-2. Representative Sensitive Plant Species of Riverine, Wetland, and Riparian Habitats in Sacramento and San Joaquin Valleys and Delta (contd.)

Species		Status			Habitat		
Common Name	Scientific Name	Federal[a]	State[b]	CRPR[c]	Riverine-Lacustrine	Wetland	Riparian Forest-Scrub
Brazilian watermeal	*Wolffia brasiliensis*	–	–	2.3	•		

Sources: CNDDB 2010; CNPS 2010

Notes:

[a] U.S. Fish and Wildlife Service — Federal Listing Categories:
T = Threatened
E = Endangered
– = No status

[b] California Department of Fish and Game — State Listing Categories:
R = Rare
E = Endangered
– = No status

[c] California Department of Fish and Game — California Rare Plant Ranks:
1A = Presumed extinct
1B = Plants rare, threatened, or endangered in California and elsewhere
2 = Plants rare, threatened, or endangered in California, but more common elsewhere

Extensions:
1 = Seriously endangered in California (> 80 percent of occurrences are threatened and/or high degree and immediacy of threat)
2 = Fairly endangered in California (20 – 80 percent of occurrences are threatened)
3 = Not very endangered in California (< 20 percent of occurrences are threatened or no current threats are known)

Key:
CRPR = California Rare Plant Rank
Delta = Sacramento-Delta–Suisun Marsh
State = State of California

Table 2-3. Representative Sensitive Wildlife Species of Riverine, Wetland, Riparian, and Agricultural Communities in the Sacramento and San Joaquin Valleys and Delta

Species		Status[1]	Habitat(s)			
Common Name	**Scientific Name**	**USFWS/DFG**	**Riverine-Lacustrine**	**Wetland**	**Riparian Forest-Scrub**	**Agricultural**
Invertebrates						
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT/–			•	
Fish						
Central Valley fall/late-fall-run Chinook salmon	*Oncorhyncus tshawytscha*	FSC/CSC	•			
Central Valley spring-run Chinook salmon	*Oncorhyncus tshawytscha*	FT/CT	•			
Sacramento River winter-run Chinook salmon	*Oncorhyncus tshawytscha*	FE/CE	•			
Central Valley steelhead	*Oncorhyncus mykiss*	FT/–	•			
Southern Distinct Population of the North American green sturgeon	*Acipenser medirostris*	FT/–	•			
Delta smelt	*Hypomesus transpacificus*	FT/–	•			
Longfin smelt	*Spirinchus thaleichthys*	–/CT	•			
Sacramento splittail	*Pogonichthys macrolepidotus*	–/CSC	•			
Hardhead	*Mylopharodon conocephalus*	–/CSC	•			
River lamprey	*Lampetra ayresii*	–/CSC	•			
Amphibians						
Foothill yellow-legged frog	*Rana boylii*	–/CSC	•			
California red-legged frog	*Rana draytonii*	FT/CSC	•	•	•	
Northern leopard frog	*Rana pipiens*	–/CSC	•	•		
Reptiles						
Western pond turtle	*Actinemys marmorata*	–/CSC	•	•		
Giant garter snake	*Thamnophis gigas*	FT/CT		•		•
Birds						
Tricolored blackbird	*Agelaius tricolor*	–/CSC		•		•
Swainson's hawk	*Buteo swainsoni*	–/CT			•	•
Northern harrier	*Circus cyaneus*	–/CSC		•		•
Western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	FC/CE			•	

Table 2-3. Representative Sensitive Wildlife Species of Riverine, Wetland, Riparian, and Agricultural Communities in the Sacramento and San Joaquin Valleys and Delta (contd.)

Species		Status1	Habitat(s)			
Common Name	**Scientific Name**	**USFWS/DFG**	**Riverine-Lacustrine**	**Wetland**	**Riparian Forest-Scrub**	**Agricultural**
Yellow warbler	*Dendroica petechia brewsteri*	–/CSC			•	
White-tailed kite	*Elanus leucurus*	FP/CSC		•	•	•
Greater sandhill crane	*Grus canadensis tabida*	CT/FP		•		•
Bald eagle	*Haliaeetus leucocephalus*	CE/FP	•			
Yellow-breasted chat	*Icteria virens*	–/CSC			•	
California black rail	*Laterallus jamaicensis coturniculus*	–/CT, FP		•		
Suisun song sparrow	*Melospiza melodia maxillaries*	–/CSC		•		
Bank swallow	*Riparia riparia*	–/CT	•			
Least Bell's vireo	*Vireo bellii pusillus*	FE/CE			•	
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*	–/CSC		•		
Mammals						
Pallid bat	*Antrozous pallidus*	–/CSC	•			•
Western mastiff bat	*Eumops perotis*	–/CSC	•			•
Western red bat	*Lasiurus blossevillii*	–/CSC	•			•
Riparian (=San Joaquin Valley) woodrat	*Neotoma fuscipes riparia*	FE/CSC			•	
Salt-marsh harvest mouse	*Reithrodontomys raviventris*	FE/CE, FP		•		
Riparian brush rabbit	*Sylvilagus bachmani riparius*	FE/CE			•	

Sources: CNDDB 2011; DFG 2010
Note:
[a] Status definitions:
CE = California listed as endangered
CSC = California species of special concern
CT = California listed as threatened
FC = federal candidate for listing
FE = federally listed as endangered
FP = California fully protected
FSC = NMFS species of concern
FT = federally listed as threatened
Key:
– = no legal status
Delta = Sacramento-San Joaquin Delta
DFG = California Department of Fish and Game
NMFS = National Marine Fisheries Service
USFWS = U.S. Fish and Wildlife Service

Figure 2-7. Fall-Run Chinook Salmon Historical and Current Distribution in Sacramento and San Joaquin Valleys

The altering of geomorphic processes as a result of construction of dams, diversions, revetment, levees, and other stressors has resulted in a substantial reduction in the extent of riparian vegetation along the Sacramento and San Joaquin rivers and their tributaries. Two important habitat components for salmonids, large woody material in river channels and shaded riverine aquatic (SRA) cover along channels, have been dramatically reduced from historical conditions.

SRA habitat with overhead vegetation, in-water cover, and natural, often eroding, bank

Large woody material consists of logs, typically more than 4 inches in diameter and more than 6 feet long, lying in river or stream channels. This material provides valuable cover and resting habitat for fish.

SRA habitat has three main attributes: (1) overhead vegetation, (2) in-water cover, and (3) natural, often eroding, bank (USFWS, 1992). Federal, State, and private application of bank protection has displaced much of the high-value SRA cover on the Sacramento River system. Current data shows that high-quality SRA, which includes all three of these attributes as defined by the USFWS, along the banks of the Sacramento River between Red Bluff and Verona has been substantially reduced from historic conditions (as described in Attachment 9G, Regional Permitting Options).

The USFWS identifies SRA as a Resource Category 1 habitat under its Mitigation Policy on the Sacramento River system. Resource Category 1 habitats are habitats “of high value for evaluation species” and are “unique and irreplaceable on a national basis or in the ecoregion section.” The USFWS mitigation goal for such habitats is “no loss of existing habitat value” (USFWS, 1981). Agricultural habitats of historical floodplains and flood basins have been affected by urbanization, availability of water supplies, technological changes, and construction of weirs, bypasses, and other flood control structures. Conversion to nonagricultural uses has been reducing the extent and quality of these agricultural habitats, as well as reducing the distribution and abundance of associated species, for several decades. Agricultural acreage peaked around 1959, and has since gradually declined as urban areas have expanded into the floodplains of the Sacramento and San Joaquin rivers. From 1990 to 2004, approximately 95,000 acres of agricultural lands were converted to nonagricultural uses in the Sacramento and San Joaquin valleys (excluding the Tulare Lake Basin) (American Farmland Trust, 2007).

Table 2-3 lists sensitive wildlife species representative of riverine, wetland, riparian, and agricultural habitats of the Sacramento and San Joaquin valleys and Delta, and the legal status of those species.

2.3 Conservation Improvements and Progress

Upper Sacramento River Restoration near Kopta Slough

Although the historical trend has been a widespread decline in wetland and riparian habitats, recent restoration efforts have started to reverse this trend in parts of the Sacramento and San Joaquin valleys. However, most habitat restoration efforts to date have involved planting riparian vegetation or creating wetlands rather than restoring fluvial and geomorphic processes that would promote natural habitat regeneration. Areas of riparian and wetland habitat that still exist, including areas of restored habitat, are primarily found between levees or within historical flood basins that serve as flood bypasses or are protected as wildlife refuges by State or federal agencies.

State, federal, and local governments and private organizations have responded to environmental degradation of riparian and riverine ecosystems in the Sacramento and San Joaquin valleys by developing and implementing numerous restoration projects and programs, and by establishing wildlife refuges and other protected areas throughout the flood management system. Examples of these protected areas include Graylodge Wildlife Area in the Butte Basin, Sutter National Wildlife Refuge in the Sutter Bypass, Vic Fazio Yolo Wildlife Area in the Yolo Bypass, and the San Joaquin River National Wildlife Refuge.

Several ongoing regional planning efforts in the CVFPP Systemwide Planning Area address specific conservation needs (see Attachment 9E: Existing Conservation Objectives from Other Plans). Examples include the SJRRP, CALFED Bay-Delta Program (CALFED) Ecosystem Restoration Program, Sacramento River Conservation Area Forum, Bay-Delta Conservation Plan (BDCP), various county-based NCCPs, and several species-focused recovery plans.

Many restoration and other conservation projects have been completed, or are currently in progress, along rivers and streams in the Central Valley. Collectively, these projects involve many State and federal agencies (including DWR, the Board, DFG, USFWS, National Marine Fisheries Service (NMFS), U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and USACE), conservation organizations, and local government agencies. Some of these projects are primarily targeted at habitat improvements, while others use habitat to solve flood problems (see Section 4.1, Progress in Flood and Ecosystem Integration, for examples). The following are additional examples of completed or in-progress conservation improvements:

> Coordinating with other planning efforts may increase economy and efficiency and can provide greater opportunities for effective, integrated, landscape-level conservation, including improving habitat connectivity and increasing the size of habitat preserves.

- Local districts have been involved in flood control efforts that have integrated flood and conservation improvements on the Feather and Bear rivers and the lower American River. On the Feather and Bear rivers, the Three Rivers Levee Improvement Authority (TRLIA) led a collaborative effort to set back levees from the main river, resulting in greatly reduced levee lengths needing maintenance and several thousand acres of new connected floodplains. Section 5.6.3, Corridor Management Strategy, describes a developing concept for coordinated planning for flood management and conservation, and its application to the lower Feather River. On the lower American River, the Sacramento Area Flood Control Agency (SAFCA) has collaborated with other agencies to develop bank protection sites that integrated riparian and in-water habitat into the design.

- Local Reclamation Districts (RD) in the Delta, with DWR local assistance funding, maintains and improves levees while also providing a net increase in habitat as required by Assembly Bill 360.

- Central Valley Project (CVP) habitat conservation programs, which consist of the Central Valley Project Conservation Program and Central Valley Project Improvement Act (CVPIA) Habitat Restoration Program. These programs are managed cooperatively by Reclamation and USFWS, in coordination with DFG, and they fund acquisition, restoration, and other projects to improve Central Valley riparian habitat, wetlands, and other habitats.

- The Riparian Habitat Joint Venture and the Central Valley Joint Venture, each of which are collaborative efforts among many public agencies and private organizations, conserve riparian and wetland habitats in the Central Valley.

- The Cosumnes River Preserve project integrates wildlife and compatible agriculture in an active floodplain. Key participants in this effort are the U.S. Bureau of Land Management, DFG, and The Nature Conservancy (TNC). Agricultural lands are farmed to produce crops during the dry season, while also providing valuable foraging habitat for Swainson's hawks (*Buteo swainsonii*). Inundation of the floodplain during the winter benefits wintering migratory waterbirds and sandhill cranes (*Grus canadensis tabida*).

2.4 Continuing Stressors

This section describes the role of ongoing human modifications to the riverine and riparian ecosystem that could be most affected by the flood management system and its operations. These human modifications include levees and bank revetment, reservoir operation, water diversions, invasive species, and fish passage barriers. This section also discusses institutional challenges to habitat conservation.

2.4.1 Levees and Bank Revetment

In selected areas of the Sacramento and San Joaquin rivers, as in many places throughout the world, the use of levees and riprap has virtually halted natural river processes that create and maintain the complexity of aquatic and riparian ecosystems, such as river channel meander migration and creation of meander cutoffs (Naiman et al., 1993; Lytle and Poff, 2004).

Bank revetment along the Sacramento River

High O&M costs are driven in part by the current footprint of the levee system, which at many locations is at odds with natural geomorphic processes. The Flood Control System Status Report (DWR, 2011) documents many historical erosion distresses and levee slope instability locations throughout the system, as well as current river reaches with high hazard levels for seepage, erosion, and slope stability.

Levees disconnect channels from the floodplain, and thus eliminate or reduce overbank flows. Overbank flows provide access by native fish to the floodplain, and water, sediment, nutrients, and seeds to the floodplain, and thus, maintain floodplain ecosystems.

Bank revetment and levees also reduce the potential for channel migration. Two important aspects of habitat for salmonids and other native fish

species are affected by a reduction in channel migration: (1) SRA cover (Fris and DeHaven, 1993), and (2) large woody material.

2.4.2 Dams

The most important impacts of dams on the hydrology of downstream river reaches are (1) decreases in flow peak frequency, magnitude, and duration, and (2) increases in the frequency, magnitude, and duration of low flows (Singer, 2007). These effects are discussed in Section 2.2.1, River Flow and Hydrologic Processes.

Dams trap bedload that would normally be deposited downstream; larger dams also trap most suspended sediment. In addition, larger dams change the magnitude and frequency of flows, affecting sediment transport in the lower river below. Over time, the channel degrades due to the loss of sediment and bedload input and becomes entrenched and static. With the loss of sediment input, channel riffles that provide seasonal habitat for salmonid spawning, develop a coarser surface layer with gravel particles too large for most flows to move and, as a result, may no longer provide usable spawning habitat for salmonids. As channel and existing floodplain conditions between the levees become relatively static, these floodplain substrates cease to be reworked by the stream flows and vegetation remains unchanged, gradually becoming a mature riparian forest without succession, regeneration, and regrowth (Jones & Stokes, 1998; Friedman et al., 1998).

2.4.3 Diversions

Various agricultural landowners and municipal water districts have constructed numerous water diversions that pump water directly out of the Sacramento and San Joaquin rivers and their tributaries. For example, an inventory of water diversions estimated that 722 such diversions are present along the Sacramento River and in the San Joaquin River Basin (Herren and Kawasaki, 2001). Many of these diversions are greater than 250 inches in diameter (Moyle and White, 2002).

In the San Joaquin River downstream from Friant Dam, the magnitude of diversion of water from the river channel into the Friant-Kern and Madera canals and the bypass system (bypasses only have substantial flows during floods) has eliminated flows to the San Joaquin River, effectively eliminating salmonid populations upstream from the confluence of the San Joaquin River with the Merced River.

2.4.4 Invasive Species

Invasive plant species can alter hydrology and sedimentation rates in riparian and aquatic systems (Cal-IPC, 2011a) and provide substantially

lower wildlife habitat value. Dense stands of invasive species can alter channel morphology by increasing the hydraulic roughness of a channel and capturing and retaining sediments. This restricts flows and reduces flood conveyance (Hunter and Platenkamp, 2003; Bossard et al., 2000). For example, saltcedar (*Tamarix* spp.) and giant reed (*Arundo donax*) trap and stabilize alluvial sediments, resulting in the narrowing of stream channels and more frequent flooding (Bossard et al., 2000). Invasive species can also quickly colonize recently disturbed areas, outcompeting and preventing native riparian vegetation from establishing. Nonnative fish species can prey on young native fish species and aquatic invasive invertebrates can displace more nutritious prey species.

Giant reed (*Arundo donax*) infestation along the Sacramento River

2.4.5 Fish Passage Barriers

Fish passage barriers, such as dams, weirs, and water diversions for agricultural and municipal uses, have greatly reduced the amount of salmonid habitat in the Sacramento and San Joaquin River basins, and many diversions also cause the direct mortality of fish. The effects of passage barriers on salmonids differ by species and race, as described below. Most species and runs of salmonids have been adversely affected by the construction of dams and similar passage barriers in the Sacramento and San Joaquin River basins. Figure 2-7 illustrates the loss of habitat for fall-run Chinook salmon (*Oncorhyncus tshawytscha*). However, spring-run Chinook salmon and steelhead (*Oncorhyncus mykiss*) have likely been the most seriously affected, in terms of direct habitat loss, by construction of passage barriers. Steelhead spawning habitat loss from construction of passage barriers has been estimated at 80 percent (Lindley et al., 2006). Construction of passage barriers has also been a stressor on winter-run Chinook. Construction of Shasta Dam has almost completely eliminated historical holding and spawning grounds for winter-run Chinook salmon. Attachment 9C: Fish Passage Assessment contains greater detail on fish passage barriers in the Systemwide Planning Area.

Examples of Barriers to Fish Passage

Dams
Road Crossings
Diversions
Flood Control Channels
Weirs
Culverts
Pumping Plants
Flow Measurement Weirs

2.4.6 Institutional and Other Challenges

In addition to the above physical stressors, habitat conservation within the flood management system has faced a variety of institutional challenges. As with many systems of this magnitude, one of the more significant challenges has been the continual need for adequate funding and broad public understanding and support for conservation. As a result, projects for a variety of different purposes (such as flood management, water supply, land use, transportation, recreation, and ecosystem conservation) have often been planned in a piecemeal manner, resulting in conflicts, inefficiencies, and missed opportunities for cost-sharing on common goals.

In recent years, public agencies have been developing more integrated regional planning approaches that are overcoming these challenges. Attachment 9E: Existing Conservation Objectives from Other Plans provides examples of such existing regional conservation planning efforts in the Sacramento and San Joaquin valleys.

Insufficient scientific and planning data is another challenge for making informed decisions related to habitat conservation efforts in the flood management system. Gaps in this knowledge include high-quality and detailed regional data sets on vegetation, public land ownership, locations of sensitive species, understanding of key species conservation needs, shared information about the importance and benefits of active floodplains, and modeling of flood and ecosystem interactions. A variety of agency programs and regional planning efforts are making progress to fill these gaps, but more work is still needed.

2.5 Increasing Stress Resulting from Rapidly Changing Climate

Rapid climate change resulting from human activities is expected to have profound effects on the riparian and riverine ecosystems of the Sacramento and San Joaquin rivers and their tributaries. This section describes these effects and consequences for flood management and ecosystem restoration, and is largely based on *Managing an Uncertain Future: Climate Change Adaptation for California's Water* (DWR, 2008).

The main direct and indirect effects on California water resources would likely include higher temperatures, a reduced Sierra Nevada snowpack, more intense and more frequent droughts, more frequent high flood flows, more frequent and more intense wildfires, more erosion and sedimentation throughout watersheds, increased agricultural and municipal water demand, reduced water quality, and sea-level rise.

Although each of these effects can be considered a stressor, the potential effects of climate change most directly affecting Sacramento and San Joaquin riparian and riverine ecosystems, such as increased temperatures and droughts, increased flood frequency, and sea-level rise, have affected natural ecosystems for thousands of years. Thus, natural adaptation of ecosystems and native species could be expected under natural conditions.

However, the climate is not known to have changed as rapidly as is happening now. In addition, riparian and riverine ecosystems are already being subjected to a number of other human-induced stressors that reduce their ability to adapt to climate change. Examples of current stressors that reduce the ability for species and ecosystems to respond to climate change include fragmentation of contiguous habitat corridors, flow alteration and/or vegetation loss that results in increased water temperatures, reduced connectivity between channels and floodplains, lack of space for tidal marshes to accommodate sea-level rise, continued land subsidence, and loss of upper watershed forest and meadow systems. Providing additional capacity in the system would allow for more flexibility to support a changing hydrograph and reduce risk of levee erosion, while accommodating ecosystem functions.

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3.0 Conservation Goals

As mentioned in Section 1, Introduction, the CVFPP has one primary goal and four supporting goals:

- **Primary Goal**
  - Improve Flood Risk Management
- **Supporting Goals**
  - Improve O&M
  - Promote Ecosystem Functions
  - Improve Institutional Support
  - Promote Multi-Benefit Projects

The Conservation Framework is supportive of these goals and provides more specific conservation goals to better articulate and guide the integration of conservation and flood management policies, programs, and actions.

The following conservation goals are based on environmental objectives in the Central Valley Flood Protection Act of 2008:[1]

- **Improve and enhance natural dynamic hydrologic (flow) and geomorphic processes in the flood management system** – These ecosystem processes are critical for maintaining habitats and species. Natural hydrologic processes provide the diversity of flows necessary to sustain fisheries and riverine habitats. These flows, in turn, sustain geomorphic processes that are essential for maintaining a variety of habitats on which species depend.

- **Increase and improve the quantity, diversity, quality, and connectivity of riverine habitats including the agricultural and ecological values of these lands** – These include aquatic, riparian,

Central Valley Flood Protection Act of 2008 California Water Code Section 9616 (a).

Environmental Objectives

- Promote natural dynamic hydrologic and geomorphic processes.
- Increase and improve the quantity, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands.
- Promote the recovery and stability of native species populations and overall biotic community diversity.

[1] California Water Code Section 9616 (a).

wetland, floodplain, and SRA habitats, as well as agricultural lands that provide important wildlife values.

Inundated floodplain

- **Contribute to the recovery and stability of native species populations and overall biotic community diversity** – These include species whose long-term viability is at risk. Although the above two goals are the foundation for species conservation, this goal also includes contributing to species recovery goals, avoiding and minimizing adverse effects on sensitive species, and developing offsite compensatory habitat.

The Conservation Framework has three additional conservation goals that contribute to conservation success:

- Reduce stressors related to the development and operation of the flood management system that negatively affect important species (e.g., loss and degradation of ecosystem functions and habitat, invasive species, impairments to in-stream water quality and flows, fish passage barriers)

- Increase support and collaboration among flood managers, regulatory agencies, local NCCP and HCP planning staff, environmental nongovernmental organizations (NGO), and agricultural interests for multi-benefit flood projects by achieving the following:

  - Increasing the use of collaborative regional planning and sustainable long-term approaches that provide multiple benefits (flood risk reduction, water supply, habitat, agricultural stewardship, recreational opportunities, and others)

  - Improving environmental benefits from all flood projects

  - Reducing long-term costs for O&M and repair in flood-prone areas

  - Improving efficiency and effectiveness of flood project environmental approval

- Increase the quality of environmental information and tools for informing flood management and conservation activities

Consistent with the level of detail of the current planning phase, more specific and measurable objectives for these goals have not yet been developed. Such objectives require more extensive discussions with interested organizations so that they are achievable and reasonable.

However, readers may be interested in reviewing measurable biological objectives from other conservation plans that overlap with the CVFPP Planning Area (see Attachment 9E: Existing Conservation Objectives from Other Plans). These give an indication of the types and magnitude of objectives being used by other agencies and organizations.

Ideally, objectives are clearly articulated descriptions of a measurable standard, desired state, threshold value, amount of change, or trend to be achieved. They help planners to evaluate more carefully the desired future conditions, what it might take to achieve those conditions, and what to monitor to track progress and successes. They contain information about the indicator being measured (types, specific attributes, desired values) as well as the geographic extent and time frame over which this will be achieved.

Some examples of potential indicators to consider for objectives are listed in Section 6, Indicators of Success. The Conservation Strategy, as described above, will be more specific about these objectives.

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4.0 Integration of Conservation and Flood Management

This section provides information about how environmental stewardship can be integrated with other flood management actions and describes the conservation aspects of the SSIA. The SSIA is described more fully in Chapters 3 and 4 of the CVFPP. Readers will understand the context of this section more fully by reading relevant sections of the CVFPP.

Integrated Flood Management

An approach to dealing with flood risk that recognizes the:

- Interconnection of flood management actions within broader water resources management, ecosystems, and land use planning
- Value of coordinating across geographic and agency boundaries
- Need to evaluate opportunities and potential impacts from a system perspective
- Importance of environmental stewardship and sustainability
- Value of rural farms and communities

Integrated flood management is an approach to dealing with flood risk that recognizes the interconnection of flood management actions within broader water resources management and land-use planning; the need to consider existing land use; the value of coordinating across geographic and agency boundaries; the need to evaluate opportunities and potential impacts from a system perspective; the importance of environmental stewardship and sustainability; and the value of rural farms and communities. Ways of using integrated flood management to simultaneously address flood and ecological challenges are presented in Section 4.1, Progress in Flood and Ecosystem Integration.

Improvements in habitats and populations of sensitive species will help deliver flood projects more efficiently and effectively and facilitate regulatory approval. When included as part of project design, ecosystem restoration and recreational benefits can help justify project funding where traditional benefit-cost ratios are low. As described in the CVFPP, more flexibility in the regulatory framework would allow the flood management system to be managed in a more integrated fashion that concurrently and efficiently achieves flood management and environmental goals. For example, some of the challenges include complex processes for developing management agreements, safe harbor agreements, and permits under multiple environmental laws; constraints imposed by regulated work windows; and potential increases in maintenance costs to accommodate improvements in habitat. As part of the development of the Conservation Strategy, DWR will work with local maintaining agencies and regulatory and resource agencies to address the integration of planning and

management of the flood control system. In addition, the State is interested in coordinating and forming partnerships with the agricultural community, consistent with many of the findings of the Agricultural Stewardship Scope Definition Subcommittee.

Monkeyflower (*Mimulus guttatus*) blooming along the Sacramento River

The SSIA reflects the State's vision for modernizing the SPFC to address current challenges and future trends and to meet CVFPP goals.The SSIA includes a broad range of physical and institutional flood damage reduction actions to improve public safety and achieve economic, environmental, and social sustainability. The SSIA will entail modifying and/or clarifying current flood management policies, authority, roles, and responsibilities for State, federal, and local partners.

The SSIA will guide future State participation in projects and programs for integrated flood management in the Central Valley. The Conservation Framework is an integral part of the SSIA. Concepts for including conservation elements into flood management actions systemwide, as well as region-specific actions, are integrated into the SSIA. All levels of CVFPP project planning and development will consider opportunities to integrate ecosystem enhancements with flood damage reduction projects.

Building on the CVFPP's description of major physical elements, this section describes ways in which those elements can be implemented to provide environmental benefits. It provides some key principles for improving integration of environmental stewardship and flood management and illustrates (Section 4.1, Progress in Flood And Ecosystem Integration) how flood management has already been using environmental approaches to solve flood management problems.

Section 4.2, Improvements Applicable to All Planning Areas, provides more information about how the CVFPP's physical improvement elements can be implemented to provide environmental benefits and solve flood management challenges. Section 4.3, Conservation Opportunities by Planning Area, provides more regional specificity about opportunities for integrating flood safety and ecosystem improvements. These physical improvement elements require further detailed analyses to refine how elements may complement each other and to develop appropriate justification for selected on-the-ground projects. Since the SSIA reflects a broad vision for SPFC modernization, element refinements, additions, and deletions can be expected as a result of future feasibility studies. Chapter

4.4 of the CVFPP provides more information about how DWR will refine this planning during the next phase.

To successfully carry out integration of conservation and flood management, the State's preferred approach as it evolves will be guided by the following principles:

- Focus on restoring and maintaining hydrologic, geomorphic, and ecological processes that are critical to meeting conservation goals. This requires an understanding of the basic causes of environmental degradation and their contribution to the current ecosystem status.

- Keep long-term success, not short-term gains, as the objective. This will require long-term management and monitoring of ecological conditions and trends at the regional and project scales, and incorporating adaptive management (see Section 5.8, Adaptive Management, for a thorough discussion of adaptive management). Using self-sustaining solutions that require minimal maintenance also will be important.

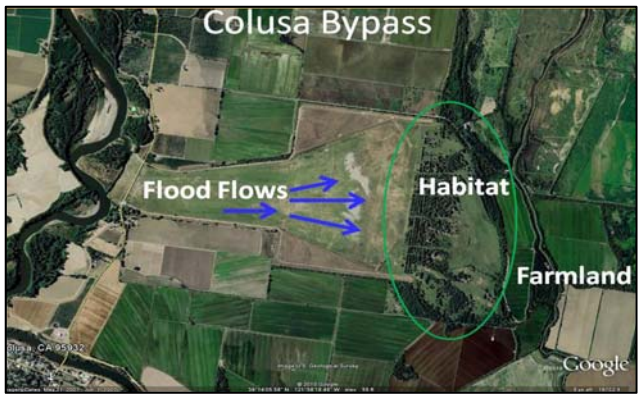
- Implement restoration projects in locations that can achieve the greatest ecological and other benefits for the investment, in the context of reducing broad regional or systemwide stressors, while minimizing the impacts to agricultural practices vital to the subsistence of the rural community.

- Collaborate with local agencies and experts in flood management, ecosystem restoration and enhancement, and farming to demonstrate integrated planning and implementation.

- Take actions that accommodate multiple interests and build public support for conservation actions. Successful use of this principle includes understanding the needs of, and coordinating with potential partners (including agricultural landowners and environmental interests) early in the process. This would promote the design of projects that enhance opportunities for cost-sharing among collaborators and solutions that optimize benefits to various stakeholders while meeting CVFPP goals.

4.1 Progress in Flood and Ecosystem Integration

Flood managers in the Central Valley have a history of using environmental approaches to solve flood management problems, and they continue to do so. This section illustrates that history and current activity



Colusa Bypass, demonstrating integrated flood management

by describing several examples of environmental approaches that achieve effective and environmentally beneficial flood management. These include (1) use of vegetation for flow and erosion management, (2) construction of setback levees to accommodate floodflows and geomorphic processes, and (3) construction of wide bypasses with native vegetation and agricultural crops that serve as floodplains.

Vegetation has been used to improve flood management for decades in the Central Valley, while also providing habitat. In-channel vegetation helps to accomplish the following: reduce the velocity of flood-flows, reduce deposition of coarse sediments on agricultural lands, filter out water contaminants, and reduce levee erosion. The riparian forest at the mouth of the Butte Basin (known as the Butte Slough Reclamation Board Forest) was initially established in the 1940s, and still functions as designed to prevent rapid drainage of the Butte Basin, which would overwhelm the Sutter Bypass downstream. Likewise, the forest at the mouth of the Colusa Bypass has helped slow the velocity of floodwaters coming over the Colusa Weir, thereby allowing gravels to deposit among the trees, rather than on the valuable agricultural lands downstream.

In addition to its role in reducing the velocity of flood-flows throughout the system, waterside vegetation along levees reduces erosion. Since 1955, the USACE Standard Operation and Maintenance Manual for the Sacramento River Flood Control Project has recommended retaining brush and small trees, where desirable, specifically for this purpose. Vegetation planted on levees on the Sacramento River and the American River is used in places to provide riparian and wetland habitat, improve levee resistance to erosion, and reduce the prevalence of burrowing mammals.

Example of Vegetation Reducing Erosion Potential

The Yolo Causeway, which crosses the Yolo Bypass, has a raised foundation (similar in nature to levees) that is exposed to strong southerly winds during major storm events. When this bypass is deeply flooded, as it is in wet years such as 2011, these winds generate large whitecapped waves, with high erosive potential, against the south-facing causeway foundation. Tule marshes immediately adjacent to this foundation dramatically absorb this wave energy and erosion potential, resulting in relatively calm water between the tule marshes and the causeway.

Setback levees have been constructed throughout the Central Valley over the last 100 years that allow for an increase in the conveyance capacity, reduce levee costs, and provide a variety of additional benefits. Compared to reaches where levees closely line river channels, reaches with setback levees have greater floodway capacity, and provide some additional transitory storage of floodwaters. Levees that are farther away from the river result in less erosional forces directed on the levees.

Bear River Levee Setback Project constructed by TRLIA in 2005-06

Floodwaters are spread out over the floodplain between the levees, which reduces flood velocities and levee erosion, potentially reducing the frequency and cost of maintenance and repair. With greater room to meander in wider floodways, rivers can maintain geomorphic processes (as described in Section 2.2.2, Geomorphic Processes and Channel and Floodplain Dynamics) and more effectively transport sediment and flows. Some river reaches with setback levees currently support flood-compatible agriculture on the floodplain, as well as SRA, riparian, and other habitats.

Long reaches with setback levees occur on the upper Sacramento River, the lower Feather River, and the lower San Joaquin River. Shorter reaches with setback levees occur throughout the system, including the lower Sacramento River and the Delta. Recognizing the multiple benefits of setback levees, flood agencies have reconstructed levees farther from river channels in several places, such as at the mouth of the Bear River and along the lower Feather River. In the Delta, small levee setbacks were constructed on Sherman and Twitchell islands to create SRA, riparian, and tidal marsh habitats while significantly decreasing erosion and stabilizing levees. A setback levee constructed on Liberty Island and Cache Slough created shallow water habitat that is prime delta smelt (*Hypomesus transpacificus*) habitat.

Wide bypasses, such as the Yolo and Sutter bypasses, do not support the geomorphic processes of rivers, but shallow flooding is very productive for rearing juvenile fish (Sommer et al., 2003). In these bypasses, a variety of row and field crops are grown on productive agricultural land. These agricultural lands provide valuable habitat for special-status species. For example, rice fields are used by giant garter snakes, grain fields are used by greater sandhill cranes, and a variety of row and field crops are used by Swainson's hawks.

Two other long-term efforts help illustrate flood and ecosystem integration. For many years, the DWR Delta Levees Program has been successfully integrating flood and ecosystem restoration. The Sherman Island and Twitchell Island setback levee and habitat enhancement projects are excellent examples of improving and maintaining levee integrity and stability, while implementing habitat development that augments the existing riparian vegetation and provides habitat for native species. DWR administers this program in close coordination with DFG staff and local RDs. The program supplies local assistance funds to more than 60 RDs in the Delta and Suisun Marsh to maintain and improve the flood control system in the legal Delta. The authorizing legislation mandates that all habitat impacts associated with levee improvements be mitigated and result in long-term net habitat improvement.

Along the Cosumnes River, State, federal, and local governments have been working closely with conservation organizations, local landowners, and water and flood control agencies as part of the Cosumnes River Preserve for several decades. The project encompasses the entire watershed of the river, and it is a broad-based effort to restore and protect the integrity of the river and associated landscapes, including Central Valley habitats and wildlife. The preserve serves several purposes, including protecting riparian forests and habitat for wintering and migratory birds, accommodating natural flooding patterns and floodplain processes, protecting important agricultural land use and providing valuable open space.

In addition to these long-standing integrated efforts, other ongoing efforts integrate flood management and ecosystem restoration. In the Delta, on McCormack-Williamson Tract, such integration is a primary component of the proposed North Delta Flood Control and Ecosystem Restoration Project. The purpose of the project is to achieve flood control, ecosystem restoration, and recreational benefits in the area of the North Delta where the Mokelumne River, Cosumnes River, Dry Creek, and Morrison Creek converge. The actions proposed on McCormack-Williamson Tract also will benefit surrounding agricultural lands by providing additional flood protection. This includes the degradation of the northeast levee to act as a fixed weir, attenuating the peak flow during high-water events.

4.2 Improvements Applicable to All Planning Areas

This section describes how CVFPP’s physical improvements can be implemented and integrated to provide environmental benefits while also reducing the risk of damaging floods, lowering long-term O&M costs, and

improving institutional support while minimizing any adverse impacts to flood flow conveyance. Physical improvements could also provide other benefits, including improved water quality, groundwater recharge, and open space benefits; and some actions would conserve agricultural land.

These improvements, more fully described in the CVFPP, are applicable to all of the planning areas, although their site-specific implementation depends on more detailed assessment and planning. Their potential application will be refined and further developed through regional and local planning efforts. The specific project features that are ultimately implemented will depend on many factors that cannot be determined or evaluated at a programmatic level for the 2012 CVFPP. These factors include detailed project designs and costs; environmental benefits and impacts; interaction with other local projects and system improvements; participation by State, local, and federal agencies in project implementation; and changing natural and institutional conditions.

Broadly applicable improvements include the following:

- Corridor management planning (Section 4.2.1)
- Ecological restoration (Section 4.2.2)
- Fish passage (Section 4.2.3)
- Easements (Section 4.2.4)
- Landowner incentive programs (Section 4.2.5)
- Levee maintenance and repair (Section 4.2.6)
- Floodway management (Section 4.2.7)
- Levee construction, reconstruction, and improvement (Section 4.2.8)
- Setback levees (Section 4.2.9)
- SPFC facilities removal (Section 4.2.10)
- Flood control structures (Section 4.2.11)
- Floodwater storage and reservoir forecasting, operations, and coordination (Section 4.2.12)
- Land-use coordination to reduce peak runoff (Section 4.2.13)

- Regional environmental permitting (Section 4.2.14)
- Bypass expansion and construction (Section 4.2.15)
- Recreation opportunities (Section 4.2.16)

Table 4-1 shows how these improvements can be used to address the major flood and ecological challenges that confront the flood management system in the Central Valley.

Table 4-1. Potential Improvements Related to Key Problems

Problem[1]	Potential Improvements[2]	
Risk/Likelihood of Uncontrolled Flooding		
Channels do not have sufficient capacity for current or future expected flows	• Setback levees, bypass expansion and/or construction: both can expand capacity	• Floodway management: can expand capacity by well-planned lowering of floodway elevations
Obstacles are present to flow in channels, choke points (bridges, vegetation, sediment load)	• Setback levees, bypass expansion and/or construction: both can expand capacity	• Floodway management: can provide habitat where it does not significantly impede flows
Levee structural integrity is compromised; levees are subject to failure; continual repairs are made to levees	• Setback levees: can reduce erosive forces on levees	• Levee maintenance and repair, floodway management: vegetation on waterside of levees can help reduce erosion
Reservoir flood storage is inadequate for major storm events; high flows threaten levee stability	• Floodwater storage and operations: can moderate flows • Setback levees, bypass expansion and construction: can expand capacity and reduce intensity of flows	• Land use coordination: can reduce runoff by improving vegetative cover, water retention, and absorption in uplands and watersheds
Ongoing expensive repairs are needed	• Setback levees: can reduce repair costs by reducing erosive forces on levees	• Levee maintenance and repair, floodway management: vegetation on waterside of levees can help reduce erosion
Consequences and Damages from Flooding		
Development behind levees that are not designed to protect valuable land use or infrastructure	• Easements: can reduce development pressure and risk of serious consequences from flooding	• Land-use coordination: can help keep development and major infrastructure out of flood-prone areas
Project delays due to environmental permitting processes	• Corridor management strategy: can provide early integrated environmental planning as part of project design	• Ecological restoration, fish passage improvements: can reduce need for compensatory mitigation if part of flood project design • Regional environmental permitting: can provide mitigation in advance of flood project development.
Reduced water quality due to flooding and runoff from agricultural/urban lands; mobilization of hazardous materials or contaminants	• Ecological restoration: wetlands can filter nutrients and impurities from runoff, process organic wastes, capture high sediment loads	• Land-use coordination: can reduce runoff by improving vegetative cover, water retention, and absorption in uplands and watersheds

Table 4-1. Potential Improvements Related to Key Problems (contd.)

Problem[1]	Potential Improvements[2]	
Sediment deposition and flooding of private agricultural lands	• Flood control structures: vegetation can increase sediment deposition near river (such as Colusa Bypass)	• Setback levees, bypass expansion and construction: can expand capacity to accommodate greater flood events within floodway
Ecological Challenges		
Loss of ecosystem processes	• Ecosystem processes can be improved with: • Floodway management • Setback levees • SPFC facilities removal • Flood control structure modification	• Floodwater storage and operations • Ecological restoration • Fish passage
Alteration of natural flow regime	• Natural flow regimes can be improved with: • Setback levees • SPFC facilities removal	• Floodwater storage and operations • Ecological restoration • Fish passage • Flood control structure modification
Loss and degradation of habitat	• Habitat quantity and quality can be improved with: • Levee and floodway management • Setback levees • Expanded or new bypasses • Easements • SPFC facilities removal	• Ecological restoration • Fish passage • Land-use coordination
Loss of floodplain food web productivity	• Floodplain food web productivity can be improved with: • Levee and floodway management • Setback levees • Expanded or new bypasses	• SPFC facilities removal • Ecological restoration
Potential conflicts between vegetation and flood risk reduction	• Conflicts can be reduced with: • Levee and floodway management • Setback levees	• Expanded or new bypasses • Corridor management strategies • Land-use coordination
Fish passage barriers	• Fish passage can be improved with: • Floodway management • Flood control structure modification • Floodwater storage and operations	• Ecological restoration • Fish passage

Key:
[1] Identified in CVFPP Interim Progress Report #1
[2] See additional descriptions of these improvements common to all planning areas in following sections.

4.2.1 Corridor Management Strategy

Corridor Management Strategy (CMS) is a developing concept for improving flood management and ecological conditions at scales that are both manageable and flexible to meet multiple needs. The geographic scope needs to be local enough to foster strong field-based partnerships, and still broad enough for multiple projects to collectively meet multiple needs. The CMS concept has substantial promise for meeting many CVFPP goals. This concept is being applied on the lower Feather River where DWR is developing the Lower Feather River Corridor Management Plan (CMP) to establish a vision for future management, restoration, and maintenance of flood control facilities, conveyance channels, agricultural lands, and floodplain and related habitat. The CMP will implement the new collaborative concept for planning, designing, and implementing projects within and adjacent to flood control features that DWR is responsible for maintaining and repairing. The experience from this effort will inform the development and use of the CMS in other parts of the flood management system. Further details are provided in Section 5.6.3, Corridor Management Strategy.

Feather River

4.2.2 Ecological Restoration

As described in Section 2, Floodway Ecosystem Status and Trends, improving species populations and habitat in the flood system depends on improving hydrologic and geomorphic processes. When these processes function well, efforts for species and habitat conservation are easier, less costly, and have higher long-term viability.

Restoration and maintenance of these ecosystem processes, habitats, and species populations are needed throughout the entire system, particularly where large gaps in connectivity exist. DWR will particularly be working collaboratively with other organizations to connect riparian habitat from the Delta to Red Bluff and Oroville. In an initial analysis of the physical potential to reconnect floodplains (connected floodplains were defined as nonurban areas having a 50 percent annual exceedence probability (AEP) of being inundated at least 1 foot under the current flow regime), there are potentially more than 320,000 acres of hydraulically connected floodplain within the Systemwide Planning Area (see Attachment 9F: Floodplain Restoration Opportunity Analysis). Sixty percent of this floodplain acreage is currently disconnected from the river system by levees.

Through implementation of the CVFPP, the State will more fully integrate ecosystem restoration into the project design. One of the primary means of accomplishing this is by leveraging flood system improvements to create habitat through levee setbacks and the extension and expansion of bypass systems. Although setting back levees and expanding bypasses is the primary means to restore floodplain habitat, other opportunities to integrate ecosystem restoration will include controlling invasive species, planting SRA, and removing barriers to fish migration.

New plantings within the Bear River Levee Setback Area

In addition to ecological restoration efforts, impacts to the environment must be avoided, minimized, and compensated through mitigation, consistent with State laws, such as California Environmental Quality Act (CEQA), CESA and California Fish and Game Code Section 1600. The most preferable, and often most cost-effective approach, is to incorporate ecosystem improvements into project design. A plan that fully integrates flood protection and ecosystem stewardship would facilitate plan implementation and ongoing O&M. Where impacts cannot be avoided, mitigation will be required. Mitigation is preferable onsite, but if not feasible, off-site mitigation is required. The State will also develop projects that improve and restore ecosystem processes and habitat where important restoration opportunities exist. Opportunities will be sought to collaborate and cost-share with other existing conservation efforts, such as those described in Attachment 9E: Existing Conservation Objectives from Other Plans.

In addition to project-by-project mitigation, the State is developing regional or programmatic mitigation approaches. Two examples are the Delta Levees Program and RAMP. In the Delta Levees Program, DWR and DFG are moving toward programmatic mitigation to accomplish legislative mandates in the legal Delta (CWC Section 12220) and provide better service to the RDs and increase public safety. The goal of programmatic mitigation would be to identify sites in the best locations for each type of habitat typically needed to offset unavoidable habitat damage associated with levee improvement projects and protect them in advance of the impacts. Programmatic mitigation is being developed to create mitigation credits for the local maintaining agencies that participate in the Delta Levees Program. Habitat enhancement/improvement, above and beyond required mitigation, is being developed separately. Funding and staff are already being dedicated to moving this effort forward and could complement restoration work undertaken within the Conservation Strategy.

Similarly, DWR has joined with several State and federal agencies to promote the creation of advance mitigation and conservation sites throughout the State under a program called RAMP (see Section 5.6.5, Regional Advance Mitigation Planning). The RAMP initiative is identifying tools that can help identify potential mitigation and conservation sites that meet multiple objectives, and are finding innovative ways to leverage multiple funding sources that allows for larger sites than could be accomplished using project-by-project funding. The first pilot project in the upper Sacramento River watershed will directly support potential work on SPFC facilities.

The State plans to develop methods to track habitat conservation and restoration efforts to inform resource agencies and the public about system improvements (see Section 6, Indicators of Success).

The State will take advantage of opportunities within the SPFC to improve aquatic habitat by restoring river flows and ecosystem processes, removing fish passage barriers, and enhancing suitable river gravels for fish spawning below major dams and in other creeks and streams where suitable spawning gravels are limited.

4.2.3 Fish Passage

Fish passage in Central Valley rivers and streams is impaired by a variety of obstacles, only some of which are related to flood management facilities and operations. Attachment 9C: Fish Passage Assessment identifies fish passage barriers within the CVFPP Systemwide Planning Area and highlights those that are part of the SPFC and are most ecologically important to remove.

Improving fish passage is an important system improvement, but it can be complex and costly. Current flood management funding is limited to making improvements related to, or beneficial to, SPFC facilities. However, Attachment 9C: Fish Passage Assessment provides a broader assessment of systemwide passage improvement projects to provide context for developing future flood management funding with potentially broader scopes. Attachment 9C: Fish Passage Assessment also provides context for flood managers about other passage improvement projects that other DWR programs and agencies are currently engaged in planning or funding. Flood managers can coordinate with these other programs and seek opportunities to develop passage improvement projects that meet the needs of multiple programs.

DWR will work with other organizations to improve fish passage at flood diversions, flashboard dams, flood management structures, and pumping stations. This includes connecting fishery habitat along the main-stem

rivers, tributaries, and bypasses. Fish passage projects, when successful, can increase recreational opportunities, so they should incorporate appropriate recreational facilities.

Fish Passage Constraints at Fremont Weir

Passage is also blocked at major dams within the Systemwide Planning Area. However, improving fish passage around these dams is complex and challenging. Formal direction from NMFS, in the form of a biological opinion for the Operations Criteria and Plan (NMFS, 2008), directs Reclamation to develop a step-wise process to evaluate the improvement of passage around several major dams, including Shasta, Folsom, and New Melones. Attachment 9C: Fish Passage Assessment, describes many different technologies currently in use in other parts of the country that could be employed to solve fish passage problems in California.

4.2.4 Easements

Purchasing easements can be valuable for a variety of purposes, including reducing the risk of future major flood consequences by retaining rural land uses, maintaining viable agricultural productivity, and creating important habitat. Individual easements can be developed to achieve multiple purposes, but the combination of these on any individual parcel needs to be carefully evaluated to ensure quality results and to avoid unintentional conflicts. To be most useful for environmental purposes, these easements, where applicable, would allow for the following:

- Periodic inundation and soil saturation important for the ecological functioning of floodplains (i.e., increasing aquatic ecosystem productivity, allowing sediment deposition on floodplains, and supplying large woody materials to aquatic ecosystems)
- Allowing natural riverine processes to occur thereby allowing more natural flows, and erosion and deposition of sediment
- Expansion of existing conservation lands and management compatible with those lands
- Preservation of existing riparian habitat, restoration of priority habitats, (e.g., riparian, SRA, and wetlands), and support of agricultural practices that benefit wildlife

4.2.5 Landowner Incentive Programs

Some landowners with conservation interests may be more attracted to participating in incentive programs than to selling easements. The State and federal governments offer a variety of incentives, including legal and statutory incentives; market-oriented institutions; financial incentives; public tax incentives; and educational, technical assistance, administrative, and recognition incentives. A national review of these programs (Casey et al., 2006) provides a useful economic and policy assessment of these incentive mechanisms. Some specific example programs are those managed by the U.S. Department of Agriculture's Natural Resources Conservation Service and Farm Service Agency (such as the Wetlands Reserve Program and the Conservation Reserve Program) and the DFG Landowner Incentive Program.

Three programs (DFG's Voluntary Local Program and Safe Harbor Agreement Program and the USFWS Safe Harbor Agreement Program) encourage landowners to enhance habitat for threatened and endangered wildlife, while maintaining viable agricultural operations. These programs allow landowners to remove the habitat enhancements with no penalties. These programs provide flexibility for landowners and flood managers but do not provide assurances of long-term habitat conservation.

The State will pursue opportunities to work with interested landowners and these incentive programs to improve program accessibility and usefulness to private landowners in the flood system.

4.2.6 Levee Maintenance and Repair

Levee damage during a storm

Current O&M levee maintenance and repair activities include manual and mechanical controling vegetation (terrestrial and aquatic), mowing, dragging and grading, burning, livestock grazing, removing trees, applying rodenticide and herbicide, filling or grouting rodent burrows and other penetration gaps, and placing fill or rock slope. These activities have been done in ways that have maintained levee reliability and reduced environmental impacts. DWR is working to improve environmental benefits associated with maintenance, including increasing the use of native plants in revegetation and reducing the spread of invasive plants.

In general, the Conservation Framework will attempt to reduce impacts associated with project-level repairs through "holistic" strategies for implementing large-scale, integrated flood management efforts, such as

Levee repair on lower Sacramento River

corridor management plans (Section 5.6.3). Regional permitting (Section 5.6.4), and regional advance mitigation programs (Section 5.6.5) can support these integrated management efforts, which will be designed to support larger scale and cost-effective facilities management practices and policies that address public safety needs and advance statewide and regional environmental goals. These strategies integrate O&M with other planning efforts, increase permitting efficiencies, have the potential to maximize the use of regionally important habitat for mitigation and habitat improvements, and can reduce O&M costs.

DWR is also developing permitting approaches to increase the effectiveness of maintenance and repair activities for providing levee reliability and environmental benefits. The Small Erosion Repair Program (SERP), being developed by a work group of the Interagency Flood Management Collaborative Program, is one example of this for small levee repair sites. Targeted to begin in 2013, the program provides that DWR maintenance staff will provide an annual list of their anticipated repairs to regulatory agencies for the upcoming year. Long-term regulatory approval will be secured in advance, thereby making the process efficient, cost effective, and consistent throughout the system. In addition, efficient repairs of small sites can prevent continuing erosion, which otherwise might become a more extensive and costly repair project with greater environmental damage.

One of the best ways to reduce long-term maintenance efforts and cost is to proactively consider long-term maintenance during the project design process. Doing so can result in reduced maintenance and features that are of greater overall benefit to biological resources. With an enhanced project design, focused on minimal or reduced maintenance, the overall level of environmental disturbance would be reduced. Considering maintenance earlier is often more costly initially. However, over time, incorporation of cost-effective design elements, such as providing adequate capacity for vegetation, should reduce maintenance and associated costs.

Planting native grass seeds on the Natomas levee

Further efforts to coordinate O&M activities include using sustainable practices such as developing a target vegetative community and focusing management efforts on attaining that target (e.g., replacing a broadleaf weed species community with one dominated by

native perennial grasses). There are a number of inherent benefits to establishing native perennial grasses on levees. First, native perennial grasses have dense, fibrous root systems that are very effective at soil stabilization and surface erosion control. An established sod cover of perennial grasses is substantially more resistant than annual grassland or bare soil to rill and gully erosion during a levee overtopping event. In contrast, typical weedy annual (nonperennial) grassland found on most levees is shallow-rooted, dries in mid- to early summer, creating a fire hazard, and produces a large volume of seed that attracts ground squirrels.

Compared to typical annual levee grassland management, levee maintenance requirements and costs over time should be less because of the reduction in herbicide application, reduced need for soil repairs due to rill erosion, and less frequent mowing requirements. The SAFCA has determined the cost effectiveness of this practice and has begun to implement it on levees associated with its Natomas Levee Improvement Program project.

4.2.7 Floodway Management

Current floodway[2] maintenance activities are similar to levee maintenance, but also include removing sediment, debris, and other flow obstructions. These activities have been implemented to maintain floodwater conveyance and environmental benefits (e.g., maintaining large trees in the Yolo Bypass following regular sediment removal). The State is also working to improve environmental benefits within channels, without compromising public safety, such as restoring habitat along the Feather River as part of the Lower Feather River CMP.

Other potential floodway management improvements that will be implemented, where suitable, include the following:

- Lowering floodway elevations for more frequent and sustained inundation of lower floodplain surfaces. Floodplain inundation and associated habitat values have been reduced where the main river channel has become incised below the floodway, river flows have been reduced, or both. In these areas, lowering floodplain surfaces or creating floodplain swales would allow more frequent and sustained inundation, restoring habitat values. This action would also help increase local floodway capacity. Projects along the lower Feather and Bear rivers help illustrate the potential of this approach

- Modifying the floodway for greater topographic and hydrologic diversity, while also eliminating features (such as isolated gravel pits or

[2] Land between levees, including river channel

deep borrow pits) that strand fish. This action can include creating, or opening up, secondary channels and overflow swales that would add riverine and floodplain habitat values, including resting or rearing areas for fish migrating downstream

- Supporting agriculture that is compatible with wildlife
- Incorporating access, drainage, and other infrastructure sufficient to support agricultural use and management of natural vegetation. Agriculture and management of natural vegetation require access roads, drainage ditches, and (for agriculture) groundwater pumps or surface water supply canals. Incorporating this infrastructure allows continued agricultural use and a greater range of restoration and conservation activities

4.2.8 Levee Construction, Reconstruction, and Improvement

Construction of new levees and reconstruction of or improvements to existing levees will be needed to achieve various flood management objectives. Where new levees need to be constructed, they should be located to reduce long-term maintenance and repair costs, restore geomorphic processes, improve floodwater capacity, provide recreational opportunities, accommodate expected hydrological changes due to climate change, and be compatible with local planning and land management.

New levee construction at Natomas

Consistent with the DWR levee vegetation management strategy, described in Section 5.4, where setback levees cannot be constructed, new or newly reconstructed levees should incorporate trees and other woody vegetation on the lower waterside slope and riverbank or berm, specifically designed for waterside planting. This planting berm, or the entire levee when necessary, should represent an over-built section with respect to minimum geometries, and be of sufficient size and configuration to mitigate any potential negative impacts to levee safety.

Where in-place reconstruction is the most feasible option for solving long-term flood management needs, designs should include environmental benefits by measures such as the following, where appropriate:

- **Incorporating biotechnical bank protection along existing levees to reduce river erosion and wave energy** – Biotechnical bank protection is the combined use of plants with other materials to stabilize streambanks and levees. This can increase bank resistance to erosion. Vegetation (e.g., tules) can also attenuate wave energy, which reduces erosive forces. Thus, biotechnical bank protection can complement or reduce the need for revetment. Biotechnical bank protection should be incorporated, where appropriate, during design or repair of facilities. It generally entails planting cuttings and container plants in shallow water adjacent to banks, in exposed soil along banks, or in revetment. If incorporated into revetment, some localized modification of revetment (such as incorporating uncompacted soil) may be necessary.

Biotechnical erosion control and in-stream fish habitat

- **Controlling the spread of invasive plants** – Infestations of invasive plants not only degrade habitat values locally, but can serve as sources of propagules that establish additional infestations (particularly downstream) and increase maintenance costs, and the costs of controlling these invasive species in general. Practices to reduce the introduction and spread of invasive species may include preconstruction surveys and mechanical and/or chemical control measures, washing of equipment entering and leaving a site, and restrictions on plant materials used for revegetation (particularly adjacent to river channels). Also, areas dominated by nonnative invasive plants can be revegetated with native plants.

- **Incorporating SRA vegetation into in-place repairs** – Waterside plants shading the adjacent water surface is an important component of SRA habitat. Requirements for incorporating these plants are similar to those for biotechnical bank protection, and in some cases incorporated SRA could also provide bank protection benefits.

- **Using excess channel sediment for levee material, if suitable** – This may expand channel capacity and may improve riverine habitats, particularly in partially isolated secondary channels, or increase the frequency, duration, and extent of the inundation of lower floodplain surfaces.

- **Applying levee design criteria that promote compatibility with existing and potential floodway habitats** – Determination of the design capacity for conveying floodwaters will include riparian vegetation (and associated roughness) in areas throughout the floodway. This allows for future changes in floodway land use and management, increasing the flexibility of the system and potential future environmental benefits.

4.2.9 Setback Levees

Setting back levees from rivers is an important approach for solving a variety of flood management and ecosystem problems, while still supporting productive agriculture within expanded floodways. Increasing the distance of levees from the main river channel reduces the erosive force of floodwaters on the levees, which can improve their reliability and reduce repair costs. This shift in levee location increases the overall capacity of the local floodway, which can reduce the velocity of floodwaters, create transitory floodplain storage, and reduce flood stage. In reaches where levees closely follow sinuous river channels, setback levees provide opportunities for significantly reducing overall levee length, which may reduce overall maintenance costs.

Setback levee at Butte City

Setback levees also generate opportunities for improving ecosystem function and increasing habitat extent, quality, and connectivity. The expanded floodway creates space for river meandering, sediment erosion and deposition, natural ecosystem disturbance processes, and a healthy diversity of riverine habitat.

Major physical differences in different regions of the Central Valley provide opportunities or constrain the use of setback levees to improve riverine geomorphic processes. The upper valley floor reaches of the Sacramento and San Joaquin rivers already have long reaches with levees that are located at relatively greater distances from active river channels, compared to lower reaches of these rivers. These reaches provide the most opportunities using setback levees for restoring riverine geomorphic processes. Such opportunities are more limited in the lower reaches, where

rivers are elevated above surrounding lower lands and more constrained by adjacent land uses. However, smaller, localized setback levees in these reaches can still provide valuable waterside habitat and provide other flood benefits. Replacing winding levees where they closely follow tight river bends with straighter levees that cut off those bends can reduce long-term levee maintenance and repair costs.

Setback levees will be designed to accommodate riparian vegetation within an expanded floodway, while still meeting conveyance and levee safety needs. Where a river channel is incised and/or flows have been substantially altered, setback levees alone may be insufficient to considerably improve ecosystem processes and habitats. Thus, in some cases, lowering the floodplain elevation (e.g. construction of swales, side channels) may also be important to allow the frequent, sustained inundation needed for aquatic productivity and other ecological processes.

When considering locations for setback levees along rivers, given the engineering (capacity and structural) feasibility is met, levees will be designed with the following features, as appropriate:

- Prioritize locations where floodplain functions and values could be restored. Elevations within the setback levee should be considered to provide for frequently inundated floodplains and therefore support riparian and wetland habitats and species. Vegetation on the new floodplain will replace any losses on the levee prism as with new levees, vegetation removal is required for access, visibility for inspections, and consistency with design standards.

- Design and model setback levee location to maximize roughness in the channel, thereby reducing long-term maintenance and conflicts with vegetation.

- Consider impacts to valuable agricultural land and practices to minimize adverse effects to these resources.

- Where permanent structures (e.g., bridges, roadways) need to be located in the floodplain, design them to minimize effects on floodplain processes (such as the need to protect structures thereby inhibiting channel migration). Remove, relocate, or modify permanent structures in the setback area to reduce impacts on floodplain processes. Minor and major infrastructure (e.g., road crossings) can impede channel migration, sediment deposition, and other geomorphic processes. Removing, relocating, or otherwise modifying this infrastructure in conjunction with levee setbacks can reduce or eliminate these effects.

4.2.10 SPFC Facilities Removal

Some SPFC levees and revetment provide minimal local and systemwide flood management benefits. Administrative or physical removal of these facilities provides the opportunity to improve hydrologic and geomorphic processes that are important for sustaining riverine and floodplain habitats. Removing levees and/or revetment from the SPFC will only be considered where it would (1) have a positive or neutral effect on flood risk, and (2) provide ecosystem benefits. On the upper Sacramento River, for example, county governments have requested removal of rock revetment that does not serve an essential flood management purpose, primarily as a way to reduce costs for maintenance and repair. For example, many entities are advocating for breaching the levee at Three Amigos (RDs 2099, 2100, and 2102), a site in Stanislaus County within the San Joaquin River National Wildlife Refuge. To date, USFWS and DWR have been unable to move forward with the Three Amigos project due to lack of established USACE precedure for removal of the levees.

Removing a facility from the SPFC may consist of physical and administrative actions, or only administrative actions. Physically removing any facility is subject to a case-by-case evaluation. For a facility to be considered for removal from the SPFC, it must be demonstrated that such action would not cause unacceptable impacts to other flood management features or nonflood management purposes. If removal of a specific facility would cause potential undesirable or unacceptable effects, mitigation measures would be implemented to offset potential adverse effects before the facility was removed.

4.2.11 Flood Control Structures

Some flood control structures, such as weirs, gates, and channel diversions, will need physical improvements under the CVFPP to more effectively manage floodwaters while reducing their impact on biological resources. Of particular concern are effects on fish passage. For example, the Fremont Weir is a significant fish passage barrier (and stranding site) for fish moving between the Sacramento River and the Yolo Bypass. Shallow water depth, high water velocity, and physical barriers all may impede salmonid passage. In general, more than 1 foot of water is needed to allow passage of adult and juvenile Chinook salmon and steelhead. Also, high water velocity impeding passage may occur at flood control structures, road crossings, and culverts. In addition to adequate depth and appropriate velocity, vertical drops that exceed the leaping abilities of Chinook salmon and steelhead also may impede passage. The ability to jump vertical drops is greatly affected by staging pool depth, jump angle, and the horizontal distance of the leap.

At flood control structures, upstream and downstream passage may be improved through adequate flow, and avoiding or modifying of problematic depth, velocity, and vertical drop conditions to be consistent with DFG, USFWS, and NMFS passage criteria. Resolving problematic conditions at potential physical barriers may require installation of fish ladders and facility modification. Attachment 9C: Fish Passage Assessment identifies important fish barriers in the CVFPP Systemwide Planning Area.

4.2.12 Floodwater Storage and Reservoir Forecasting, Operations, and Coordination

Storage of floodwater, whether in foothill reservoirs or in floodplains and historic overflow basins, and coordination of reservoir releases are valuable tools for managing flood risk. They also generate opportunities to integrate and benefit water supply (including groundwater recharge and conjunctive use), water quality, ecosystem conservation and restoration, agricultural conservation, and recreation. Opportunities for further floodwater storage evaluation and analysis, in coordination with other ongoing programs and efforts of the State, include modifications to flood operation at existing reservoirs, coordinating the flood operation of multiple reservoirs, expanding flood storage in existing reservoirs, conjunctive groundwater management, and floodplain storage.

Modification and coordination of flood operations can provide a diversity of flow releases, as described in Section 2, Floodway Ecosystem Conditions and Trends, to benefit riverine ecosystems and associated species. For example, potential Friant Dam releases could be coordinated to benefit downstream upper San Joaquin River flows to support the goals of the SJRRP. Such flows can improve aquatic habitat conditions, sustain riverine habitats, reduce fish stranding and passage barriers, and generate other environmental benefits.

4.2.13 Land- and Water-Use Coordination to Reduce Peak Runoff

Peak runoff from upper watersheds occurs during larger precipitation events. As recognized by the State's California Water Plan, land-use planning has an important role in reducing this runoff. Integrated planning with local land-use authorities and major public land managers in watersheds can help reduce the intensity of flooding event, by designating land uses (e.g., native vegetation and agricultural crops) that absorb floodwaters and increase percolation into groundwater reservoirs.

Integrated watershed and water planning has become a useful tool in California for addressing a variety of water quality, water supply, and land management issues. Major public land management agencies, such as the

U.S. Forest Service and the U.S. Bureau of Land Management, as well as local resource conservation districts and other interest groups, have established a variety of working partnerships in the watersheds of the Central Valley. Support for these groups, and for establishing new groups, can be a cost-effective way of leveraging funds to help manage runoff, while creating a broad base of organizational and public support. DWR using voter-approved bond funds, is providing grants for local groups to develop Integrated Regional Water Plans. These plans are designed to integrate planning at the regional and local level for water supply, flood management, ecosystem restoration, and other important values. DWR will work to improve coordination between such plans and regional flood management planning efforts. DWR also will be working to ensure that CVFPP and the California Water Plan are well coordinated and supportive of each other.

From an environmental perspective, important actions to manage runoff include improving cover of native vegetation and agricultural crops and expanding the extent of seasonal or perennial wetlands in upland areas.

4.2.14 Regional Environmental Permitting

Beyond seeking project-specific permits, DWR will work with regulatory agencies to develop regional strategies for environmental permitting, which may include NCCPs, HCPs, or programmatic ESA Section 7 consultations (see Section 5.6.4, Regional Permitting). This will improve flood project delivery while also improving ecological conditions. RAMP (see Section 5.6.5, Regional Advance Mitigation Planning) is an innovative approach for providing advance mitigation on a regional scale, and it is currently being tested for infrastructure projects. Several current conservation plans (see Section 5.6.2, Collaborating with Existing Regional Conservation Plans) present opportunities for coordinating such permitting.

4.2.15 Bypass Expansion and Construction

To improve system flexibility and reduce peak flood discharges, the State will evaluate options and work to expand existing bypasses and to build new bypasses. These flood improvements will be designed to accommodate viable agriculture and include environmental benefits, as described above in Section 4.2.2, Ecological Restoration; Section 4.2.3, Fish Passage; 4.2.6 Levee Maintenance and Repair; Section 4.2.8, Levee Construction, Reconstruction, and Improvement; Section 4.2.9, Setback Levees; and Section 4.2.12, Flood Control Structures.

In addition, the State proposes to investigate modifying the operation of weirs that spill flood water to the bypasses. The concept is to physically lower crests of overflow weirs and modify operations so bypasses carry

flows earlier and longer during high river stages. The more frequently activated floodplain in the bypasses would help the ecosystem restoration within the bypasses and provide for more sustainable and quality habitat. Depending on the changes in flow regime, the more frequent flooding may also contribute to food web productivity and fish rearing habitat.

4.2.16 Recreation Opportunities

In 2006, the California Department of Parks and Recreation (DPR) conducted an extensive public outreach effort, holding town-hall-style meetings across the Central Valley, to identify priority recreation areas, which resulted in the Central Valley Vision (CVV) report. In 2007, the governor approved Assembly Bill 1426, which directed DPR to develop a detailed implementation plan for the CVV. This CVV implementation plan's objectives included improving recreational opportunities at existing State parks and other public lands and acquiring other lands important for recreation (particularly along water corridors). Many of the recommendations in this CVV implementation plan were prepared anticipating opportunities to incorporate recreational improvements into flood damage reduction projects.

One example of linking recreation and flood management, DWR and DPR developed an Interagency Agreement that supports multi-benefit project for the Colusa Sacramento River State Recreation Area. This effort is designed to provide recreation and public access compatible with wildlife habitat conservation.

DWR will evaluate other opportunities to assist DPR in implementing the CVV and pursue such opportunities as part of developing integrated flood projects as feasible.

4.3 Conservation Opportunities by Planning Area

Regional conservation opportunities are physical actions or projects that can be applied, where appropriate, to achieve local, regional, and systemwide benefits. They will be refined and further developed through regional and local planning efforts. The specific project features that are ultimately implemented will depend on many factors that cannot be determined or evaluated at a programmatic level for the 2012 CVFPP.

At the broad scale, different regions of the Central Valley have major physical differences that either provide opportunities or constrain the type of possible ecosystem improvements. The upper valley floor reaches of the

Sacramento and San Joaquin rivers, with their longer reaches of broader floodways, provide the most opportunities for restoring riverine geomorphic processes. Such opportunities are more limited in the lower reaches, where rivers are elevated above surrounding lower lands and more constrained by adjacent land uses (see Figure 2-2). These lower reaches still provide opportunities for maintaining and improving food web productivity (such as in the broad Yolo and Sutter bypasses) and for improving habitat. Habitat improvements in these more constrained reaches are likely to be more limited in extent and unlikely to contribute significantly to improving riverine geomorphic processes. However, they can be important to provide continual SRA habitat for migrating fish, habitat for endangered species, and important breeding and migratory stopovers for waterfowl and songbirds. The opportunities to improve habitat are likely to be most constrained in urban areas, but even small improvements in these areas are possible and could be strategically very valuable.

At the more project-specific level, additional factors need to be considered, such as detailed project designs and costs; environmental benefits and impacts; interaction with other local projects and system improvements; participation by State, local, and federal agencies in project implementation; and changing natural and institutional conditions. Successful programmatic or regional permitting of projects will require adequate funding, measurable goals, implementation timelines, timely mitigation, and long-term management and monitoring. Because the costs and benefits of these conservation opportunities are very sensitive to on-the-ground conditions, they are presented as options to be considered in future regional flood management planning.

Regional conservation opportunities are described for five planning areas within the Systemwide Planning Area. These planning areas encompass larger areas than the CVFPP Implementation Zones to provide broader context for conservation planning to support CVFPP actions:

- Upper Sacramento River Planning Area, including the Sacramento River and tributaries from Red Bluff to Fremont Weir
- Feather River Planning Area, including the Yuba and Bear rivers and other tributaries
- Lower Sacramento River Planning Area, including the Sacramento River and tributaries from Fremont Weir to Isleton
- Upper San Joaquin River Planning Area, including the San Joaquin River and tributaries from Friant Dam to Merced River

- Lower San Joaquin River Planning Area, including the San Joaquin River and tributaries from the Merced River to Stockton

A sixth planning area, encompassing the Delta outside the SPFC, is also addressed in this section.

Some of these conservation opportunities may be implemented in the short term and others are long-term projects requiring further study and analysis before implementation. Many of the conservation opportunities were identified during stakeholder meetings conducted as part of the Floodplain Restoration Opportunities Analysis (FROA), which is described in greater detail in Section 5.6.1, Restoration Opportunities Analysis, and Attachment 9F: Floodplain Restoration Opportunity Analysis, or were conservation opportunities recommended by prior studies such as the *Sacramento-San Joaquin River Basins Comprehensive Study* (USACE, 2002a), *Sutter Basin Feasibility Study* (USACE, 2010a), SJRRP, CALFED, and similar regional water resources planning programs. Projects identified through the FROA or by prior studies were only included if the project scope and conservation opportunities were sufficiently defined; projects that were largely conceptual in nature were not included. Projects that may not be part of SPFC facilities, but are within the Systemwide Planning Area, were included because they may have the potential to become part of the SPFC, benefit operation of the SPFC, or may provide habitat to reduce the need for mitigation for future SPFC improvements. Additionally, their inclusion provides context for developing future flood management funding sources.

4.3.1 Upper Sacramento River Planning Area

Riparian and other native habitats exist within the flood management system primarily along river corridors and between levees, and occur on both private lands and a variety of conservation lands managed by State, federal, and local agencies, and private organizations, including portions of lands associated with the Sacramento National Wildlife Refuge. Public agencies (including DWR) and nonprofit organizations have invested substantially in restoring ecosystem processes and habitat in this planning area, particularly north of Colusa.

Beyond other broadly applicable types of improvement (see box), specific conservation opportunities to consider within this planning area include a combination of the following potential projects:

Broadly applicable improvements that apply to the Upper Sacramento River Planning Area

- 4.2.1 Corridor Management Strategy
- 4.2.2 Ecological Restoration – Key habitats in this planning area include wetlands, floodplains, riparian (especially SRA), eroding banks, and spawning gravel beds.
- 4.2.3 Fish Passage
- 4.2.4 Easements
- 4.2.5 Landowner Incentive Programs
- 4.2.6 Levee Maintenance and Repair
- 4.2.7 Floodway Management.
- 4.2.8 Levee Construction, Reconstruction, and Improvements
- 4.2.9 Setback levees
- 4.2.10 SPFC Facilities Removal
- 4.2.11 Flood Control Structure Modification
- 4.2.12 Floodwater Storage and Operations
- 4.2.14 Regional Environmental Permitting

- Purchase easements adjacent to the Sutter Bypass to preserve land uses compatible with periodic flooding and generate opportunities for seasonal and/or permanent habitat conservation and restoration.

- Improve fish passage at flood control structures in and around Chico (Big Chico Creek, Lindo Channel, and Butte Creek).

- Screen fish from entering the Colusa Drain.

- Increase the current capacity of the Sutter Bypass to convey large flood events, including modifying the Colusa, Moulton, and Tisdale weirs, if applicable. This element will be designed to accommodate ecosystem restoration features, improve fish passage, and include conserving and restoring aquatic and floodplain habitats and/or agricultural land uses within the bypass.

- Collaborate with others on planning and implementing the River Sanctuary restoration project, which includes riparian habitat restoration and side channel excavation to improve fish and wildlife habitat along the Sacramento River.

- Collaborate with DFG, USFWS, and TNC on a variety of habitat restoration and flood damage reduction projects within the Chico Landing subreach of the Sacramento River. These projects primarily involve converting agricultural lands subject to frequent flooding and damage to riparian habitat and removing nonessential bank revetment.

- Collaborate with others investigating the feasibility of China Bend, Cecil Lake, and similar projects along the Sacramento River. These projects would potentially involve constructing setback levees, reconnecting side channels to the river, restoring riparian and wetland habitat, and reducing floodway maintenance.

- Evaluate potential expansion of floodway capacity near the town of Princeton to accommodate riparian and floodplain restoration and to reduce the need for ongoing floodway maintenance.

- Collaborate with USFWS, DFG, and TNC on a variety of habitat restoration and flood damage reduction projects between Colusa and Princeton. These projects would primarily involve restoring riparian and floodplain habitats, reducing floodway maintenance, and removing nonessential bank revetment.

- Collaborate with others to construct a setback levee at Hamilton City. The levee would be constructed to accommodate riparian and floodplain restoration, protect agricultural land, and to reduce the need for ongoing floodway maintenance.

Mature riparian forest

- Collaborate with others on the lower Deer Creek Flood Control Project. This project would potentially include constructing setback levees, restoring floodplain and riparian habitat, improving fish passage, protecting agricultural lands, and reducing floodway maintenance.

- Collaborate with DFG, USACE, California State Parks, agricultural interests, and others on the Kopta Slough project. This project would potentially include removing nonessential bank revetment, restoring floodplain and riparian habitat, and reducing floodway maintenance.

- Collaborate with California State Parks to integrate recreational facilities at Woodson Bridge State Recreation Area, Bidwell-Sacramento River State Park, Colusa Sacramento State Recreation Area and a proposed Elkhorn recreation area at the upstream end of the Yolo Bypass with those available in restored habitat areas.

- Collaborate with Sacramento River Conservation Area Forum to develop restoration planning and project designs that address local and regional concerns.

Bank swallow habitat along the Feather River

4.3.2 Feather River Planning Area

The Feather River retains a significant remnant of the Central Valley's riparian forests and passes through the Oroville Wildlife Area and several other DFG-managed properties. The most significant levee setback constructed to date within the SPFC (the TRLIA levee setback) is found within this reach and presents an opportunity for riparian and floodplain habitat restoration.

Broadly applicable improvements that apply to the Feather River Planning Area

- 4.2.1 Corridor Management Strategy
- 4.2.2 Ecological Restoration – Key habitats in this planning area include wetlands, floodplains, riparian (especially SRA), eroding banks, and spawning gravel beds.
- 4.2.3 Fish Passage
- 4.2.4 Easements
- 4.2.5 Landowner Incentive Programs
- 4.2.6 Levee Maintenance and Repair
- 4.2.7 Floodway Management.
- 4.2.8 Levee Construction, Reconstruction, and Improvements
- 4.2.9 Setback levees
- 4.2.10 SPFC Facilities Removal
- 4.2.11 Flood Control Structure Modification
- 4.2.12 Floodwater Storage and Operations
- 4.2.14 Regional Environmental Permitting
- 4.2.15 Bypass Expansion and Construction

Beyond other broadly applicable types of improvement (see box), specific conservation opportunities within this planning area include the following potential projects:

- Collaborate with others on the planning and implementation of the Federal Energy Regulatory Commission (FERC) license and settlement agreement at Oroville Reservoir to potentially provide river flows that produce enhanced environmental benefits such as frequently inundated floodplains or improved spawning habitat conditions.
- Collaborate with Yuba County Water Agency, USACE, and NMFS to improve fish passage around the Daguerre Point Dam to increase spawning habitat availability within the upper portion of the lower Yuba River below Englebright Reservoir.
- Design and operate any new potential Feather River Bypass from the Feather River to Butte to accommodate ecosystem restoration features and benefits, including conservation and restoration of aquatic and floodplain habitats and continued compatible agricultural land uses within the bypass.
- Collaborate with others on the planning and implementation of the FERC license and settlement agreement for Oroville Reservoir to enhance spawning gravel within the low-flow section of the Feather River.

- Implement habitat restoration projects within the Oroville Wildlife Area, including projects to restore floodplain and riparian habitat and to enhance spawning habitat.

- Implement habitat restoration projects within the Feather River Wildlife Area, including the Abbott Lakes, O'Connor Lakes, and Nelson Slough projects, which would restore floodplain and riparian habitats and, potentially, reduce floodway maintenance.

- Restore habitat within the TRLIA levee setback area, including restoring riparian, wetland, and floodplain habitats and reducing floodway maintenance.

- Collaborate with others to investigate a variety of projects described in the *Sutter Basin Feasibility Study* (USACE, 2010a). These projects would potentially involve restoring riparian, wetland, and floodplain habitat, excavating floodplains, enhancing spawning habitat, and reducing floodway maintenance.

4.3.3 Lower Sacramento River Planning Area

In this planning area, the riparian corridor and SRA habitat have been reduced to disconnected remnants along the river confined by narrowly spaced levees. The Yolo Bypass, although not providing geomorphic processes, provides important rearing habitat for juvenile fish.

Broadly applicable improvements that apply to the Lower Sacramento River Planning Area

- 4.2.1 Corridor Management Strategy
- 4.2.2 Ecological Restoration – Key habitats in this planning area include wetlands, floodplains, riparian (especially SRA), eroding banks, and spawning gravel beds.
- 4.2.3 Fish Passage
- 4.2.4 Easements
- 4.2.5 Landowner Incentive Programs
- 4.2.6 Levee Maintenance and Repair
- 4.2.7 Floodway Management.
- 4.2.8 Levee Construction, Reconstruction, and Improvements
- 4.2.9 Setback levees
- 4.2.10 SPFC Facilities Removal
- 4.2.11 Flood Control Structure Modification
- 4.2.14 Regional Environmental Permitting
- 4.2.15 Bypass Expansion and Construction

Beyond other broadly applicable types of improvement (see box), specific conservation opportunities identified within this planning area include the following potential projects:

- Collaborate with Reclamation, resource agencies, and local organizations to improve fish passage at the Fremont Weir and in Putah Creek and Cache Creek.

- Collaborate with Reclamation, resource agencies, and local organizations to increase capacity and inundation frequency for the Yolo Bypass to increase the extent and duration of floodplain habitat for fish, while also planning for conservation of other species.

- Collaborate with others to implement the Knaggs Ranch project to enhance riparian habitat and restore wetland and woodland habitat along the Sacramento River and Yolo Bypass, south of Fremont Weir.

Broadly applicable improvements that apply to the Upper San Joaquin River Planning Area

- 4.2.1 Corridor Management Strategy
- 4.2.2 Ecological Restoration – Key habitats in this planning area include wetlands, floodplains, riparian (especially SRA), eroding banks, and spawning gravel beds.
- 4.2.3 Fish Passage
- 4.2.4 Easements
- 4.2.5 Landowner Incentive Programs
- 4.2.6 Levee Maintenance and Repair
- 4.2.7 Floodway Management.
- 4.2.8 Levee Construction, Reconstruction, and Improvements
- 4.2.9 Setback levees
- 4.2.10 SPFC Facilities Removal
- 4.2.11 Flood Control Structure Modification
- 4.2.12 Floodwater Storage and Operations
- 4.2.14 Regional Environmental Permitting
- 4.2.15 Bypass Expansion and Construction

- Collaborate with others to support habitat restoration in Cache Slough, southern Yolo Bypass, Dutch Slough, McCormack/Williamson, and other parts of Delta.

4.3.4 Upper San Joaquin River – Friant Dam to Merced River

Numerous opportunities exist on the upper San Joaquin River to restore ecosystem functions, particularly as flow impediments are removed and as flows that are more representative of the river's natural hydrograph are initiated as part of the SJRRP. Within this planning area, the CVFPP will focus on coordinating with other entities, as needed, on implementing the SJRRP. DWR is working closely with the SJRRP to foster compatibility between SJRRP goals and FloodSAFE principles. The State's involvement in the SJRRP is primarily funded through Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal protection Bond Act of 2006.

Beyond other broadly applicable types of improvement (see box), specific conservation opportunities within this planning area include the following potential projects:

- Collaborate with Reclamation to improve fish passage between Friant Dam and Gravelly Ford and at the Sand Slough Control Structure, Stevenson Weir, Helm Canal, Sack Dam, and the Chowchilla Bypass Bifurcation Structure.

- Improve flood protection for small communities through reconstructing and improving existing levees or, potentially, constructing setback levees with habitat enhancement and restoration measures incorporated, wherever possible.

- Collaborate with Reclamation and other agencies to improve fish passage at Friant and Goodwin dams.

- Collaborate with the San Joaquin River Conservancy on projects involving habitat restoration, invasive species removal, isolation and/or filling of gravel pits, and other channel and floodplain restoration within the upper San Joaquin River above State Route 99.

- Collaborate with the SJRRP to modify levees and floodways to convey mandated flows and provide floodplain habitat, including constructing setback levees between Gravelly Ford and Mendota Pool and in the Mendota Pool Bypass, and modifying the San Joaquin River Headgate Structure.

- Collaborate with the San Joaquin River Partnership to integrate recreational facilities along the San Joaquin River in accordance with the San Joaquin River Blueway Vision.

Upper San Joaquin River

4.3.5 Lower San Joaquin River – Merced River to Stockton

The Lower San Joaquin River Planning Area encompasses the San Joaquin River from the Merced River to, and including, the Stockton Metropolitan Area. SPFC facilities generally include intermittent levees along the San Joaquin River and levees along the lower reaches of various tributaries and Delta distributaries. Major reservoirs with flood management functions tributary to the planning area include New Hogan Reservoir, Farmington Flood Control Basin, New Melones Lake, New Don Pedro Reservoir, and Lake McClure.

The San Joaquin River is actively meandering in portions of this planning area, and the river corridor includes floodplain with complex topography such as oxbows, swales, and other products of channel migration. This planning area contains portions of the San Joaquin River National Wildlife Refuge.

As described above for the Upper San Joaquin Planning Area, opportunities exist on the lower San Joaquin River to restore ecosystem functions, particularly as flow impediments are removed and as flows that are more representative of the river's natural hydrograph are initiated as part of the SJRRP. Within this planning area, the CVFPP will focus on coordinating with other entities, as needed, on implementing the SJRRP. DWR is working closely with the SJRRP to foster compatibility between SJRRP goals and FloodSAFE principles.

Beyond other broadly applicable types of improvement (see box), specific conservation opportunities that have been previously identified within this planning area include the following potential projects:

Broadly applicable improvements that apply to the Lower San Joaquin River Planning Area

- 4.2.1 Corridor Management Strategy
- 4.2.2 Ecological Restoration - Key habitats in this planning area include wetlands, floodplains, riparian (especially SRA), eroding banks, and spawning gravel beds.
- 4.2.4 Easements
- 4.2.5 Landowner Incentive Programs
- 4.2.6 Levee Maintenance and Repair
- 4.2.7 Floodway Management.
- 4.2.8 Levee Construction, Reconstruction, and Improvements
- 4.2.9 Setback levees
- 4.2.10 SPFC Facilities Removal
- 4.2.11 Flood Control Structure Modification
- 4.2.12 Floodwater Storage and Operations
- 4.2.14 Regional Environmental Permitting
- 4.2.15 Bypass Expansion and Construction

- Reconstruct and improve existing levees around Stockton with vegetated berms and similar measures incorporated, where possible, to increase habitat values.

- Design, construct, and operate any new potential bypass in the South Delta, including or in combination with expansion of Paradise Cut and/or other South Delta waterways, to accommodate ecosystem restoration features and benefits, including conservation and restoration of aquatic and floodplain habitats and continued compatible agricultural land uses within the bypass.

- Purchase easements in southern Delta for purposes of floodwater storage, ecosystem restoration, and preservation of land uses compatible with periodic flooding.

- Collaborate with others to implement several projects within this planning area. These projects would include restoring riparian, wetland, and floodplain habitat, removing nonessential bank revetment and levees, removing invasive species, reducing floodway maintenance, and creating connections to historical river channels and sloughs.

- Coordinate flood management actions with State Water Resources Control Board's (SWRCB) efforts to develop and implement flow objectives for the southern Delta and the San Joaquin River.

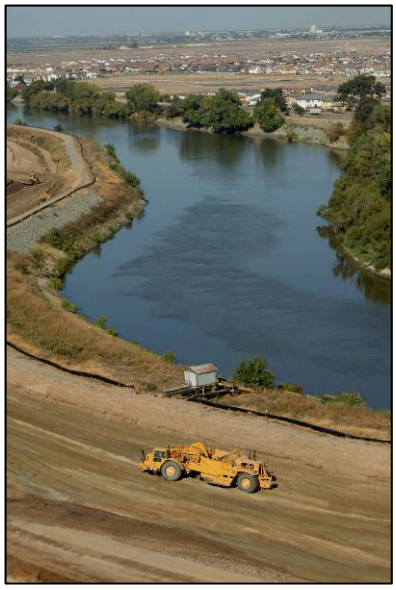
- Collaborate with others to implement several projects (e.g., Grayson Bypass, Merced River Reaches Mi, M2, and M3) within tributaries to this reach of the San Joaquin River. These projects would include restoring riparian, wetland, and floodplain habitat, removing nonessential bank revetment and levees, removing invasive species, reducing floodway maintenance, and enhancing spawning habitat.

- Collaborate with others to reconnect historical sloughs and oxbows, restore riparian habitat, remove invasive species, and restore floodplains to San Joaquin River roughly between River Mile (RM) 57 and RM 118.

- Collaborate with USACE and others on the Three Amigos project to restore wetland, riparian, and floodplain habitat, remove nonessential levees, reduce floodway maintenance, and remove invasive species.

- Work with affected federal and conservation land managers to reduce or stop maintaining levees in the vicinity of Mariposa Bypass, Deep Slough, and adjacent parts of the San Joaquin River to restore riparian, wetland, and floodplain habitat and reduce floodway maintenance.

- Improve fish passage at pumping stations for water diversions, including those pumping stations on the Calaveras and Mokelumne rivers, Stockton Diversion Canal, and Mormon Slough.



Levee near Lathrop on the San Joaquin River

- Collaborate with the San Joaquin River Partnership to integrate recreational facilities along the San Joaquin River in accordance with the San Joaquin River Blueway Vision.

- Collaborate with California State Parks to integrate recreational facilities, including boating trails, in the South Delta, Dos Rios sites, and along San Joaquin River at Mossdale/Vernalis with those available in restored habitat areas.

4.3.6 Sacramento-San Joaquin Delta Areas Not Protected by State Plan of Flood Control

The Delta is contained within the Systemwide Planning Area for the CVFPP. Areas within the Delta that contain or receive flood protection from the SPFC are included in the Lower Sacramento River and Lower San Joaquin River planning areas. Areas of the Delta outside the SPFC include the Sacramento River and its distributaries generally located to the south and the east of Isleton, and the San Joaquin River and its distributaries generally located to the west of Stockton.

Restoring ecosystem functions and aquatic habitats in the Delta has been, and continues to be, the focus of various State, federal, and local efforts in this area. These include the Delta Stewardship Council's Delta Plan, Delta Vision's Strategic Plan, and the BDCP. Local agencies are responsible for

flood management in these areas, supported by the State's Delta Levee Program.

The focus of the CVFPP in Delta areas not protected by the SPFC will continue to emphasize the Delta Levee Program, which includes Subventions and Special Projects. These programs are required to not only fully mitigate environmental impacts, but to also provide a net increase in fish and wildlife habitat. With the net increase goal embedded in the enabling statutory authority, this program provides an excellent example of integrating environmental stewardship into flood management at all decision levels. The Delta Levee Program also exemplifies collaboration with other State (e.g., BDCP, Delta Plan), federal (e.g., Delta Islands and Levees Feasibility Study), and local (e.g., McCormack/Williamson, Cosumnes Preserve) planning efforts and programs. The State will continue to support Delta flood management and environmental improvements through existing programs.

5.0 Implementation

Implementation of the Conservation Framework and subsequent Conservation Strategy is the State's preferred approach to providing ecosystem benefits within the Systemwide Planning Area. This section restates the link with the SSIA, describes broad approaches related to funding and systemwide benefits, outlines the CVFPP approach to managing vegetation in the flood management system, and describes other important implementation steps.

The State understands and acknowledges that successful implementation of both the Conservation Framework and Conservation Strategy will involve the continued engagement of diverse (e.g., environmental, agricultural, recreational, rural, and urban) interests and stakeholders, and the generation of mutual benefits among these diverse interests. Chapter 4 of the CVFPP presents further information on overall CVFPP implementation.

5.1 State Systemwide Investment Approach Implementation

The SSIA is outlined in Chapters 3 and 4 of the CVFPP, and incorporated conservation actions are contained in Section 4 of this document, Integration of Conservation and Flood Management. The SSIA is an integrated set of programs, policies, principles, guidance, and on-the-ground regional elements that will require more than 20 years to implement. While the SSIA is a broad approach for how system improvements could fit together, not all elements, including some conservation elements, have been developed to a level of detail necessary for near-term implementation. Some elements have already been completed, others will be accomplished before the first update of the CVFPP in 2017, and many will require additional time to fully develop and implement. Ongoing planning, feasibility studies, designs, funding, and partnering are required to better define and incrementally implement these elements over time.

As part of the SSIA, investment in actions to carry out the Conservation Framework will be made with funding available for flood management improvements, funding specifically earmarked for ecosystem projects, and through partnering with other entities that have an interest in projects that benefit habitats and species associated with the flood management system.

All levels of CVFPP project planning and development will consider opportunities to integrate ecosystem enhancements with flood damage reduction projects.

5.2 Funding Approach

The CVFPP provides a broader discussion of funding flood system improvements. This section builds on that discussion by identifying environmentally related funding issues.

As a general rule, flood management projects that produce benefits for multiple project objectives (e.g., flood risk management and ecosystem restoration) are likely to have a higher level of federal interest in sharing the cost of implementation. For those projects in which the federal government has an interest, cost-sharing between State and federal flood management agencies is established in State and federal law. The USACE *Trade-Off Analysis Planning and Procedures Guidebook* (2002b) contains details on what types of projects USACE shares costs in, and lays out a framework on how to allocate those costs to different project objectives.

For those flood management projects in the Central Valley for which a federal interest is not established, project costs are often allocated among the State and local partners. In accordance with legislation enacted in 2007 (Assembly Bill 5, Chapter 366, Section 26 (codified at CWC Section 9625)), DWR developed cost-sharing formulas for the Early Implementation Projects program using funds made available by Proposition 1E and Proposition 84, which has funded numerous flood management projects in advance of adoption of the CVFPP. However, it is recognized that these formulas for State-funded flood management projects may not fully account for the lesser ability of rural areas to pay for flood projects.

Additionally, the formulas may need to be strengthened to sufficiently account for non-flood-risk-reduction benefits, such as enhancing ecological processes and habitats that are fundamental to sustainable flood management. Therefore, an effort is underway to reevaluate existing cost-share formulas to better address ecosystem restoration and conservation associated with flood management. Broad policy issues are expected to figure in the revision of cost-share formulas and, more broadly, into case-by-case determinations of how costs for multipurpose projects could be allocated to beneficiaries on a regional or systemwide scale. In some cases, it may be in the State's interest to fund 100 percent of project costs, with additional incentives to local agencies to create projects that generate more than traditional flood-risk-reduction benefits.

In the specific case of creating new habitat areas within a setback levee, local agencies or other entities may be interested in receiving “credits” associated with the creation of that habitat. This could be in the form of an advance mitigation bank in which an agency could use that habitat to offset mitigation requirements of nonroutine O&M, or it could hold the option of selling habitat credits to other entities that are striving to meet their own regulatory mitigation obligations. Such incentives will have to be developed creatively in consultation with State, federal, and local agencies at the individual project level, and their application will have to consider whether a project is economically feasible (not just lowest in cost).

Beyond the upfront initial costs of land acquisition, restoration planning, site construction, and habitat restoration, mitigation projects need continued funding for long-term monitoring and management. Ongoing management issues often involve activities such as controlling invasive species, trash and dumping cleanup, maintaining equipment and facilities, and maintaining water control operations.

In summary, individual projects will need to be carefully evaluated to identify potential benefits, beneficiaries of those benefits, and how much the beneficiaries are willing to pay for benefits. DWR’s Environmental Stewardship Policy includes a provision for DWR to include environmental stewardship and ecosystem protection and restoration as a criterion in project funding decisions for all DWR programs.

5.3 Systemwide Benefits

The Central Valley Flood Protection Act of 2008, as codified by CWC Section 9616, requires the CVFPP to describe structural and nonstructural means for improving the performance and eliminating deficiencies of the flood control system and to meet multiple objectives. Among these objectives are several environmentally related objectives, as described in Section 3. Properly implemented, the same objectives should increase the safety and sustainability of the flood management system, and also present opportunities for supporting habitat needs for fish and wildlife.

Section 4.3, Conservation Opportunities by Planning Area, describes the primary flood management actions that the State will consider. Prominent among these are setback levees, new and expanded floodwater bypasses, and easements to preserve land uses compatible with periodic flooding.

These actions present opportunities to reduce flood damages, increase the sustainability of the flood management system, reduce levee maintenance costs, and generate additional habitat for fish and wildlife. The risk of flood

damage to property is likely to decline because the levees will be safer, be able to accommodate higher peak floodflows, be subject to less erosion, be properly engineered to current standards, and be less vulnerable to catastrophic failure. The flood management system would become more financially sustainable with less need for costly repairs and emergency actions. Such costs can be reduced by consolidating meandering levees into shorter setback lengths and distancing levees from the river's main erosive flows. The system's ecological sustainability would also improve with improvements in floodplain processes, habitat quality, quantity, and connectivity.

Although these actions should contribute to achieving multiple systemwide benefits, additional efforts are needed to achieve the environmental objectives of the Central Valley Flood Protection Act and State and federal law. Established DWR policy is to "incorporate ecosystem restoration as an objective in water and flood management projects, including partnering with restoration efforts of others, to achieve net environmental benefit" (see Section 1.4, Conservation Framework Development). To achieve the environmental objectives of the Central Valley Flood Protection Act of 2008, designs and budgets for flood projects should include actions that provide ecosystem benefits. DWR will also collaborate with others to restore habitat and ecosystem processes throughout the system.

5.4 Levee Vegetation Management Strategy

The following section describes the State's strategy for managing vegetation on levees within the SPFC. The section describes the background and risk assessment that provides the rationale for the development and implementation of a flexible and adaptive levee vegetation management strategy that would achieve public safety goals and protect and improve habitat within the SPFC. Implementation of the State's strategy for levee vegetation management will be adaptive and responsive to (1) the results of ongoing and future research, and (2) knowledge gained from levee performance during high water events. Background of the strategy pertaining to retention of Public Law 84-99 Disaster Recovery eligibility is discussed in Chapter 3 of the CVFPP, and investment challenges are presented Chapter 4 of the CVFPP.

5.4.1 Risk-Informed Context for Levee Vegetation Management

DWR has implemented the FloodSAFE California initiative, a comprehensive flood risk reduction program that includes the concurrent planning, design, and construction of flood risk reduction projects that

integrate habitat protection and improvements. This program is prioritized by targeting projects or actions that result in the greatest public safety and ecosystem improvements with early financial investments. Prioritization is necessary because of resource limitations. These early investments target, but are not exclusive to, high consequence systems (urban areas) most vulnerable to deep flooding. Agencies with flood management responsibility generally agree that levee sites posing the highest risk (with "risk" defined as the cumulative product of the probability of failure and the consequence of those failures) should be corrected at the earliest opportunity.

Woody and non-woody growth along base of levee

DWR appreciates the need for, and benefits of, broad nationwide guidance from USACE to meet a variety of objectives, including guidance for vegetation management on flood protection levees. However, DWR also believes there is a clear need for such nationwide guidance to be flexible and adaptable to regional conditions to serve the highest priority of public safety. A flexible strategy recognizes the pitfalls of one-size-fits-all approaches to protecting public safety, and improves the efficiency of local solutions to address local risks. Both DWR and USACE agree on public safety as the highest priority, and, as such, it has been identified as the primary goal of the CVFPP. To this end, the Levee Vegetation Management Strategy for the CVFPP described below characterizes vegetation management within the context of risk prioritization in order to make judicious investments of public funds.

DWR recognizes that woody vegetation on levees must be adaptively managed, including appropriate clearing and thinning of "legacy levee vegetation" for visibility (inspections) and accessibility (maintenance and flood fight activities). DWR defines "legacy levee vegetation" as vegetation that was inspected by USACE and for which there is no documentation that the nonfederal sponsor was notified before 2007 that the vegetation needed to be removed. This includes vegetation present on State-federal project levees at the time the project was turned over by USACE during the 1950s, vegetation that was planted for mitigation as part of a cost-shared USACE project, and vegetation that has been allowed by USACE to remain to meet ESA or other requirements.

Levee failure mechanisms (or risk factors) such as underseepage, through-seepage, slope and structural instability, erosion, and deep rodent burrows indisputably have negative impacts on levee integrity and public safety.

Legacy levee vegetation does not fall into such a grouping of unequivocal failure mechanisms. However, because currently accepted methods of analysis cannot fully take into account the effects of woody vegetation, the USACE Engineering Technical Letter (ETL) 1110-2-571, *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams and Appurtenant Structures* (2009), treats vegetation as introducing unacceptable uncertainties, which must be remediated through removal or engineering works. Given that USACE Engineer Research and Development Center's (ERDC) research report (July 2011) shows that woody vegetation has the potential to increase or reduce risk, depending on a variety of factors, DWR believes it is appropriate to characterize woody vegetation as only a "potential risk factor" that should be considered in relation to the unequivocal risk factors and to site-specific conditions. One of the findings of DWR's *Flood Control System Status Report* (DWR, 2011) was that while risk factors such as seepage, stability, and erosion were rated as medium-to-high relative threats, levee vegetation was rated as a low threat to levee integrity, consistent with the fact that no documented levee failures in California have been attributed to vegetation.

Another important consideration is that a rigidly conservative and precautionary approach that calls for removal of levee vegetation runs at odds with State and federal environmental requirements. State and federal resource agencies find that the ETL itself, and the potential impacts of widespread vegetation removal due to strict enforcement of that regulation, poses a major threat to protected species and their recovery. Similarly, local agencies are concerned about negative impacts to public safety from rigid ETL compliance due to redirection of limited financial resources to lower priority risks. For this reason, widespread vegetation removal is unlikely to be a feasible management action for many of California's levees.

5.4.2 Lower Waterside Vegetation Benefits and Risk Assessment

The levees that confine river systems in California support the last remnants of once great riparian forest ecosystems. This is especially true in the Central Valley, where more than 95 percent of the riparian habitat has been lost. Many of California's native fish and wildlife resources evolved in this complex and dynamic natural community and many are now State listed and/or federally listed as threatened or endangered species largely because of the cumulative loss of habitat along riparian corridors. Woody vegetation found on Central Valley levees is a significant portion of the remaining riparian habitat that provides nesting, foraging, and cover habitat for migratory birds (including neotropical migrants, raptors, and others); vegetation on the lower waterside slope of the levee provides overhead cover and shade that moderates water temperatures and energy input to

river productivity at all trophic levels. The lower waterside slope is defined as the portion of the waterside slope that is below the vegetation management zone (which is typically 20 feet, but may be less on short levees).

From a flood threat perspective, lower waterside slope vegetation rarely presents an unacceptable threat to levee integrity. However, lower waterside slope vegetation more typically provides beneficial functions such as slowing near-shore water velocities and holding soil in place to reduce erosion; and in the case of larger vegetation, providing an additional stabilizing force on the levee itself. The USACE ERDC report titled *Initial Research into the Effects of Woody Vegetation on Levees* (July 2011) included a finding that trees can increase or decrease levee safety, depending on their location on levees; modeling of trees at the levee toe observed a reinforcing effect due to the tree acting as an anchor and counterweight to sliding. While ERDC called for additional research, its report did not characterize levee vegetation – particularly on the lower waterside – as a major risk factor.

Lower waterside slope vegetation is generally considered to be beneficial, or in the worst case, to pose a low threat to levee integrity:

- Due to its position on the levee, it does not interfere with flood fight, inspection, and access. It is at the greatest distance from the landside levee slope, which reduces concerns about (1) erosion that might occur should a tree fall and expose erodible levee soils, and (2) seepage that might travel along rotten tree roots.

- California Levee Vegetation Research Program (CLVRP) research shows that in some cases, vegetation may impede seepage, and was unable to confirm the theory that rotten roots promote piping.

- University of California, Davis, tree root architecture research study shows that roots of the two predominant native tree species growing on levee slopes in California, valley oak (*Quercus lobata*) and cottonwood (*Populus* sect. *Aigeiros*), do not penetrate all the way through levees. Exceptional roots of large cottonwoods may grow some distance into the levee, following beneath the watereside slope surface, or following soil lenses, but roots do not go from water to landside.

- Woody vegetation may have beneficial functions, such as holding soil in place to avoid erosion, recruiting sediment, and aiding slope stability.

Public funds expenditures need to be well justified. When addressing multiple risks in a major levee system using limited public funds, a rational strategy is to prioritize the investment based on the risk and public benefit. In making prioritized investments solely based on risk, the highest risks are addressed first and the lowest risks are addressed last. In consideration of the low potential threat to public safety and high potential impact to State and federally protected species, the CVFPP considers removal of lower waterside vegetation, or levee improvements designed for the specific purpose of mitigating lower waterside vegetation, to be among the lowest priorities for use of public flood risk reduction funding. However, because of the limited extent of this waterside vegetation, the CVFPP considers projects that enhance (go beyond mitigation) the lower waterside vegetation, or levee improvements designed to address public safety and significantly increase the lower waterside vegetation, to be among the highest priorities for the use of public funding.

Lower waterside vegetation

From an ecosystem perspective, widespread removal of waterside vegetation (particularly, SRA habitat – critically important in protection and recovery efforts for special status species along California's riparian corridors and its adjacent waterways) would result in ecological impacts that would be considered essentially "unmitigable." To be effective, mitigation would need to be placed in the same aquatic ecosystem from which the vegetation is removed. Additionally, loss of habitat for some species cannot be mitigated with off-channel or offsite locations; specific location is essential for many species that use this ecosystem for all or part of their life cycle. California currently has over 400 species listed under CESA and ESA. A number of these species are wholly or partially dependent on riparian habitat for their life requisites. The risk is to the ecosystem as a whole, not just listed species within the ecosystem. If there are locations where vegetation has been determined as the highest flood management and levee threat, direct and indirect riparian ecosystem impacts will be evaluated in consultation with appropriate resource agencies.

5.4.3 Vegetation Management Strategy

The State will implement a comprehensive, integrated management strategy that meets both public safety goals and protects and enhances sensitive habitats within the Sacramento and San Joaquin valleys. The State's strategy to levee vegetation management will be adaptive and responsive to (1) the results of ongoing and future research, and (2) knowledge gained from levee performance during high-water events. The strategy is built on concepts embodied in *California's Central Valley Flood System Improvement Framework* (Framework Agreement), signed in 2009 by California Levees Roundtable participants, and includes a systemwide risk-informed process to address the requirements of USACE national vegetation policy within the context of multiple levee risk factors. Policies and implementation of these policies regarding removing trees and other woody vegetation on levees are evolving and will be informed by ongoing and future research.

Management of vegetation on Central Valley levees is at the heart of the disagreement between the USACE vegetation policy and resource agency recovery efforts for river corridors. Long-term management of vegetation will generally be accomplished through adaptive management of vegetation on the levee – both within the vegetation management zone and on the lower waterside slope (outside of the vegetation management zone). This strategy allows existing "legacy" trees and other woody vegetation to live out their normal life cycles unless they pose an unacceptable threat, while maintaining visibility for inspection and access for maintenance and floodfight. This strategy allows for the retention of lower waterside vegetation (below the vegetation management zone).

Vegetation Management Zone

The Vegetation Management Zone is the area on and near a levee in which vegetation is managed for visibility and accessibility using a life-cycle management strategy.

The vegetation management zone includes the entire landside levee slope plus 15 feet beyond the landside toe (or less if the existing easement is less than 15 feet), the levee crown, and the top 20 feet (slope length) of the waterside levee slope.

For levees that have a waterside slope of less than 20 feet, the vegetation management zone includes the entire waterside slope plus the extent of berm within 20 feet of the crown as measured along the ground surface.

For levees that have a short waterside slope above the water surface elevation that submerges the lower waterside slope frequently enough to prevent long-term tree establishment, the lower 5 feet (slope distance) of the waterside slope immediately above that water surface elevation is not included in the vegetation management zone and should remain unmanaged.

For levees with a landside berm, the vegetation management zone is determined by using the projected landside levee slope instead of the actual landside levee slope.

The vegetation management zone is illustrated on Figures 5-1 and 5-2.

Adaptive Levee Vegetation Management

Implementation of the State's strategy to levee vegetation management will be adaptive and responsive to (1) the results of ongoing and future research, and (2) knowledge gained from levee performance during high-water events. The strategies outlined below for the lower waterside slope and for the vegetation management zone provide a path forward for CVFPP implementation.

Lower Waterside Slope

In order to sustain critical habitat, the CVFPP levee management strategy retains lower waterside vegetation (below the vegetation management zone). Vegetation would be removed (in coordination with resource agencies) only when it presents an unacceptable threat.

Vegetation Management Zone: Life Cycle Management (LCM)

LCM achieves "visibility and accessibility" criteria while progressing gradually (over many decades) toward the current USACE vegetation policy goal of eventually eliminating woody vegetation from the vegetation management zone on the landside slope, crown, and upper waterside slope of levees.

LCM addresses resource agency objectives to protect and improve riparian habitat by largely preserving in the near term existing vegetation within the vegetation management zone that does not impair visibility and accessibility, while developing additional habitat under the Conservation Strategy to offset gradual die-off of existing trees and the removal of trees that pose an unacceptable threat to levee integrity. For the long term, it is anticipated that continued scientific research, potential system modifications, and evolving vegetation policy will support preservation and restoration of sustainable riparian habitat within the levee system.

The vegetation management strategy within the SPFC planning area is focused on improving public safety by providing for levee integrity, and visibility and accessibility for inspections, maintenance, and flood fight operations, while at the same time protecting and enhancing important and critical environmental resources, such as SRA. For the systemwide scale of the CVFPP, it is not practical to assess each levee segment individually to determine relative risk factors and to prioritize integrated system improvements. An expectation of "site by site" or "tree by tree" assessments would create an unreasonable administrative burden for project proponents and agency staff of all project partners. However, through routine inspections, levees will be inspected multiple times each year for a wide variety of potential problems, including trees that may pose an unacceptable threat to levee integrity. Such trees would be removed in coordination with the resource agencies.

This strategy affords maintaining agencies with flexibility and encourages them to retain existing trees and other woody vegetation. Because of the importance of these critical vegetation resources, it is anticipated that implementing this vegetation policy will result in retaining, in the near term, the vast majority of existing trees and other woody vegetation that provide important and critical habitat. In the long term, it is anticipated that the vast majority of trees and other woody vegetation on the lower waterside levee slope would be left to continue to grow with little or no management.

Vegetation Management Procedures

The following summarizes DWR's vegetation management procedures in support of the 2012 CVFPP to manage vegetation on levees protecting

urban, urbanizing, and non urban levees in the Sacramento-San Joaquin valleys. Specific vegetation management procedures implemented will be dependent on whether a levee is (1) a new or legacy levee, or (2) directly adjacent to the river or set back from the channel. This is an adaptive levee vegetation management strategy and, based on the results of ongoing and future research or knowledge gained on levee performance during high water events, revisions to this strategy may be made in future 5-year updates to the CVFPP.

Measuring plantings on levee

Waterside Vegetation

Flood management actions will protect existing, and promote the development of, appropriate vegetation for erosion control on the waterside slope, outside of the vegetation management zone. Brush, snags, and tree growth, especially on the lower portions of the levees in the natural banks or waterside levee slope, often have beneficial effects, including stabilizing levee materials, reducing erosive forces on levee embankments by slowing near-bank flows and dissipating wave action, which in turn encourages local deposition of sediment. USACE regulations, 33 Code of Federal Regulations, Part 208, recognize that vegetation can improve public safety by reducing the potential for levee erosion based upon the following language taken from a USACE "vegetation variance letter" dated August 3, 1949: "Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees." The 1949 letter also stated that "brush and small trees may be retained on the waterward slope where desirable for the prevention of erosion and wave wash."

Waterside vegetation below the vegetation management zone, usually the top 20 feet (slope length), should remain in place, unless through an engineering evaluation it is determined that it poses an unacceptable risk to levee integrity, in which case it would be removed. However, the removal of vegetation will need to comply with environmental regulations, including obtaining necessary permits and mitigation requirements.

As described in Section 5.4.2, mitigating for environmental impacts due to wholesale removal of waterside levee vegetation would be nearly impossible to achieve because the availability of in-kind mitigation is, at best, questionable. However, in isolated instances where lower waterside vegetation is removed because it poses an unacceptable threat, mitigation may be possible by planting vegetation where it does not currently exist. For example, locations where there is no existing riparian vegetation or

SRA habitat may be suitable for planting and should be used to the fullest extent possible. Planting additional riparian habitat will increase connectivity along the riparian corridor, an ecosystem improvement objective included in the SSIA, and will help meet objectives in the *Central Valley Salmon and Steelhead Recovery Plan* (NMFS, 2009), which identifies enhancing riparian and floodplain corridors throughout the Central Valley flood system. Planted areas may need to be monitored, managed, and protected for the long term pursuant to CESA and ESA.

Setback Levees

Improvements to the Central Valley State-federal levee system will strive to achieve multiple objectives through use of setback levees, where practical, to separate the flood control system from the riverbanks and their attendant riparian vegetation. Setback levees can increase channel capacity and reduce water surface elevations at flood stage locally, while avoiding loss of important riparian and SRA habitat and improving floodplain area. This can result in flood system and habitat improvements. Engineering requirements for new setback levees are the same as for new levees. The expanded floodways provided by setting levees back will be designed to accommodate vegetation, while still meeting channel conveyance and ETL requirements for the new levees.

Newly Constructed Levees

The State proposes adherence to USACE guidance for new levee construction, which typically would be new setback, bypass, or ring levees located away from the river channel. These standards limit vegetation to native grass species on levee crowns and slopes and within 15 feet of the levee toe (or less, if the existing easement is less than 15 feet).

To minimize impacts to SRA, new levees along the river should be designed and constructed to include a specially designed waterside planting berm to accommodate trees and other woody vegetation to sustain continuous SRA habitat along the river, as described in the SSIA, and still meet the requirements of the ETL. Such berm designs are not only intended to offset impacts of vegetation removal required for project construction, but also to provide opportunities for improving connectivity of SRA habitat. This planting berm must represent an overbuilt section with respect to minimum geometries. The planting berm also must be of sufficient size and configuration to mitigate potential negative impacts to levee safety with respect to seepage, stability, and erosion criteria should either windfall or root decay occur.

Levee Repair or Improvement

For levee repair or improvement, vegetation can be removed to meet the objectives of a specific project. Any vegetation removed as part of direct

construction activities would likely not be replaced at that location, but would require off site, in-kind mitigation, to be determined in consultation with the appropriate resource agencies. However, vegetation on other sections of the levee, not affected by construction activity, should remain in place.

Note that in many locations where levees are repaired, waterside trees and other woody vegetation should remain in place, particularly on the lower waterside slope and channel bank, because of environmental and engineering benefits that include erosion protection, soil reinforcement, and sediment recruitment. If removed for the purposes of the repair, lower waterside woody vegetation (below the typical 20-foot vegetation management zone) should be allowed to reestablish, and may be restored (subject to regulatory approval). Root mitigation alternatives, such as described below, may be included as part of any levee improvement program:

- The overall width of the levee would be widened landward by at least 15 feet beyond the standard minimum levee dimensions, where feasible, or

- An effective root or seepage barrier would be installed within the upper 10 to 15 feet of the levee crown to mitigate potential impacts by tree roots.

This is consistent with the *Sacramento River Bank Protection Project Programmatic Biological Opinion* (USFWS, 2008), which states that "existing riparian vegetation will be protected on site to the maximum extent possible where it does not affect flood system safety."

Levees with Preexisting "Legacy Levee Vegetation"

DWR does not believe that the presence of properly maintained woody vegetation on "legacy levees" constitutes a degree of risk that necessarily requires removal of vegetation or constructing engineered works to address the perceived risk. Instead, such previously defined "legacy levee vegetation" needs to be considered in a balanced recognition of its role to the ecosystem and to the levee's integrity.

A critical limitation of the USACE ETL is that it is written strictly in terms of new levee construction, and fails to recognize and address the unique engineering and environmental attributes presented by well-established "legacy vegetation" as an integral aspect of many SPFC levees. Taking all the above factors into consideration, the CVFPP builds on the 2009 Framework Agreement by proposing to adhere to the USACE guidance for new levee construction (typically setback, bypass, or ring levees located

away from the river channel). For "legacy levee vegetation," however, the CVFPP vegetation management strategy has been developed to be adaptable to achieve compatibility with implementation of USACE national vegetation policy. The State suggests that the USACE national vegetation policy needs flexibility to recognize and accommodate regional differences – something that could be achieved through a collaboratively developed variance policy that provides such regional flexibility.

Levee with preexisting vegetation

Levees with preexisting vegetation are to be maintained according to the levee vegetation inspection criteria described below. DWR's levee inspection program first developed "interim criteria" for use in the fall 2007 levee inspections, which were later described as "interim criteria for visibility and accessibility" in the Framework Agreement. The criteria have been implemented by maintaining agencies since 2008 and have been successful in achieving visibility and accessibility along the levee system to meet public safety goals.

The inspection criteria establish a vegetation management zone in which trees are trimmed up to 5 feet above the ground (12-foot clearance above the crown road) and thinned for visibility and access. Brush, weeds, or other such vegetation over 12 inches high are to be removed in an authorized manner. The vegetation management zone includes the entire landside levee slope plus 15 feet beyond the landside toe (or less, if the existing easement is less than 15 feet), the levee crown, and the top 20 feet (slope length) of the waterside levee slope.

For levees that have a waterside slope of less than 20 feet, the vegetation management zone includes the entire waterside slope plus the extent of berm within 20 feet of the crown, as measured along the ground surface. For levees with a short waterside slope above the water surface elevation that submerges the lower waterside slope frequently enough to prevent long-term tree establishment, the lower 5 feet (slope distance) of the waterside slope immediately above that water surface elevation is not included in the vegetation management zone and should remain unmanaged. For levees with a landside berm, the vegetation management zone is determined by using the projected landside levee slope instead of the actual landside levee slope (see Figures 5-1 and 5-2).

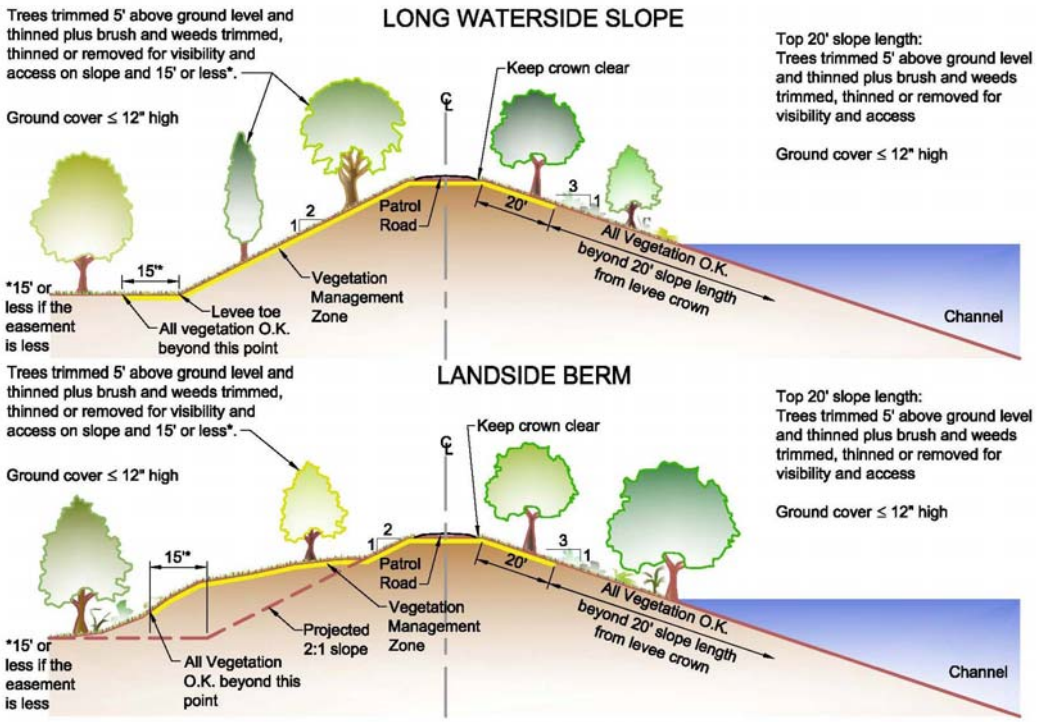


Figure 5-1. DWR Vegetation Inspection Criteria for Standard Levees –Long Waterside Slope and Landside Berm

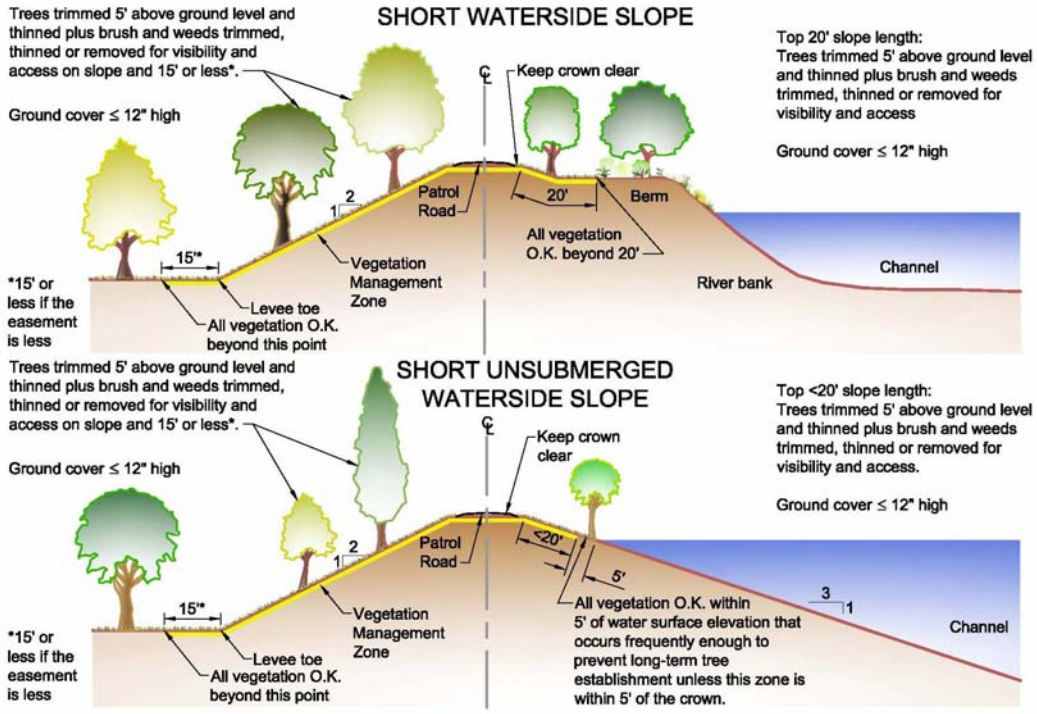


Figure 5-2. DWR Vegetation Inspection Criteria for Standard Levees – Short Waterside Slope and Short Unsubmerged Waterside Slope

Waterside vegetation below the vegetation management zone should remain in place without trimming or thinning, unless it poses an unacceptable threat to levee integrity.

Vegetation that was introduced, allowed, required as mitigation, or endorsed by a previous USACE action as necessary to comply with environmental requirements, and/or was present when the levee system was transferred from the USACE to a non-federal sponsor, will not be removed (unless changed conditions cause such vegetation to pose an unacceptable threat or it creates a visibility problem within the vegetation management zone).

Life-Cycle Vegetation Management and Early Establishment of Riparian Forests

DWR will implement and encourage maintaining agencies to implement a long-term adaptive vegetation life-cycle management (LCM) plan that will lead to the eventual elimination of trees and other woody vegetation through removal of immature trees and woody vegetation. LCM will be implemented in the vegetation management zone, as described above.

This plan will allow existing “legacy” trees and other woody vegetation beyond a certain size to live out their normal life cycles on the levee, unless they pose an unacceptable threat. Removal would be accomplished in consultation with appropriate resource agencies.

Under the LCM plan, removing immature trees and woody vegetation less than 4 inches in diameter at breast height will be conducted in consultation with the appropriate resources agencies.

Because implementing the LCM plan will result in loss of important habitat throughout the State and federal project levee system, LCM includes early establishment of riparian forest corridors to compensate for the potential eventual loss of this habitat. The intention is that these riparian forest corridors will be established adjacent to existing and new levees such that the net effect will be to maintain and improve riparian corridor function for wildlife habitat. This approach will allow replacement habitat to develop and mature over time while the existing trees within the vegetation management zone are allowed to live out their normal life cycles on the levee slopes.

To address concerns about habitat lost under LCM, trees will be planted concurrently during this period. The goal is to plant vegetation within the floodway, but site limitations or regulatory constraints (Board restrictions) may require that trees be planted on the landside (outside the current levee easement). A site protection mechanism (such as a conservation easement),

long-term funding strategy, and monitoring and management plan for the planted riparian areas will be developed.

Levee vegetation subject to removal through the LCM plan will be quantified, using best available information. Specific rates for replanting and other details of implementation of the LCM plan will be determined through collaboration with the appropriate agencies as part of Conservation Strategy development.

As described in the draft *Urban Levee Design Criteria* (DWR, 2012), before any tree removal, an engineering inspection and evaluation should be conducted to identify trees and woody vegetation (alive or dead) that pose an unacceptable threat to the integrity of the levee. These engineering evaluations should be based on best available science and state-of-practice, and should be commensurate with risk. It is expected that future research will build upon current draft guidance to better address how to determine (in advance of and during high-water events) when a tree poses an unacceptable threat. These inspections should address both the hazards and benefits of vegetation with respect to potential failure mechanisms. The analysis may also include a risk assessment of all factors that adversely affect levee safety. Mitigation will likely be required for any trees removed because of an unacceptable threat determination. Appropriate compensation and/or mitigation for the loss of habitat will be addressed in consultation with the resource agencies and in the development of the Conservation Strategy.

Blue elderberry (*Sambucus nigra ssp. caerulea*)

Endangered Species Act Compliance

Levee vegetation management actions in the Central Valley have the potential to adversely impact listed anadromous fishes and terrestrial species, and their critical habitat, under the ESA and CESA, such as the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), riparian brush rabbit(*Sylvilagus bachmani riparius*), least Bell's vireo (*Vireo bellii pusillus*), and southwestern willow flycatcher (*Empidonax traillii extimus*). The draft Recovery Plan for Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead highlights riparian corridor protection and enhancement as high priorities for recovery of these species. In addition, levee vegetation management actions in the Central Valley could adversely affect Essential Fish Habitat of Pacific salmon, as designated by the Magnuson-Stevens Fishery Conservation and Management Act. The Conservation Framework anticipates that habitat

replacement plans will be negotiated with the appropriate resource agencies in conjunction with, or in advance of, implementing management actions that propose to remove vegetation. Future projects proposing to remove vegetation that is considered essential to the protection and recovery of listed species will likely need to be compensated for on site and in-kind.

As part of the Conservation Strategy, DWR and the maintaining agencies will work collaboratively with the appropriate resource agencies to fill information gaps on threatened and endangered species and other species of concern. Relevant information from other planning efforts will be used, as appropriate. For example, an inventory of elderberry shrub distribution within and adjacent to the State-federal project levee system has not been completed. This knowledge is essential for valley elderberry longhorn beetle habitat enhancement projects.

The Conservation Strategy may include establishing conservation banks, compensation site protection mechanisms (such as conservation easements), and will require a dedicated long-term funding strategy for maintenance, management and monitoring of areas used for this purpose. DWR and maintaining agencies will work with the appropriate resource agencies on future vegetation management activities with the goal of preventing adverse effects on State and federally listed species, and federally designated critical habitat, and impacts to riparian habitat or the species that depend on it.

Through the development of the Conservation Strategy, mitigation for environmental effects of flood system improvements and habitat enhancements implemented as part of multi-objective projects will be part of environmental considerations for the entire levee system.

Update Maintenance Agreements

DWR and maintaining agencies must obtain all required permits to carry out maintenance activities. Without such permits, DWR and the maintaining agencies cannot lawfully proceed. Maintaining agencies will need to work with the appropriate resource agencies (DFG/NMFS/USFWS) to obtain and update routine maintenance agreements under which vegetation management and appropriate minimization and mitigation can occur on a regular basis. This should be accomplished through development of a more efficient regulatory mechanism.

A process for assisting maintaining agencies to achieve environmental compliance and for obtaining necessary permits is expected to be addressed as part of near-term initiatives included in the SSIA. Support for this activity will be included in the Conservation Strategy. Attachment 9G:

Regional Permitting Options provides a preliminary review of permitting options to consider.

Continue and Expand Research

Currently, State and local agency-sponsored research by the CLVRP, along with USACE-sponsored research by ERDC, is addressing information gaps surrounding levee performance through applied research and an ongoing synthesis of historical information. Findings of these research programs are informing current policy development, and will continue to do so for future CVFPP updates. In addition, further research will follow-up on recent research into the effects of woody vegetation on levees, and to address other data gaps. Some of the initial CVLRP research included developing a checklist of monitoring requirements during implementation of LCM. A further goal is to develop more detailed guidance for local maintainers to use for recognition of "unacceptable threat" thresholds.

In addition to future research focusing on levee integrity, research will include evaluating effects to riparian ecosystem function from eliminating natural recruitment under LCM. This research may include a monitoring program to determine if LCM affects species composition, recruitment, and the survival of lower waterside vegetation.

Alternate Variance Procedure and Shared Responsibility

The ETL essentially established a woody vegetation-free zone on all levees and the adjoining ground within 15 feet of the levee on both sides (April 10, 2009), which is at odds with DWR's independent assessment described above. As an implementation directive for the ETL, the USACE subsequently issued a draft Policy Guidance Letter (PGL), *Variance from Vegetation Standards for Levees and Floodwalls* (February 9, 2010). Congress, through the Water Resources Development Act of 1996, Section 202 (g), had mandated that USACE "address regional variations in levee management and resource needs" – but the February 2010 draft PGL did not address regional variations. Before and following release of the draft PGL, DWR has repeatedly encouraged USACE to collaborate in the formulation of a variance process that is workable on a systemwide scale, and allows for consideration of the geotechnical, hydraulic, environmental, and economic factors that DWR believes are important in formulating and prioritizing levee repairs and improvements.

Because the February 2010 draft PGL was not workable from DWR's perspective, in May 2010, DWR proposed an alternative variance procedure for USACE consideration. Although the USACE has not accepted DWR's proposal to collaboratively develop a variance policy that recognizes and accommodates regional differences, DWR remains hopeful

that USACE will issue a final vegetation variance PGL which will complement and be consistent with the CVFPP.

A further complication is the question of shared responsibility for activities to address woody vegetation. The USACE ETL and associated draft PGL fail to recognize that legacy vegetation exists for a wide variety of reasons (in many cases because USACE itself placed it or encouraged its placement or retention), and instead treats all legacy vegetation as if it were "deferred maintenance" and solely a non-federal responsibility. Consequently, USACE asserts through the ETL and draft PGL that all of the administrative and financial burdens for ETL compliance, or for obtaining a variance, should be placed on its non-federal partners. The State encourages USACE to accept shared responsibility for addressing levee vegetation issues as appropriate – which would also facilitate USACE plan formulation as a partner in cost-shared flood risk reduction projects.

It is important to note that DWR's purpose in advocating for shared responsibility is not to commit federal funds toward the enormous cost of removing vegetation to achieve ETL compliance. Rather, DWR is advocating that such inordinate costs be avoided by having USACE participate with DWR as true partners in addressing legacy levee vegetation issues, jointly considering the environmental and risk reduction implications of vegetation remediation within the context of prudent expenditure of limited public funds. DWR will continue dialog with USACE on plan formulation concepts that recognize shared responsibility for addressing vegetation issues (in parallel with traditional levee risk factors) within a systemwide risk-informed context that is intended to enable critical cost-shared flood system improvements to move forward.

5.5 Environmental Improvement Projects

The State is making a variety of physical improvements in the flood system and is working to integrate ecological benefits into those improvements. In addition, the State has funding to strategically initiate new restoration projects, collaborating and cost-sharing with others.

The State has developed draft guidelines for allocating available funding to projects that meet the intent of the Conservation Framework, and anticipates the first cycle of projects will be funded during 2012. The funding allocated to capital projects is targeted at two distinct purposes: (1) to acquire, protect, or restore properties that would provide advance mitigation solutions for activities undertaken for SPFC facilities, and (2) and to implement projects that incorporate environmental stewardship and sustainability principles into flood management activities. Projects that

meet the intent of the Conservation Framework will be evaluated and funded, in accordance with the State's guidelines, based on the significance (size and connectivity) of ecological improvements, technical and political feasibility, and cost reasonableness/cost-sharing opportunity. Identifying multi-benefit projects that can be supported by diverse interests is an important overall goal.

5.6 Regional Conservation Planning

To provide faster and better delivery of flood management projects, DWR is considering regional planning options, including regional flood management planning; collaborating with other regional conservation plans; developing regional permits and plans (such as NCCPs, HCPs, programmatic ESA Section 7 consultations, or Regional General Permits); CMS; regional vegetation management planning; watershed planning; and RAMP. More detailed descriptions of RAMP and other regional permitting efforts and plans are located in Attachment 9A: Regional Advance Mitigation Planning, Attachment 9E: Existing Conservation Objectives from Other Plans, and Attachment 9G: Regional Permitting Options.

Because of the degraded status of riverine and floodplain ecosystems in the Systemwide Planning Area, attaining the ecological goals of this Conservation Framework depends in part on restoring riverine and floodplain functions. Consequently, the CVFPP includes management actions related to restoring ecosystems, and in particular to restoring physical processes that sustain riverine and floodplain habitats. Future CVFPP regional flood management planning will need to address ecosystem restoration opportunities.

5.6.1 Floodplain Restoration Opportunity Analysis

The State has conducted an initial analysis of potential restoration opportunity areas (see Attachment 9F: Floodplain Restoration Opportunity Analysis) to help guide restoration actions. This analysis identifies areas where floodplain functions could be restored within the Systemwide Planning Area by considering physical suitability; opportunities and constraints related to existing land cover and land uses, road and railroad locations, and conservation status of land; and locations that stakeholders are interested in restoring. Physical suitability was evaluated using the concept of floodplain inundation potential. This analysis identifies floodplain areas, both directly connected to the river and disconnected from the river (e.g., behind natural or built levees or other flow obstructions) that could be inundated by biologicially meaningful floodplain flows.

This type of analysis will continue to be improved to evaluate restoration opportunities based on their potential ecological, flood management, and other benefits (e.g., reduced maintenance); potential effects on other species; cost; and regulatory, institutional, technological, and operational feasibility.

5.6.2 Collaborating with Existing Regional Conservation Plans

Implementation of the Conservation Strategy will occur in an environment with many other ongoing overlapping conservation efforts. The State is already conducting regional planning in coordination with other public agencies and ongoing collaborative efforts. This collaboration will continue for areas of common interest and on projects with mutual objectives. DWR needs to communicate with planners of these other efforts to identify common goals, assess opportunities to work together and reduce unintentional conflicts, and seek ways to collaborate and share funding on projects of common interest.

Existing regional conservation plans are generally NCCPs, HCPs, and species recovery plans. More than 30 plans have been identified to date, and are detailed in Attachment 9E: Existing Conservations Objectives from Other Plans; examples are as follows:

- **Yolo County Natural Heritage Program** – The Yolo County Natural Heritage Program is a comprehensive, county-wide plan designed for long-term conservation and management of sensitive and at-risk species and the habitats on which they depend, while accommodating other important uses of the land. The plan serves as an HCP and NCCP; the plan area includes 653,820 acres (Yolo County HCP/NCCP Joint Powers Agency et al., 2004).

- **San Joaquin County Multi-Species Habitat Conservation Plan and Open Space Plan (OSP)** – The goal of the HCP/OSP is to create 100,841 acres of preserves, predominantly located on productive agricultural lands throughout the county. The HCP/OSP requires that 600 acres of preserves be established to offset incidental take or accidental loss on neighboring lands of limited numbers of California tiger salamander (*Ambystoma californiense*), red-legged frog (*Rana draytonii*), valley elderberry longhorn beetle, giant garter snake, western pond turtle (*Actinemys marmorata*), northern harrier (*Circus cyaneus*), and California horned lark (*Eremophila alpestris acti*) (San Joaquin Council of Governments, 2000).

- **Bay-Delta Conservation Plan** – The “overarching goals of the BDCP are to advance the restoration of the ecological functions and

productivity in the Delta and improve the reliability of water supplies provided by the SWP and the CVP…" (BDCP 2010). The plan's list of proposed covered species includes 5 species of anadromous salmonids (Central Valley steelhead; Sacramento River winter-run Chinook salmon; and Central Valley spring-, fall-, and late fall-run Chinook salmon); 5 other fish species, such as delta smelt and North American green sturgeon (*Acipenser medirostris*); 6 species of mammals, including the San Joaquin kit fox (*Vulpes macrotis mutic*) and the riparian woodrat (*Neotoma fucipes riparia*); 12 bird species; and 5 species of reptiles and amphibians (BDCP, 2010).

Many of these regional conservation plans are still in progress, potentially allowing for cross-plan collaboration during development.

There are also opportunities to collaborate with regional recreational planning efforts such as the San Joaquin Blueway Vision, California State Parks' Central Valley Vision, and California State Parks' Recreation Proposal for the Sacramento and Joaquin Delta and Suisun Marsh.

The Corridor Management Strategy process involves developing a vision, strategy, and plan (Corridor Management Plan) for managing a corridor that integrates flood risk management, improved ecosystem function and integrated water management over a long-term (greater than 30 years) planning horizon.

5.6.3 Corridor Management Strategy

Implementation of integrated flood management can be effectively accomplished at the corridor scale, where participants can more readily interact, understand different perspectives, and work on a series of individual projects that collectively contribute to a broad set of goals and find ways to integrate, to the extent possible, multi-sector interests.

The CMS process involves developing a vision, strategy, and plan (CMP) for managing a corridor that integrates flood risk management, improved ecosystem function and integrated water management over a long-term (greater than 30 years) planning horizon. A CMP includes a strategy for managing flood protection facilities, conveyance channels, floodplains, and associated uplands; a maintenance plan; a restoration plan; and identifies policies for compatible land uses such as agriculture and recreation within the corridor. In addition to addressing habitat restoration and flood facility maintenance, CMPs are a foundation for securing programmatic regulatory agency approvals for ongoing maintenance activities and habitat restoration. CMPs rely on coordination, collaboration, and cooperative working relationships with interested parties and stakeholders, including State, federal, and local agencies, NGOs, maintenance districts, agricultural interests, and landowners. The State has initiated development of a CMP on a 20-mile long reach of the lower Feather River (from Yuba City to the Sutter Bypass). The CMP process will be a key method for working with

local stakeholders including agricultural communities in a coordinated approach to implementing the Conservation Strategy.

CMP development involves assessing the current biological and physical conditions of the proposed management plan coverage area. This may include reviewing existing reports, maps, and aerial photography, hydraulic modeling, and reconnaissance-level biological resources surveys. The information collected is used to create a mapped inventory of existing vegetation, hydrology, land uses, public land ownership and other relevant resource information. This baseline information is then used to identify localized facility maintenance needs, assess the probability of occurrence of special-status plants, fish, terrestrial wildlife and habitats, and identify restoration opportunities in the study area. Additional hydraulic modeling is often necessary to determine channel conveyance and sediment transport patterns, hydraulic impacts, channel and flow constrictions; and to identify opportunities to improve capacity and transitory storage in the system through the construction of setback levees, sediment removal, or other methods.

An inclusive planning process engages stakeholders, regulatory agency staff, and other interested parties early to identify goals and objectives, and facilitate development of a comprehensive and coordinated CMP. Under this framework, flood management agencies, maintenance districts, and resource and regulatory agencies participate in the project design process. Collaborating with biologists, hydrologists, and hydraulic modelers, the planning team can determine an appropriate spatial arrangement of habitat types to be created and restored within a corridor in a manner that meets flood conveyance needs; considers adjacent land uses, hydraulic, hydrologic, regulatory and other constraints; minimizes ongoing maintenance needs; and maximizes habitat values.

By addressing what are often competing resource issues and stakeholder concerns on a regional basis, CMPs help meet regulatory mandates requiring maximum avoidance and minimization of project effects to sensitive resources. Additionally, CMPs may identify target areas for providing onsite compensatory mitigation for unavoidable impacts to sensitive resources such as wetlands and State-listed and federally listed species. CMPs thereby set the stage for programmatic approvals by State, federal, and local agencies, and provide the foundation for integrated, streamlined permitting processes.

CMP strategies are means of restructuring existing flood management practices and policies implemented within a given management area to benefit and enhance the environment without compromising actions required by practices and policies. CMPs effectively support the objectives

of the CVFPP in establishing an integrated management plan to reduce flood risk, improve ecosystem function, and create a more sustainable flood management system that allows for ongoing O&M of flood management facilities.

5.6.4 Regional Permitting

As described in Section 1, Introduction, the State is pursuing a new approach to go beyond traditional compensatory mitigation, with a goal of improving ecological conditions and trends. Within the realm of regulatory permitting; however, the State will take advantage of new strategies that improve the efficiency and effectiveness of permitting and associated conservation.

Traditional project-by-project environmental permitting has resulted in several shortcomings, both for project proponents and conservation interests. These shortcomings can include time-consuming negotiations for each project to identify, where required, suitable offsite mitigation areas as compensation for habitat losses, project delays, establishment of small, isolated restoration areas that are difficult to manage, and temporary losses in habitat while compensation sites are restored.

Several new regional permitting methods have been developed in the past 20 years to solve these permitting and conservation challenges, and local governments in California have been using these approaches to both permit land development and maintain healthy ecosystems. These methods include regional HCPs, NCCPs, programmatic ESA Section 7 consultations, and Regional General Permits. New methods are under development, including CMS (see Section 5.6.3) and RAMP (see Section 5.6.5).

Regional permitting methods are being used, or can be used, to collectively meet permitting needs for multiple projects, over longer planning horizons, while also consolidating mitigation and conservation efforts into larger, more viable conservation areas. Attachment 9G: Regional Permitting Options, provides more detailed information about the following:

- Types of flood management activities that could potentially be covered under regional permitting
- Description and evaluation of several options for developing regional permits for the flood management system
- Summary of other important environmental regulations that apply to flood management projects

The State still needs to evaluate how existing regional conservation plans can help meet its flood management permitting needs and to identify suitable tools that can be used where no efforts are ongoing. Several conservation planning efforts that overlap with the CVFPP Statewide Planning Area are listed in Attachment 9E: Existing Conservation Objectives from Other Plans.

5.6.5 Regional Advance Mitigation Planning

RAMP (see Attachment 9A: Regional Advance Mitigation Planning) has been in preparation by a multiagency work group since 2008. RAMP is focused on developing mitigation processes that integrate project-specific mitigation with regional and statewide conservation priorities, and that offset unavoidable impacts of planned infrastructure projects before the prospects are constructed. To develop advance mitigation in the Systemwide Planning Area, the State would work with regulatory agencies to estimate the range of mitigation needs early in the timelines of multiple projects. This process minimizes permitting and regulatory delays and reduces mitigation costs by securing and conserving valuable natural resources at an economically efficient scale and before potential mitigation lands are converted to incompatible land uses. Having RAMP-sponsored mitigation sites in strategic locations throughout the Systemwide Planning Area could speed approvals for the State's infrastructure agencies when the agencies seek permits for "take" of endangered species, fill of wetlands, or disturbance to streambeds and their banks. Adopting a strategic, forward-looking, and regional approach, in which natural resources agencies are encouraged to identify mitigation needs early, can provide a vehicle for identifying solutions that address conservation priorities in ways that are coordinated and take into account agricultural communities and land uses.

RAMP Work Group has identified the following benefits that could result from implementing a RAMP program, a more detailed description of these potential benefits can be found in Attachment 9A: Regional Advance Mitigation Planning:

- Lower mitigation costs and simplified permitting for the infrastructure funding agency
- Fewer permitting or regulatory delays resulting from the need to find mitigation solutions
- Greater ecological and financial predictability
- Mitigation site planning, management, and monitoring efficiencies

- The ability to focus on large-scale conservation to benefit sensitive species through higher quality habitat, improved connectivity between habitat areas, and better long-term protection

- The ability to leverage and assist ongoing conservation efforts

The RAMP Work Group has developed a Statewide Framework document (2011a) that describes the goals, benefits, and operational framework of a statewide RAMP initiative. This group is also working on other documents, including a Regional Assessment that includes a preliminary test of RAMP for a pilot region in the Sacramento Valley and a RAMP Manual, which will serve as a comprehensive guidance document for planning and implementing regional advance mitigation throughout California. The RAMP Manual will incorporate lessons learned during development and completion of the Regional Assessment. More information about RAMP can be found in Attachment 9A: Regional Advance Mitigation Planning and at the RAMP Work Group Web site, https://rampcalifornia.water.ca.gov (2011b).

Riparian brush rabbit (Sylvilagus bachmani riparius)

5.6.6 Targeted Conservation Planning

This Conservation Framework focuses on restoring ecosystem processes as a primary strategy for restoring habitat and populations of species at risk. In many cases, this strategy will cover the important conservation needs of many species, particularly those that rely on the condition, structure, and function of single habitats. For some species at risk, however, an ecosystem process or single-habitat focus alone does not adequately address important conservation needs. For these species, more targeted species-focused conservation planning can be useful, particularly where no recovery plans exist. Such planning can more systematically and efficiently address species conservation needs and demonstrate how individual flood projects can incrementally contribute to species recovery.

These more targeted species-focused conservation plans can help develop and maintain partnerships among flood managers, State and federal fish and wildlife agencies, NGOs, agricultural interests, and the general public. These plans can also provide a solid foundation for long-term regulatory authorizations under State and federal endangered species laws for the operation of the flood system by providing information about:

- Critical life history elements and sensitivities
- Distribution, both rangewide and within Central Valley flood management system
- Status and trends historical, current, and future expectations
- Conservation goals and measurable objectives
- Strategic conservation and restoration opportunities

Examples of species in the Central Valley that are suitable for this more targeted conservation planning include the following:

- Swainson's hawk
- Giant garter snake
- Greater sandhill crane
- Tricolored blackbird (*Agelaius tricolor*)
- Bank swallow (*Riparia riparia*)
- Riparian brush rabbit

Such plans will be developed as opportunities arise to work collaboratively with wildlife agencies on species of common priority. DWR will also collaborate with resource agencies to implement existing recovery plans (such as NMFS Central Valley Anadromous Fish Recovery Plan) within the flood management system.

5.7 Science and Conservation Planning Information

Attaining this Conservation Framework's ecological goals requires a large number of science-based decisions during development of policies and capital projects, and during conservation planning. The State will inform those decisions with several types of scientific and technical activities:

- **Inventory** – Data on existing conditions are integral to implementing the Conservation Framework and avoiding and minimizing impacts, and are basis in part for modeling and other analyses, and for identifying potential conservation areas. Conservation-related

inventories include mapping resources and other documentation of existing physical and biological conditions. Inventorying can also entail compiling information on infrastructure (e.g., permitted flow capacity of water diversions in the Systemwide Planning Area).

- **Analyze and model** – Estimates and simulations of existing and future ecosystem conditions and of the consequences of alternative actions are integral to the processes of project design, policy evaluation, alternatives analysis, and conservation planning. Conservation-related analyses and modeling include actions as varied as estimating the regional demand for mitigation land to support RAMP; evaluating existing hydrology data to better understand ecosystem status and trends; hydraulic modeling to identify potential ecological benefits and impacts of proposed flood management actions; and formulating conceptual models to create a framework for communication.

Fish sampling along the Sacramento River

- **Monitor** – Documentation of actions and ecosystem conditions is required to comply with terms and conditions of permits, necessary to determine the effectiveness of actions, and integral to adaptive management. Conservation-related monitoring ranges from documenting actions to monitoring ecological indicators of overall success of the Conservation Strategy.

- **Conduct management-oriented research** – Reducing key uncertainties can substantially improve the scientific basis and effectiveness of flood management and conservation-specific policies, projects, and planning efforts. Generally, management-oriented research is related to uncertainties affecting a policy or multiple projects and planning efforts (e.g., vegetation benefits to levee stability or management effects on species that are conservation targets). Management-oriented research often can consist of analyses based on inventory or monitoring actions that also serve other purposes.

- **Manage and access information** – Results of inventories, analyses, and modeling, monitoring, and management-oriented research are often broadly applicable to flood management and conservation-specific actions within the Systemwide Planning Area. Thus, the management and distribution of this information improves the scientific and technical basis of flood management and conservation-specific

decisions, and is a primary means of scientific and technical collaboration with other conservation efforts. Information management and access entails developing documentation and tools for archiving and disseminating information (e.g., databases, Web sites).

During development of the 2012 CVFPP and this Conservation Framework, conservation science and planning activities have included medium and fine-scale mapping of vegetation, evaluation of ecosystem status and trends, and the FROA. Specific future needs for conservation science and planning information are being identified and will be met in collaboration with others during development and implementation of policies related to conservation, capital projects, and development of the 2017 Conservation Strategy.

5.8 Adaptive Management

The Central Valley flood management system is complex and dynamic, and the State must balance multiple competing objectives to improve the status and trends of biological resources within the system. These trends will unfold over decades, and understanding of the complexities of the system will change during that period. A robust and scientifically sound adaptive management program must be in place for future projects to achieve their stated goals. Adaptive management is a systematic and iterative process that generates feedback between monitoring and management actions. The feedback mechanism is engaged when monitoring data are analyzed and results are used to adjust project management, or future project design, in a manner that optimizes achieving project goals. Adaptive management employs a structured approach, yet it is also a flexible tool that can adjust to a dynamic environment and evolving projects. Adaptive management can thereby keep a project “on track” toward meeting its goals and objectives, despite the variability inherent in dynamic, natural systems over varying spatial and temporal scales.

The State is committed to using an adaptive management approach in its Conservation Strategy. Two key elements of an adaptive management program to be developed include (1) a description of the organizational structure for the participants to implement the adaptive management process, and (2) a conceptual model of the adaptive management process itself.

The State anticipates developing an organizational structure that allows for input from technical representatives of various interests, including agricultural and environmental interests, and regulatory and resource agencies. Once an organizational structure is in place, an adaptive

management program will develop the initial monitoring activities proposed to evaluate project progress toward meeting goals and objectives. It is therefore important to also develop conceptual models of the biological systems in question so that ecosystem functions can be linked to quantitative monitoring elements. The program must then establish the triggers (or thresholds) that would initiate a management response and describe the range of potential adaptive management actions. Management triggers define the specific point, or a range of values, where monitoring data indicate that a project may be developing along an unexpected or unfavorable trajectory, and where management actions may be necessary so that the project meets habitat and regulatory performance goals.

Once project monitoring determines that a management trigger has been "activated," there are three possible response pathways:

1. Determine that more data are required and continue (or modify) monitoring.

2. Identify and implement a remedial action.

3. Modify project goals and objectives (this option would only be considered as a last resort and after careful consideration).

Multiple possible management actions may activate a particular trigger, depending on a variety of factors such as how far the project is from achieving a specific goal, or whether the situation is an imminent threat to local infrastructure, ecosystem services/functions, or site stability, etc. Adaptive management is flexible because it allows a wide range of management actions but, just as importantly, it imposes a structured process because management actions must derive from monitoring results. This process is shown on Figure 5-3.

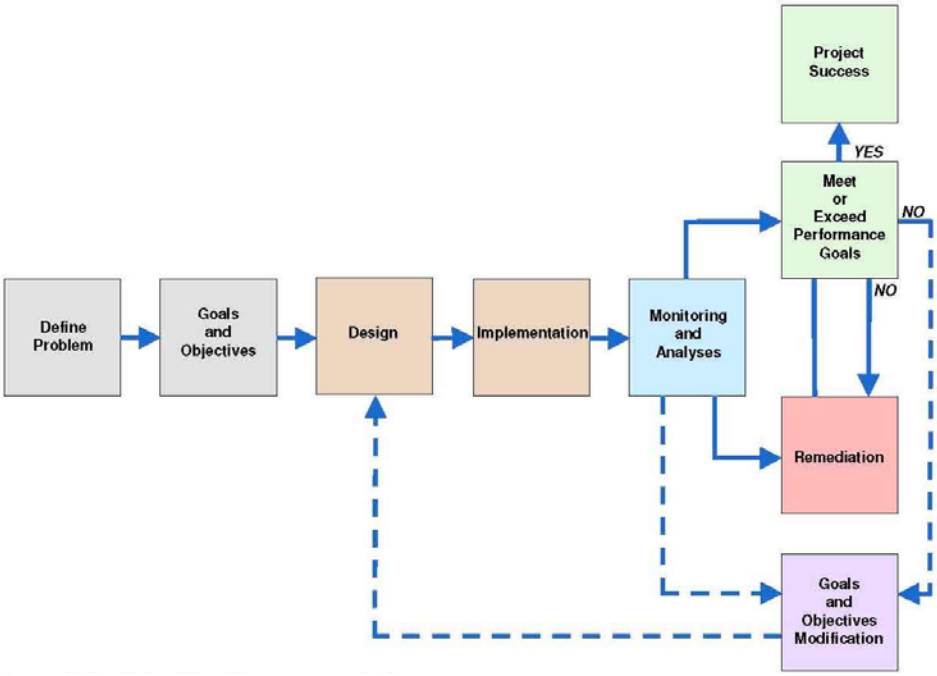


Figure 5-3. Adaptive Management Process

Technical expertise is critical to understanding potential linkages between goals and proposed actions. Therefore, DWR will identify a lead scientist who can identify and prioritize technical issues and develop an outside technical review team for peer review of methods, data, and interpretation and application of results. Applying scientific rigor to adaptive management will be critical for the long-term success, and political and public support, of any proposed projects.

Adaptive management is a simple and logical process, but often difficult to implement. One of the most challenging aspects of developing an adaptive management program is defining the problem. This includes not only technical details of the problem, but also the temporal and geographic scale. A good adaptive management program will clearly state goals and objectives that are linked to performance criteria. However, setting thresholds and triggers for specific future management actions can often be difficult and controversial. Common technical questions include verifying adequacy of baseline information and/or reference sites to make meaningful comparisons; establishing the structure and time frame for decisions based on monitoring results; adequately managing data to handle the amount generated from multiple projects over many years; and confirming the willingness of stakeholders to be flexible in light of new information.

Given the complexity and depth of issues facing the State, adaptive management is a powerful tool to efficiently and effectively communicate

the trajectory of the CVFPP and the natural resources it affects and, ultimately, result in successful flood management and ecosystem restoration projects.

5.9 Outreach, Engagement, and Education

Leading up to the 2017 CVFPP, DWR will refine the CVFPP and develop the associated Conservation Strategy. This process is described more fully in Chapter 4.4 of the CVFPP and in Section 7, Next Steps, below.

Achieving CVFPP goals will require public support and effective partnerships. To facilitate constructive exchanges and garner support, the State will pursue multiple approaches to engage a variety of interests in developing and updating the Conservation Strategy. Outreach and engagement will incorporate input from the public, agricultural and conservation communities, maintaining agencies, and regulatory and resource agencies. Educational programs will be built on components of the State's existing science education framework. The State is interested in coordinating and forming partnerships with the agricultural community, consistent with many of the findings of the Agricultural Stewardship Scope Definition Subcommittee.

Public outreach and engagement for the Conservation Strategy is aligned, in a parallel structure, to the five planning areas within the Systemwide Planning Area, with a designated individual assigned to public meetings and workshops for each planning area. This individual is the point of contact for the public and coordinates outreach activities within a planning area. The State will develop a Conservation Strategy Web site, educational materials, presentations, and workshops as part of public outreach and engagement. In addition, an effort will be made to engage agricultural communities in developing the Conservation Strategy.

To promote a strong working relationship with resource and regulatory agencies, DWR has established an Interagency Advisory Committee to provide guidance on development and content of the Conservation Strategy and associated environmental regulatory compliance. Participants currently include the Board, USACE, USFWS, DFG, NMFS, and SWRCB. A parallel effort will be formulated to engage agricultural and conservation communities with a strong interest in the future of the Central Valley's flood management system. DWR will use the committee to accomplish the following:

- Solicit advice on policy and technical conservation topics.

- Identify critical issues and discuss options for resolving these issues.
- Identify key opportunities for collaboration with other programs and efforts
- Expand partnerships for improving conservation in the Central Valley flood management system.

A parallel effort will be formulated to engage agricultural, rural and conservation groups, and local governments with a strong interest in the future of the Central Valley's flood management system in the development of the Conservation Strategy. Outreach on RAMP is being coordinated by the RAMP Work Group.

To help achieve the State's goals for improving educational materials about flood system conservation, DWR is working with the San Joaquin County Office of Science and Special Projects and Project Water Education for Teachers to organize a Floodplain and Delta Ecology Teacher Institute. This effort is designed to create meaningful activities for the classroom and interactive content learning for fourth- through eighth-grade teachers focused around the ecological significance of the Delta and Central Valley floodplains. The model framework created for the Floodplain and Delta Ecology Teacher Institute is adaptable and can be easily expanded to address more grade levels, and more teachers, and include more comprehensive information about the CVFPP and Conservation Strategy.

6.0 Indicators of Success

Progress toward the ecological and planning goals of this Conservation Framework can be measured using several types of indicators. In general, indicators should be readily understandable, quantifiable, possible, and affordable. The indicators should be able to be repeated to show trends, and should be sensitive to management actions. Furthermore, for a long-term program, they should yield useful information despite the major ecological, institutional, scientific, and technological changes that are likely during long time spans.

The following two sections discuss potential indicators for the Conservation Framework ecological and planning goals, respectively. The process to develop the 2017 Conservation Strategy will identify a more refined set of indicators of conservation-related progress. In the interim, the State is committed to developing baseline information that will be used to develop and track possible ways that progress toward achieving conservation goals can be measured, as detailed below.

6.1 Ecological Indicators

Improvements in ecological conditions and trends need to be monitored for ecosystem processes, habitats, and species. Monitoring needs to be capable of indicating changes at the project, reach, and systemwide geographic scales. Information related to the following potential indicators will be developed at multiple geographic scales, and individual projects can use these indicators to measure their contribution to systemwide improvements. Possible metrics include the following:

Bank Swallows (Riparia riparia)

- **Ecosystem Processes**
  - **River meandering (sinuosity)** – Meander migration is a key process for many important ecosystem functions, including riparian vegetation establishment, floodplain creation, habitat creation (e.g., bank erosion for swallow habitat), and creation of off-channel habitats (e.g., oxbow lakes, side channels, sloughs) by progressive migration and cutoff processes. Possible metrics include the following:

    - Number of unnatural hard points within and along channels (over time, the goal would be a reduction in riprap and other channel-controlling features along a river)
    - River overall length and length of river with natural floodplain disturbance patterns
    - Channel depth, width, and slope by reach
    - Area of floodplain reworked through sediment erosion, transport, and deposition
    - Point bar characteristics, such as area, slope, and texture
  - **Floodplain activation flows**
    - Timing, depth, duration, and extent of flooding that activates ecological processes (such as germination and aquatic food web production)
- **Habitat**
  - **Habitat connectivity**
    - Extent of floodplain subject to regular flooding (floodplain-to-river connectivity)
    - Landscape-level habitat fragmentation and connectivity indices (connectivity between patches of same habitat type, connectivity among habitat types)
    - Number and influence of fish passage barriers
  - **Habitat quantity** (extent and distribution) and diversity
    - Total extent and distribution of natural habitat and agricultural lands that provide important wildlife values
    - Total extent and distribution of riparian habitat in diverse age classes
    - Total extent and distribution of major habitat types (including SRA, riparian forest, wetlands, spawning gravels, eroding banks, and floodplain fish-rearing habitat)
  - **Habitat quality**

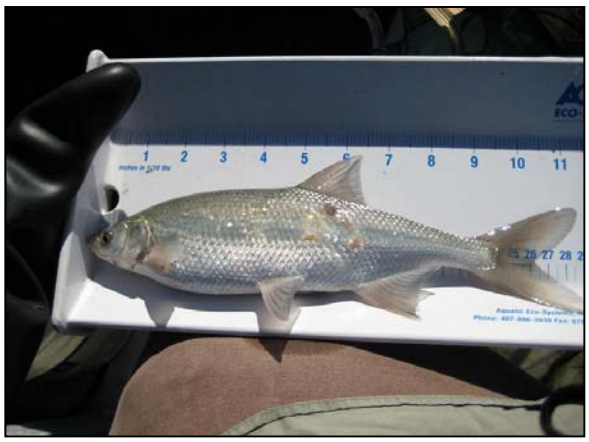
- Extent of habitats with invasive plant or animal species (over time, the goal would be a reduction in invasive species)
- Abundance and use by species that are sensitive to changes in habitat quality

Riparian vegetation monitoring

- **Species**
  - Abundance, diversity, and distribution of species that are sensitive to flood system management actions
  - Incidences of fish stranding at or associated with flood control facilities

6.2 Planning Indicators

In addition to ecological indicators, organizational and institutional indicators are also necessary to assess the success of the CVFPP Conservation Framework and Conservation Strategy. Success will therefore be determined not only by the ecological benefits, but also by the changes to the way the State carries out its mission. Successful conservation depends on such features as strong collaborative partnerships, broad support, strategic planning, and high-quality information. Progress in developing and maintaining these key features could be measured by the following:


Hitch (*Lavinia exilicauda*) measured during DWR monitoring at levee repair sites along the Sacramento River

- **Collaborative partnerships and broad support**
  - Portion of rivers within the Systemwide Planning Area covered by CMPs
  - Number of projects being collaboratively developed with existing NCCPs, recovery planning, joint ventures, or other conservation planning efforts
  - Support among flood managers, regulatory agencies, agricultural interests and environmental NGOs for multi-benefit flood projects

- **High quality information**
  - Portion of Systemwide Planning Area with fine-scale, high-quality vegetation mapping and high-quality data set of sensitive species locations (the results of the recently conducted medium-scale vegetation mapping effort are presented in Attachment 9D: Improving Vegetation Data).
  - Number and quality of broadly supported conceptual ecological models for priority habitats and species
- **Strategic planning**
  - Number of RAMP projects that have been approved by the Mitigation Banking Interagency Review Team and are available for transferring habitat credits for flood projects
  - Number of integrated flood projects that expand flood capacity in specific river corridors and systemwide, and that contribute to the above ecological goals
  - Average time required per flood project for environmental approval
  - Cost reductions for O&M and repair in flood areas (e.g., levee reaches, bypasses, channels)

The above indicators are likely examples of indicators that would be tracked to demonstrate a trajectory of increasing ecological values and institutional progress. Specific elements may be eliminated or added per the needs and goals of a specific project. DWR will establish a database to receive and track data from individual projects. These data will help demonstrate cumulative progress. While no specific targets are given for individual monitoring elements, each project must maximize these improvements in these indictors (or justify their exclusion), and show an overall trajectory toward achieving CVFPP goals.

6.3 Indicators from CVFPP Scope Definition Work Groups

As mentioned in Section 1.4, DWR convened several groups of stakeholders early in the CVFPP planning process to identify the potential scope for the 2012 CVFPP. As part of their summary reports, the ESSDWG and the Agricultural Stewardship Scope Definition Joint

Subcommittee recommended indicators for use in evaluating the success of integrating environmental and agricultural issues into the CVFPP.

Recommended indicators from the ESSDWG (DWR, 2009) for successful integration of environmental stewardship into the CVFPP are shown in Table 6-1. These indicators show a range of potential content for defining successful, partially successful, and no integration with 12 key attributes (i.e., key features) related to environmental stewardship.

The Agricultural Stewardship Scope Definition Joint Subcommittee provided a similar set of indicators to evaluate successful integration of agricultural issues into the CVFFP (DWR, 2010). While these indicators are most appropriately addressed within the CVFPP, they are important reference points for developing a holistic approach that acknowledges the importance of rural areas to integration of conservation and flood management.

Table 6-1. Environmental Stewardship Scope Definition Indicators of Successful Integration of Environmental Stewardship into CVFPP

Key Action Measured	Description	Evaluating Content Quality		
		Successful Integration	Partially Successful Integration	Not Successful Integration
Identify and Describe Existing Conditions for Processes and Habitat	Identify, describe, and quantify (1) physical and ecological processes, and (2) key species and their habitat that are affected by the flood management system in the Sacramento-San Joaquin valleys and Delta.	The plan identifies and describes important physical and ecological processes, habitats and key species and their relationship to the flood management system. It describes cause-and-effect conceptual relationships for many species and ecosystems, and provides GIS-based maps to identify where the processes, species, and habitats are affected by the flood management system.	The plan identifies and describes important physical and ecological processes, habitats, and key species and their relationship to the flood management system. The plan inadequately describes cause-and-effect conceptual relationships. GIS-based maps are not included, or are insufficient.	The plan does not identify or describe important physical and ecological processes, habitats, and key species.
Build on Existing Data and Lessons Learned	Identify and build on previous conservation planning efforts in the Sacramento-San Joaquin valleys and Delta (both written and GIS-based datasets), incorporate lessons learned, and avoid duplicate efforts.	The plan provides a comprehensive summary of other relevant large-scale conservation planning efforts, including a description of key lessons learned by each effort). The plan builds on these efforts and incorporates lessons learned.	The plan provides a comprehensive summary of other relevant large-scale conservation planning efforts, but does not incorporate the lessons learned from these efforts.	The plan does not make an attempt to build on other relevant conservation planning efforts.

Table 6-1. Environmental Stewardship Scope Definition Indicators of Successful Integration of Environmental Stewardship into CVFPP (contd.)

Key Action Measured	Description	Evaluating Content Quality		
		Successful Integration	Partially Successful Integration	Not Successful Integration
Identify Key Data Gaps, Assumptions, and Areas of Uncertainty	Identify key data gaps, assumptions, and areas of uncertainty affecting integration of environmental stewardship into the 2012 CVFPP, and recommend a stepwise approach to the development or refinement of additional models, data, tools, and other resources that could enhance future integration of environmental stewardship into the flood management planning process.	The plan identifies a comprehensive set of key data gaps, assumptions, and areas of uncertainty, and provides recommendations, including specific steps to take, for closing each data gap, validating assumptions, and reducing uncertainty.	The plan identifies key data gaps, assumptions, and areas of uncertainty, but it does not provide recommendations to close these gaps.	The plan does not identify any data gaps, assumptions, and areas of uncertainty and/or recommendations for closing data gaps.
Rehabilitate and Sustain Physical and Ecological Processes	Develop SMART[1] objectives and management actions to rehabilitate and sustain key physical processes and ecological functions, including (1) floodwater conveyance, groundwater recharge, and other hydrologic functions; (2) sediment transport and retention and geomorphic processes, including channel meander; (3) nutrient cycling, and the retention, removal, and degradation of pollutants; and (4) growth, reproduction, and dispersal of terrestrial and aquatic organisms.	The plan contains SMART objectives and management actions that will enhance and sustain (in the context of climate change) each of the listed set of functions.	The plan contains SMART objectives and management actions that will enhance and sustain (in the context of climate change) some of the listed functions.	The plan does not contain SMART objectives and management actions that will enhance and sustain any of the listed functions.

Table 6-1. Environmental Stewardship Scope Definition Indicators of Successful Integration of Environmental Stewardship into CVFPP (contd.)

Key Action Measured	Description	Evaluating Content Quality		
		Successful Integration	Partially Successful Integration	Not Successful Integration
Restore and Enhance Aquatic, Wetland, and Riparian Ecosystems	Develop SMART objectives and management actions to increase and improve the (1) quantity, (2) diversity, and (3) connectivity of (A) riparian, (B) wetland, (C) shallow floodplain, and (D) shaded riverine aquatic habitats within the flood management system, linking these objectives and management actions to key species identified in No. 1 and processes identified in No. 4. Provide GIS maps depicting potential locations for restoration.	The plan contains SMART objectives and management actions that will result in a net increase in the three listed attributes for each of the four listed ecosystems and provides a GIS map to depict potential locations for restoration. The objectives and management actions for habitat improvements are linked to key species and their habitat requirements.	The plan contains SMART objectives and management actions for some of the attributes for some of the communities. OR, the plan contains objectives and management actions for all of the attributes and communities, but the objectives and management actions are not tied to key species habitat requirements.	The plan does not contain SMART objectives and management actions that will result in a net increase in and/or improved habitat conditions.
Reduce Conflicts Between Flood Conveyance and Other Ecosystem Functions and Values	Identify existing or potential conflicts between flood conveyance and other functions and values, including (1) water supply, (2) fish and wildlife habitat, (3) recreation, (4) agriculture, and (5) cultural heritage sites and provide solution sets to reduce the conflicts.	The plan identifies conflicts between flood conveyance and each of the five listed functions and values, and includes actions to reduce identified conflicts with each of the five listed functions and values.	The plan includes actions to reduce conflicts for some listed functions and values.	The plan does not include actions to reduce conflicts for any of the listed functions and values in the plan.

Table 6-1. Environmental Stewardship Scope Definition Indicators of Successful Integration of Environmental Stewardship into CVFPP (contd.)

Key Action Measured	Description	Evaluating Content Quality		
		Successful Integration	Partially Successful Integration	Not Successful Integration
Support the Recovery of Threatened and Endangered Species	Describe actions that support the recovery of threatened and endangered species associated with the flood management system.	The plan includes actions that contribute to the recovery of all sensitive, threatened, and endangered species associated with the flood management system.	The plan includes actions that contribute to the recovery of some threatened and endangered species associated with the flood management system.	The plan does not include actions that contribute to recovery of threatened and endangered species associated with the flood management system.
Encourage Compatible Multiple Uses of Flood Management System	Describe actions that encourage compatible multiple uses of the flood management system, including (1) public education, (2) public access, (3) recreation, and (4) Native American communal activities in the flood management system.	The plan includes actions that address all four of these uses.	The plan includes actions that address one to three of these uses.	The plan does not include actions that address any of these uses.
Control and Reduce Invasive Species	Describe comprehensive guidance, including management actions to (1) discourage the establishment of new invasive species, (2) prevent the spread of existing infestations, and (3) reduce the extent of existing infestations within the flood management system.	The plan includes management actions that address all three of these invasive species issues for all of the major invasive species in the flood management system.	The plan includes management actions that only partially address all three of these invasive species issues; or only addresses them for a small set of invasive species.	The plan does not address any of these three issues.

Table 6-1. Environmental Stewardship Scope Definition Indicators of Successful Integration of Environmental Stewardship into CVFPP (contd.)

Key Action Measured	Description	Evaluating Content Quality		
		Successful Integration	Partially Successful Integration	Not Successful Integration
Support the Conservation of Agricultural Lands for Environmental Stewardship	Describe actions that improve the effectiveness of agricultural landscapes to, in turn, improve water quality and conserve habitat. Provide specific management actions that will maintain and increase the value of agricultural land for water quality and habitat.	Includes management actions for agricultural lands that provide mutual benefits to agriculture, water quality, and wildlife within the flood management system.	Agricultural landscapes are considered in some solution sets related to water quality and habitat. The plan does not describe wildlife-friendly and water quality best management practices.	The plan does not consider the benefits of agricultural landscapes in solution sets.
Minimize Environmental Effects of Maintaining Flood Management System	Ensure that all CVFPP actions strive to minimize, and compensate for, the negative environmental effects to (1) natural processes, (2) water quality, (3) special-status species, and (4) native vegetation and wildlife species associated with ongoing maintenance of the flood management system while maintaining flood conveyance.	The plan contains a comprehensive set of actions to minimize, and compensate for, the negative environmental effects of maintenance activities to all four components identified.	The plan contains actions to minimize, and compensate for, negative effects, but it is not a comprehensive set and does not address all four components.	The plan does not include minimization or compensatory actions.
Improve Efficiency and Effectiveness of Environmental Compliance	Describe actions that improve efficiency and effectiveness of compliance with environmental regulations by the flood management system.	The plan includes actions to improve efficiency and effectiveness of complying with each major environmental regulatory process.	The plan includes actions for more efficient compliance with some, but not all, of the major environmental regulatory processes.	The plan does not include actions for more efficient compliance with any of the major environmental regulatory processes.

Note:
[1] SMART – Specific, Measurable, Achievable, Relevant and Timed

Key:
CVFPP = Central Valley Flood Protection Plan
Delta = Sacramento-San Joaquin Delta
GIS = geographical information system
SMART = specific, measureable, attainable, relevant, time-bound

7.0 Next Steps

As mentioned in Section 1, Introduction, the State will use this Conservation Framework to guide conservation actions associated with the CVFPP until the Conservation Framework is replaced by the 2017 Conservation Strategy. During the next 5 years, the State will continue to develop environmental components for the 2017 CVFPP update and Conservation Strategy.

Anticipated outcomes for the 2017 Conservation Strategy are guidance on streamlined permitting processes for CVFPP-related projects; inclusion of environmental stewardship into flood risk reduction projects; decrease in need for continued maintenance through a more sustainable flood management system; contribution to the recovery of listed and/or special status species and habitats, leading to the potential of decreased mitigation requirements in the future; and ensuring that the citizens of California are better protected from loss of life and property by flood through a more naturally functioning floodplain ecosystem.

Development of the 2017 Conservation Strategy continues in close coordination with, and supports development of, 5-year updates to the CVFPP. This collaborative development provides environmental planning, policy, and technical support to develop public outreach and engagement; to identify opportunities to solve flood problems with environmental approaches; and to provide a solid scientific foundation for improving environmental conditions and trends. In addition to collaboration with the CVFPP, the Conservation Strategy will be developed through engagement with the Board, environmental, recreational, and agricultural interests. This collaboration between the CVFPP and the Conservation Strategy includes the following items:

- **Developing measurable objectives for the Conservation Strategy, consistent with goals of the CVFPP and this Conservation Framework and by engaging interested organizations.**

- **Initiating or partnering with others on ecosystem restoration projects and plans to achieve Conservation Framework goals** – Involvement in capital projects includes strategic use of conservation-specific funding.

- **Conducting regional conservation planning, in coordination with other State programs and ongoing collaborative efforts, including NCCP/HCPs, programmatic ESA Section 7 consultations, and**

Integrated Regional Water Plans – Conservation planning includes identifying restoration opportunities; conducting targeted, species-focused conservation planning; and developing corridor management strategies, regional advanced mitigation, and regional permitting strategies that improve flood project delivery.

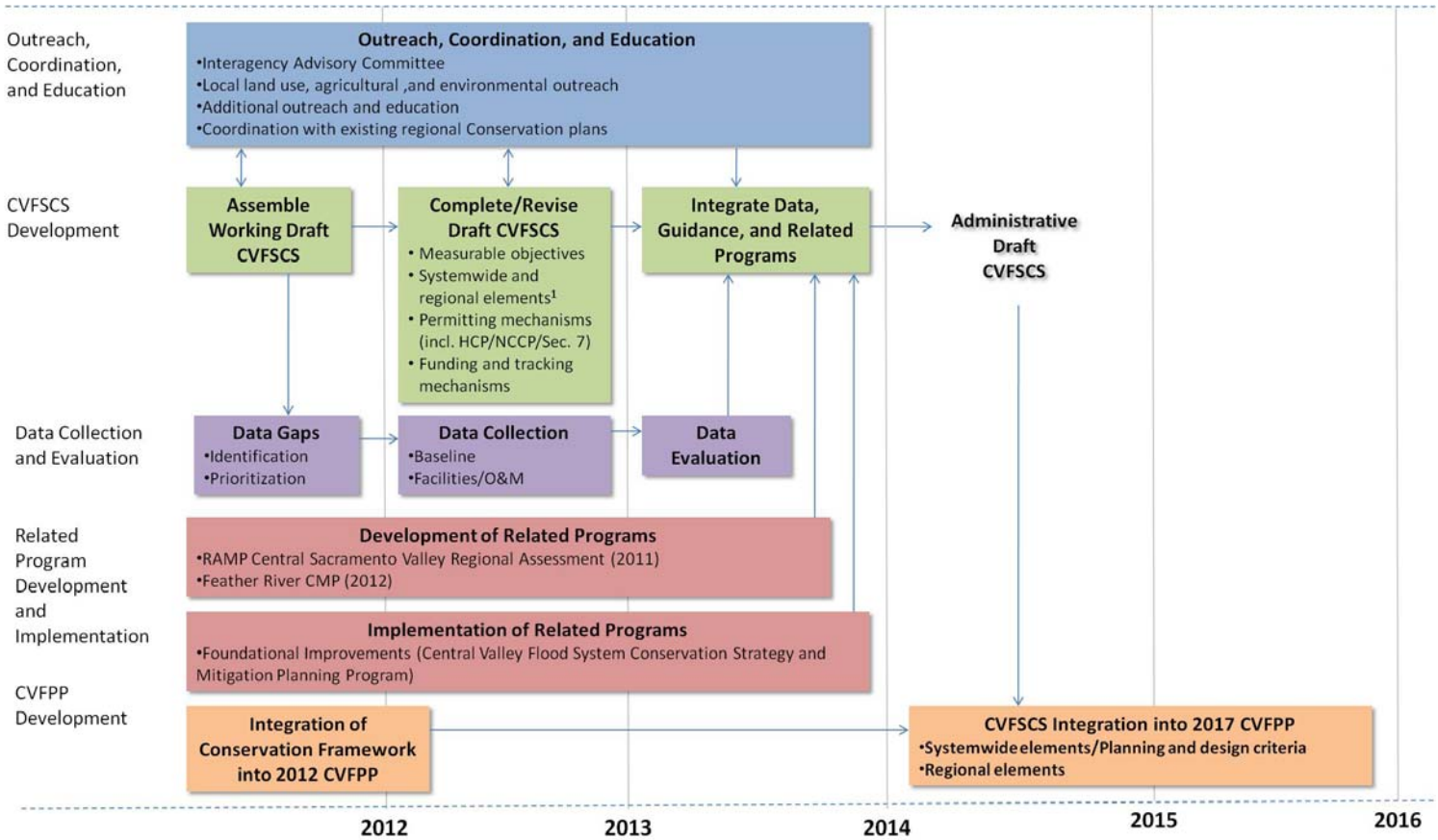
- **Participating in development and implementation of relevant policies** – Relevant policies include those regarding vegetation management, O&M, and other issues related to flood management; environmental river flows; and the State's environmental stewardship policy.

- **Improving environmental scientific and technical basis for informing flood management decisions** – Improvements are made through inventory, analysis and modeling, monitoring, management oriented-research, and information management and access.

- **Developing more effective partnerships with others and improving public outreach and engagement** – This partnering, outreach, and engagement occurs through sharing information and recommendations with interagency committees, independent science advisers, flood managers, and stakeholders (e.g., regulatory, transportation, and land managing agencies, NGOs, agricultural interests, private landowners) and interested members of the public.

- **Developing a funding strategy for ecosystem improvement and project mitigation, including identifying the source of ongoing funds for longer term management and monitoring of mitigation lands.**

These activities are described in greater detail in Section 5, Implementation. Figure 7-1 shows the work plan and timeline for developing the Conservation Strategy.



Note:
[1] – Systemwide elements = integrated into other flood management actions throughout the system (e.g., O&M practices, planning and design criteria); Regional elements = region-specific actions to be implemented or further evaluated (e.g., modification of a specific structure)
Key:
CMP = Corridor Management Plan
CVFSCS = Central Valley Flood System Conservation Strategy
CVFPP = Central Valley Flood Protection Plan
HCP/NCCP = Habitat Conservation Plan/Natural Communities Conservation Plan
O&M = Operations and Maintenance
RAMP = Regional Advance Mitigation Planning
State = State of California

Figure 7-1. Overview of Conservation Strategy Work Plan and Timeline

DWR has established an Interagency Advisory Committee to engage State and federal natural resource and regulatory agencies in developing, improving, and implementing the 2017 Conservation Strategy.

Taken together, the Conservation Framework and ensuing Conservation Strategy incorporate meaningful avoidance, minimization, mitigation, and enhancement measures into the CVFPP to benefit ecosystems and species that rely on the aquatic and terrestrial habitats of the flood management system, while simultaneously improving the performance of the flood management system. Through development of multibenefit projects, the Conservation Framework and Conservation Strategy will provide to the

flood management planning process information, tools, and techniques appropriate to realize the ecosystem goals of the Central Valley Flood Protection Act of 2008. Appropriate policies, funding formulas, and benefit evaluations will allow the Conservation Framework and Conservation Strategy to be implemented concurrent with flood management improvements throughout the Systemwide Planning Area.

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CNDDB. *See* California Natural diversity Database.

CNPS. *See* California Native Plant Society.

DFG. *See* California Department of Fish and Game.

DWR. *See* California Department of Water Resources.

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9.0 Acronyms and Abbreviations

AEP ..... annual exceedence probability

BDCP ..... Bay-Delta Conservation Plan

Board..... Central Valley Flood Protection Board

CALFED ..... CALFED Bay-Delta Program

CEQA ..... California Environmental Quality Act

CESA..... California Endangered Species Act

CLVRP ..... California Levee Vegetation Research Program

CMP ..... Corridor Management Planning

CMS ..... Corridor Management Strategy

Conservation Strategy Central Valley Flood System Conservation Strategy

CVFPP ..... Central Valley Flood Protection Plan

CVIFMS..... Central Valley Integrated Flood Management Study

CVP ..... Central Valley Project

CVPIA..... Central Valley Project Improvement Act

CVV ..... Central Valley Vision

CWC..... California Water Code

Delta ..... Sacramento-San Joaquin Delta

DFG..... California Department of Fish and Game

DPR..... California Department of Parks and Recreation

DWR..... California Department of Water Resources

ERDC ..... Engineer Research and Development Center

ESA ..... Federal Endangered Species Act

ESSDWG ..... Environmental Stewardship Scope Definition Work Group

ETL..... Engineering Technical Letter

FERC..... Federal Energy Regulatory Commission

FloodSAFE ..... FloodSAFE California Initiativee

FROA ..... Floodplain Restoration Opportunities Analysis

GIS ..... Geographic Information System

HCP .....Habitat Conservation Plan

LCM .....life-cycle management

NCCP.....Natural Community Conservation Plans

NGO .....nongovernmental organizations

NMFS.....National Marine Fisheries Service

O&M .....operations and maintenance

OSP .....Open Space Plan

PGL .....Policy Guidance Letter

RAMP .....regional advance mitigation planning

RD .....Reclamation District

Reclamation.....U.S. Department of the Interior, Bureau of Reclamation

RM .....River Mile

ROA .....Restoration Opportunities Analysis

SAFCA.....Sacramento Area Flood Control Agency

SERP .....Small Erosion Repair Program

SJRRP .....San Joaquin River Restoration Program

SPFC .....State Plan of Flood Control

SRA .....shaded riverine aquatic

SSIA .....State Systemwide Investment Approach

State .....State of California

SWRCB .....State Water Resources Control Board

TNC .....The Nature Conservancy

TRLIA .....Three Rivers Levee improvement Authority

USACE .....U.S. Army Corps of Engineers

USFWS.....U.S. Fish and Wildlife Service

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