

CENTRAL VALLEY FLOOD MANAGEMENT PLANNING PROGRAM



PUBLIC DRAFT | December 2011

2012 Central Valley Flood Protection Plan

*A Path for Improving Public Safety, Environmental Stewardship,
and Long-Term Economic Stability*



PUBLIC SAFETY

ENVIRONMENTAL STEWARDSHIP

ECONOMIC STABILITY

Cover Photo: Sacramento Weir (December 24, 1964), DWR Photo Lab

The Sacramento Weir and Bypass discharges excess flows from the Sacramento River (on the left) into the Yolo Bypass (not shown).

The 1964-65 water year was marked by one of the most disastrous floods in California's history.

2012 Central Valley Flood Protection Plan

Public Draft | December 2011

*This document was prepared for submission to the
Central Valley Flood Protection Board
Pursuant to the California Central Valley
Flood Protection Act of 2008*

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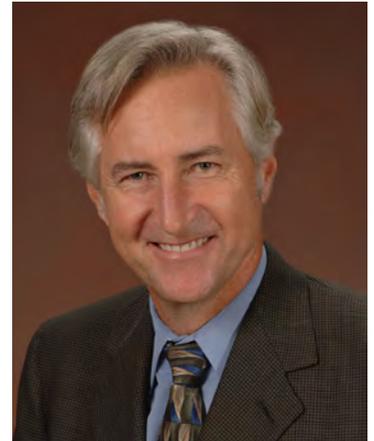
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Foreword

More than one million Californians live and work in the floodplains of the Sacramento-San Joaquin Valley where flood risks are among the highest in the nation. In response to this threat to people, property and the environment, the Central Valley Flood Protection Act of 2008 directed the Department of Water Resources (DWR) to prepare the Central Valley Flood Protection Plan (CVFPP) for Central Valley Flood Protection Board adoption. The CVFPP is the most comprehensive flood management planning effort ever undertaken in California, addressing flood risks in an integrated manner while concurrently improving ecosystem functions, operations and maintenance practices, and institutional support for flood management.



In preparing the CVFPP, DWR examined a range of potential approaches for improving flood management. The recommended approach – known as the State Systemwide Investment Approach (SSIA) – sets forth a strategy for responsibly meeting the State’s objectives to improve public safety, ecosystem conditions, and economic sustainability, while recognizing the financial challenges facing local, State, and federal governments today. Under this approach, California will prioritize investments in flood risk reduction projects and programs that incorporate ecosystem restoration and multi-benefit projects, without precluding future actions, such as those presented in the Enhance Flood System Capacity Approach, should additional State and federal funding become available.

The SSIA outlines a sustainable flood management strategy that will support California’s vital agricultural economy, maintain agricultural land uses, limit growth in undeveloped floodplains, and provide policies, programs, and incentives to encourage wise long-term floodplain management. The SSIA includes significant capital investments to strengthen levees that protect existing urban areas and small communities, prioritizing improvements to the 1,600-mile levee system included in the State Plan of Flood Control. The SSIA also will help improve system resiliency in the face of climate change by expanding flood conveyance capacities, coordinating reservoir operations, and restoring floodplains.

In the coming years, DWR will continue to work collaboratively with local, State, and federal agencies, environmental interests, and other parties to develop regional flood management plans and focus investments on expanding flood bypasses to lower flood risks in flood prone areas. In addition, DWR will continue to refine the CVFPP as projects and policies evolve, additional information is gathered, elements are implemented, and funding becomes available.

With the support and cooperation of partnering and permitting agencies, property owners, interest groups, and the public at large, DWR is committed to making real improvements every year — including stronger levees, enhanced flood capacity, a healthier ecosystem, improved preparations for and responses to flood emergencies, greater resiliency, and leaner, more efficient operations. With California’s first-ever CVFPP, we have a path for improving public safety, environmental stewardship, and long-term economic stability.

A handwritten signature in black ink, appearing to read 'Mark W. Cowin'. The signature is fluid and cursive, written on a light-colored background.

Mark W. Cowin, *Director*

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Attachment 1: Legislative Reference

Attachment 2: Conservation Framework

Attachment 3: Documents Incorporated by Reference

Attachment 4: Glossary

Attachment 5: Engagement Record

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NOTE: A number of technical attachments to the 2012 Central Valley Flood Protection Plan are forthcoming. They will be available in early 2012 to support review and adoption of the Central Valley Flood Protection Plan by the Central Valley Flood Protection Board.

1.0 RESPONDING TO THE NEED FOR IMPROVED FLOOD MANAGEMENT IN THE CENTRAL VALLEY

1.1 What is the Central Valley Flood Protection Plan?

The Central Valley Flood Protection Plan (CVFPP) is a critical document to guide California’s participation (and influence federal and local participation) in managing flood risk along the Sacramento River and San Joaquin River systems. The CVFPP proposes a systemwide investment approach for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP will be updated every five years, with each update providing support for subsequent policy, program, and project implementation.

The State of California (State) conducted planning and investigations for the 2012 CVFPP from 2009 through 2011, representing the most comprehensive flood evaluations for the Central Valley. Following the anticipated adoption of the CVFPP in 2012 by the Central Valley Flood Protection Board (Board), preparation of regional- and State-level financing plans will guide investments in the range of \$14 billion to \$17 billion during the next 20 to 25 years. These financing plans are critical to CVFPP implementation, given the uncertainty in State, federal, and local agency budgets and cost-sharing capabilities. Figure 1-1 shows the progression of flood planning, financial planning, and project implementation leading to the 2017 update of the CVFPP and beyond.

Implementation of some elements included in the CVFPP began in January 2007 when bond funding provided a down payment towards SPFC improvements outlined in the CVFPP. On-the-ground construction has begun to solve some key levee problems, and management of the system has improved. With adoption of the CVFPP, the pace of implementation should significantly increase.

WHY A FLOOD RISK REDUCTION PROGRAM IS NEEDED IN THE CENTRAL VALLEY

- Existing level of flood protection – among lowest for metropolitan areas in the Nation
- State Plan of Flood Control urban levees – about half do not meet current engineering criteria
- State Plan of Flood Control nonurban levees – about 60 percent have relatively high potential for failure
- Population at risk – about 1 million in floodplains
- Assets at risk – about \$70 billion
- Lands within Federal Emergency Management Agency 100-year (1% annual chance of occurrence) floodplain – 1.2 million acres
- Cumulative flood damages in 1983, 1986, 1995, and 1997 – well in excess of \$3 billion (2011 cost level)
- Flood in 1997:
 - » All Central Valley counties declared disaster areas
 - » Over 120,000 people evacuated
 - » Over 9,000 homes destroyed
 - » Many businesses flooded
 - » Thousands of acres of agricultural land flooded
 - » Over \$1 billion (2011 price level) in direct flood damages
- Potential economic losses – disruption in local, regional, and State economies
- Ecosystem – riparian habitat and key species in crisis
- Operations and maintenance – flood risk reductions actions and ecosystem needs not often in harmony

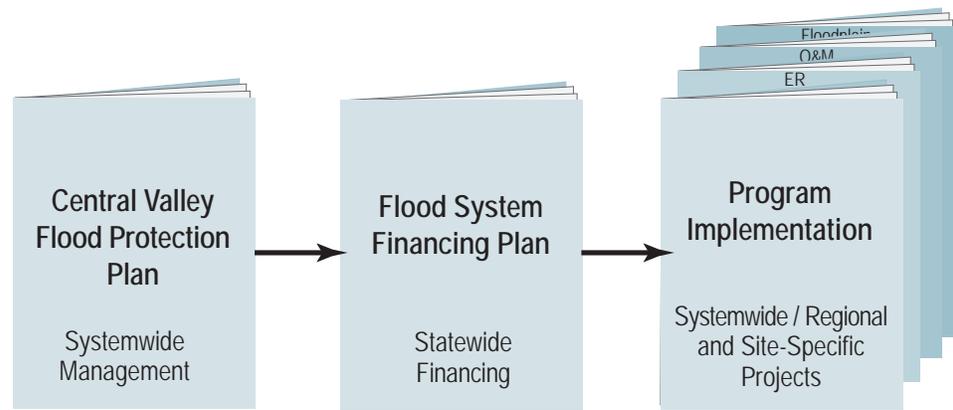


Figure 1-1. Rollout of Future Programs

During the next five years (2012 to 2017), flood managers will continue to build infrastructure improvements that upgrade levees in high risk urban areas and will begin other flood management improvements. Subsequent infrastructure improvements will be based on results of detailed feasibility studies that consider improvements for high risk urban areas, small communities, rural-agricultural areas, and more complicated systemwide facilities, such as bypass expansions. Integral to these improvements will be the inclusion of environmental considerations in all phases of flood management planning and implementation.

1.2 Setting and Historical Context

Floods have had devastating effects on life and property in the Central Valley and on the economic prosperity of the State of California. The most recent significant floods in the Central Valley, which occurred in 1986 and 1997, together caused over \$1 billion in damage¹ (U.S. Army Corps of Engineers [USACE], 1997). Despite the protection provided by the current flood management system, residual flood risk in the Central Valley remains among the highest in the country. Currently, even small flood events with a 5 % annual chance of exceedence can stress parts of the flood system.

The Central Valley of California is a broad, gently sloping valley that drains into the largest estuary on the West Coast, the Sacramento-San Joaquin Delta (Delta). Lower-lying lands along the valley's two major rivers, the Sacramento River and the San Joaquin River, were floodplains that were regularly inundated for long periods during large, seasonal flood events before reclamation. The valley is bounded on the west by the Coast Range, on the north by the Cascade Range, and on the east by the Sierra Nevada Range. The most devastating floods are caused by warm Pacific storms that sweep in from the west or southwest, picking up moisture over thousands of miles of ocean, causing torrential rains when intercepted by the mountains surrounding the Central Valley.

¹ *Sacramento and San Joaquin River Basins, California Post-Flood Assessment* (USACE, 1999).

Catastrophic floods in the Central Valley have been documented since the mid-1800s. Hydraulic mining in the Sierra Nevada Mountains in the late 1800s sent large amounts of sediment downstream, choking the channels of rivers such as the Yuba River, Feather River, and American River and increasing flooding by raising channel beds above their natural levels and surrounding lands.

In response to frequent flood events and the challenges posed by the huge and recurring sediment loads created by hydraulic mining, the current flood management system has evolved through an incremental learning and construction process (Figure 1-2). SPFC facilities have been constructed through the individual and combined efforts of local, State, and federal agencies. The facilities were constructed with materials at hand over many decades, to evolving design standards and construction techniques. As a result, these facilities provide varying levels of protection, depending on when and how they were constructed and upgraded. Construction of these facilities has also resulted in loss of floodplain habitats and marshes.

The process was originally driven by the need to defend the developing valley floor against periodic floods while maintaining navigable channels for commerce. Over time, with development of the railroads in the late 1800s and early 1900s, and the highway system since then, river navigation has become less economically important. However, the importance of Central Valley rivers and floodplains as conduits for municipal, industrial, and agricultural water supply, fisheries and wildlife habitat, and recreation has increased as a result of population growth and environmental degradation in the State.

The Central Valley flood management system includes levees along the major rivers and streams of the valley floor and around the islands of the Delta, a major bypass system for the Sacramento River and its tributaries, several bypass segments along the San Joaquin River, and reservoirs on almost all major rivers and streams draining to the Central Valley.

Levee construction and improvement began in about 1850 and continues to this day. The Sacramento River bypass system was federally authorized in 1917. It includes a system of flood relief structures and weirs that release Sacramento River flows into the bypass system when flows exceed downstream channel capacity at five locations, from the latitude of Chico to Sacramento (see Section 1.2.1). At the latitude of Sacramento, the Yolo Bypass carries 80 percent or more of floodflows southward to the Delta.



1862 Flooding in Sacramento



Construction of Yolo Bypass Levee

Significant Flood Management Events

1849	California Gold Rush
1850	Federal Arkansas Act giving away "California Swamplands"
1850	California Statehood
1861	State Flood Control Act Reclamation District Act
1883	Federal Anti-Debris Act ends hydraulic mining
1911	State Reclamation Board created
1933	Central Valley Project authorized
2003	Paterno Decision
2005	DWR Flood Warning White Paper
2006	Propositions 1E and 84 passed
2007	Flood Management Reform Legislation



1862 Flood in Sacramento



1849 Sutter's Mill



1997 Flood in Central Valley



1955 Folsom Dam built

Sacramento River Basin

1850	First levee built in Sacramento
1917	Sacramento River Flood Control Project authorized
1944	Shasta Dam was built
1955	Folsom Dam was built
1967	Oroville Dam was built
1969	New Bullards Bar Dam was built



1949 Friant Dam built

San Joaquin River Basin

1944	Lower San Joaquin River and Tributaries Project
1949	Friant Dam completed
1955	Bypasses and levees authorized on San Joaquin River above Merced River
1963	Camanche Dam was built
1964	New Hogan Dam was built
1967	New Exchequer Dam was built
1971	New Don Pedro Dam was built
1978	New Melones Dam was built
1993	Redbank/Fancher Creeks Project



1907 Flood in Stockton



1978 New Melones Dam built

Figure 1-2. Chronology of Flood Management-Related Actions in Central Valley

Nearly 150 reservoirs have been constructed on streams draining to the Central Valley since 1850 by a variety of public agencies, including utilities, water districts, the USACE, the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), and the California Department of Water Resources (DWR). Of these, ten major multipurpose reservoirs play a critically important role in moderating Central Valley flood inflows²:

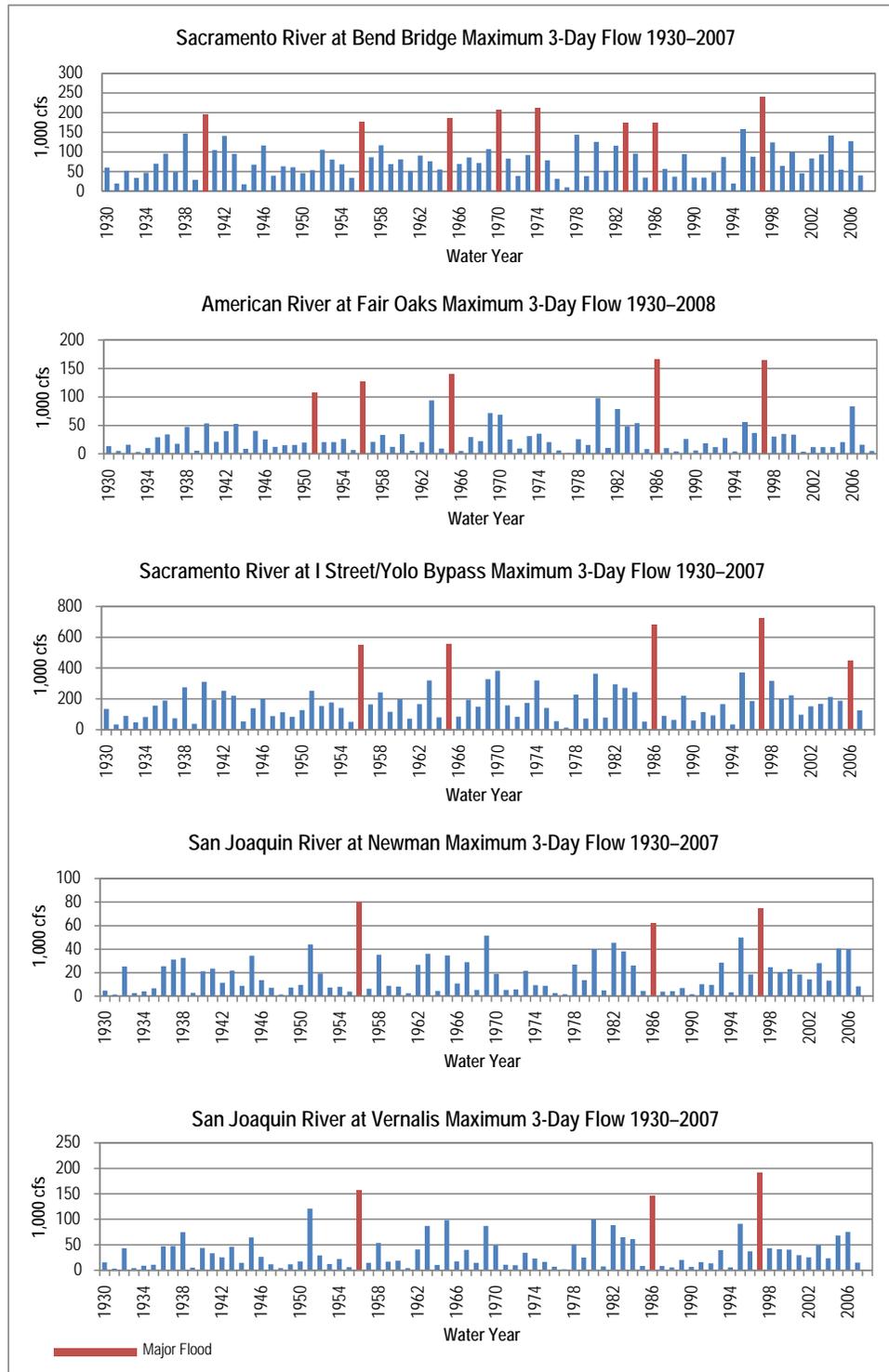
- Shasta Lake on the Sacramento River
- Lake Oroville on the Feather River
- New Bullards Bar Reservoir on the Yuba River
- Folsom Dam on the American River
- Camanche Reservoir on the Mokelumne River
- New Hogan Reservoir on the Calaveras River
- New Melones Reservoir on the Stanislaus River
- New Don Pedro Reservoir on the Tuolumne River
- Lake McClure on the Merced River
- Millerton Lake on the San Joaquin River

These reservoirs are operated in accordance with flood control rules established by USACE. In general, the flood control rules require that during the flood season, a portion of the storage space in the lake is reserved for capturing floodflow peaks and releasing them gradually so that downstream channel capacity is not overwhelmed. In some reservoirs, the required flood control space is adjusted in proportion to the seasonal precipitation, soil moisture, and snowpack. This space is drained as quickly as feasible after each flood peak to be ready for the next floodflow peak. The rules are tuned to the particular runoff characteristics of each river basin.

During major flood events, there is close coordination between State, federal, and local agencies to forecast weather and runoff conditions, manage and coordinate flood releases from the reservoir system, patrol and floodfight along the levee and bypass system, and operate the Sacramento Weir, drainage pumps, and other flood control structures. These activities are important in preparing for and coordinating responses to damaging flood events. The effort required varies significantly from basin to basin due to differences in river flows, shown in Figure 1-3. The figure displays historical maximum three-day floodflows in the Sacramento and San Joaquin River basins. Instead of using instantaneous peak flows, maximum three-day flows were selected to provide more consistent comparisons of the highest flood flows each year due to the large basin size and reservoir regulation of floods.

2 Note: The rivers draining into the Tulare Lake Basin, including the Kings River, Kaweah River, Tule River, and Kern River, are not considered to be part of the Sacramento-San Joaquin River System, but Kings River drains northward during very wet years, such as 1968 – 1969, 1982 – 1983 and 2005 – 2006.

USACE has played a key role in plan formulation, design, construction, inspection, and floodfighting in the Central Valley since the late 1800s. USACE is responsible for the maintenance of navigation, management of hydraulic mining debris, and the construction and operation of many of the large multipurpose reservoirs that moderate flows into the Central Valley. USACE continues to be responsible for implementing most federally authorized flood control projects, in partnership with State and local agencies.



Key: cfs = cubic feet per second

Figure 1-3. Sacramento and San Joaquin Rivers Hydrographs

1.2.1 Definition of State Plan of Flood Control

The SPFC represents a portion of the Central Valley flood management system for which the State has special responsibilities, as defined in the California Water Code (Figure 1-4, Figure 1-5, and Table 1-1). It is defined as follows:

“...the state and federal flood control works, lands, programs, plans, policies, conditions, and mode of maintenance and operations of the Sacramento River Flood Control Project described in Section 8350, and of flood control projects in the Sacramento River and San Joaquin River watersheds authorized pursuant to Article 2 (commencing with Section 12648) of Chapter 2 of Part 6 of Division 6 for which the board or the department has provided the assurances of nonfederal cooperation to the United States, and those facilities identified in Section 8361.” – California Water Code Section 9110 (f)

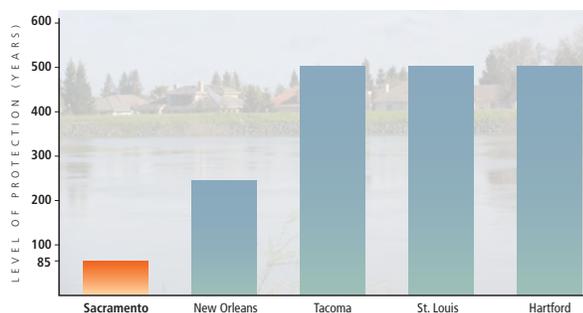
The *State Plan of Flood Control Descriptive Document* (DWR, 2010) provides a detailed inventory and description of the levees, weirs, bypass channels, pumps, dams, and other structures included in the SPFC.

1.3 Assets Protected by State Plan of Flood Control

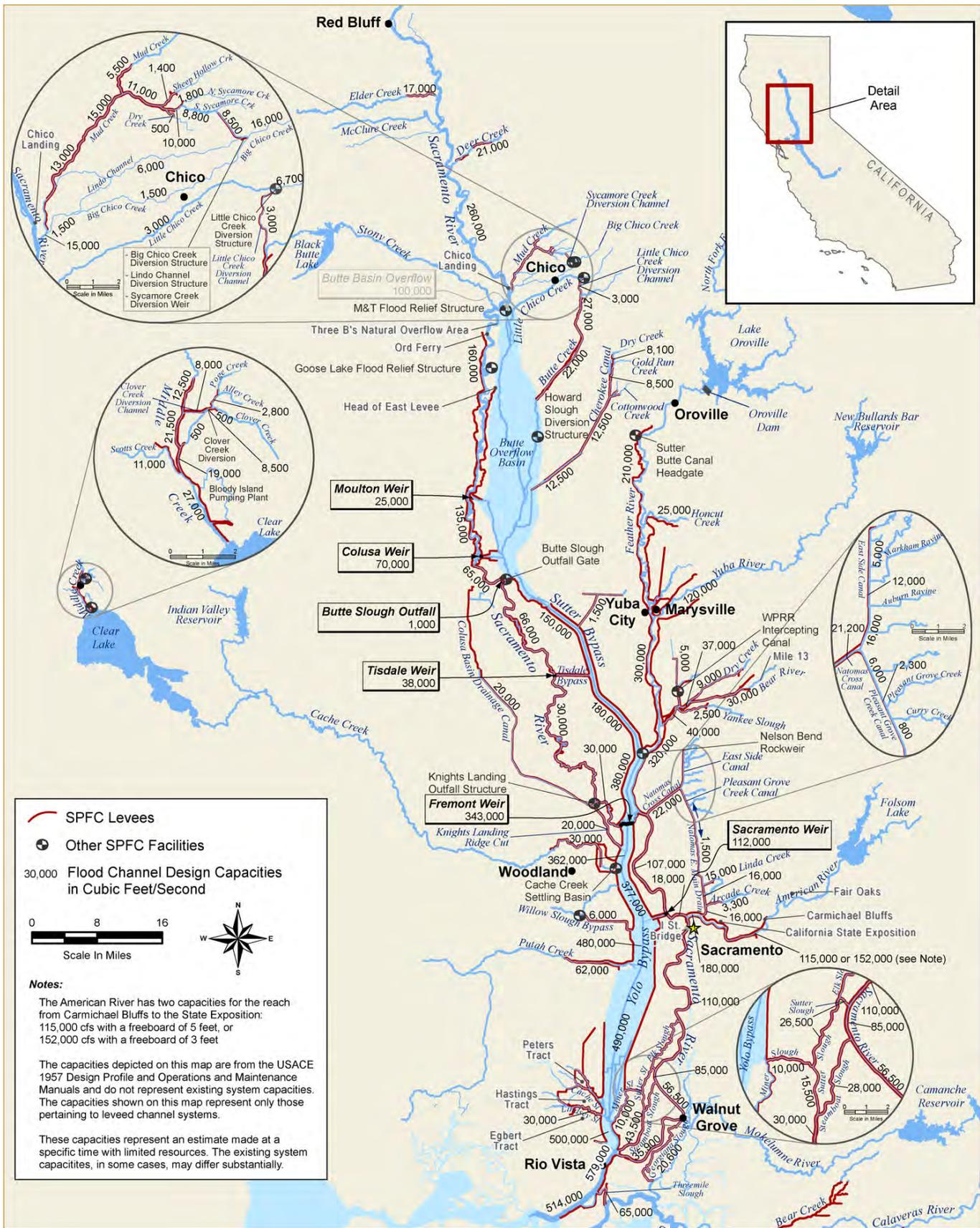
Over the last century, the Central Valley has experienced intensive development to meet the needs of a growing population. A complex water supply and flood risk management system supports and protects a vibrant agricultural economy, several cities, and numerous small communities. The SPFC protects a population of over one million people, major freeways, railroads, airports, water supply systems, utilities, and other infrastructure of statewide importance, including \$69 billion in assets (includes structural and content value and estimated annual crop production values) (Figure 1-6). Many of the more than 500 species of native plants and wildlife found in the Central Valley rely to some extent on habitat existing within the SPFC.

1.4 Current Problems and Future Trends Facing State Plan of Flood Control

Much of the Central Valley levee system was built over many years using the sands, silts, clays, and soils, including organic soils that were conveniently available, often poorly compacted over permeable foundations. The system was designed to contain the record floods of the early twentieth century with the aim of fostering development of an agriculturally oriented economy and promoting public safety. The subsequent construction of a series of multipurpose reservoirs with substantial

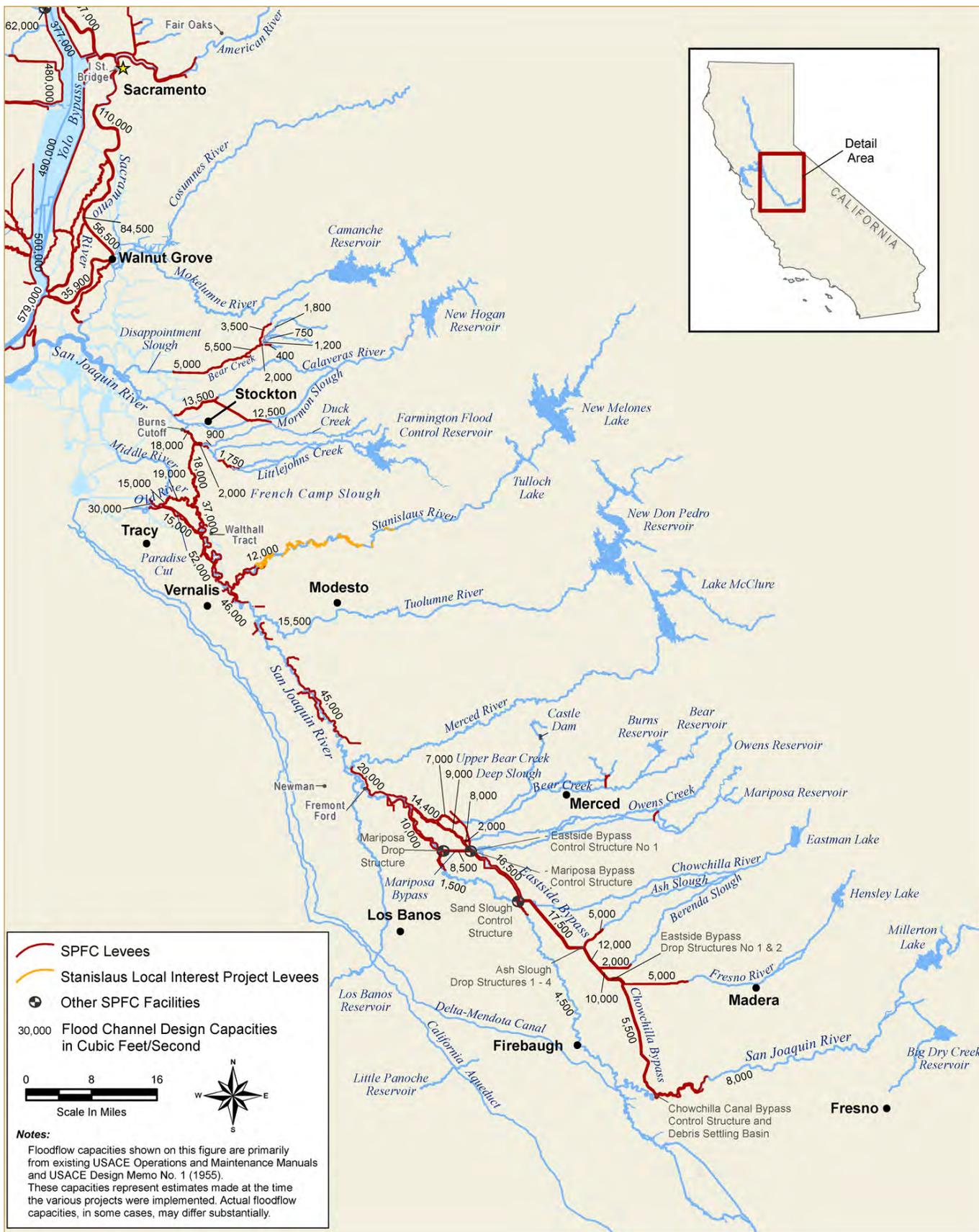


Level of Flood Protection for Selected Major River Cities in the United States



Key: cfs = cubic feet per second SPFC = State Plan of Flood Control USACE = U.S. Army Corps of Engineers

Figure 1-4. State Plan of Flood Control Facilities, Sacramento River Basin



Key: SPFC = State Plan of Flood Control

USACE = U.S. Army Corps of Engineers

Figure 1-5. State Plan of Flood Control Facilities, San Joaquin River Basin

Table 1-1. Overview of State Plan of Flood Control

FEATURE AND DESCRIPTION AS OF 2010
Project Works
<ul style="list-style-type: none"> • Approximately 1,600 miles of levees • Two flood relief structures and one natural overflow area spilling floodwaters from the Sacramento River into the Butte Basin • Four fixed weirs (Moulton, Colusa, Tisdale, Fremont) and one operable weir (Sacramento) spilling floodwaters from the Sacramento River into the Butte Basin, Sutter Bypass, and Yolo Bypass • Four dams • Five control structures directing flow in bypass channels along the San Joaquin River • Seven major pumping plants • Channels • Bypasses and sediment basins • Environmental mitigation areas • Associated facilities, such as bank protection, stream gages, and drainage facilities
Lands
<ul style="list-style-type: none"> • Fee title, easements, and land use agreements • Approximately 18,000 parcels
Operations and Maintenance
<ul style="list-style-type: none"> • Two standard operations and maintenance manuals • 118 unit-specific operations and maintenance manuals • Maintenance by State and local maintaining agencies
Conditions
<ul style="list-style-type: none"> • Assurances of Cooperation (as specified in Memorandums of Agreement, the California Water Code, and agreements) • Flood Control Regulations, Section 208.10, 33 Code of Federal Regulations • Requirements of standard and unit-specific operations and maintenance manuals • Design profiles (1955 and 1957)
Programs and Plans
<ul style="list-style-type: none"> • Historical documents and processes • As-constructed drawings • Oversight and management • Ongoing programs and plans

flood control capability significantly augmented the capacity of the flood management system and contributed greatly to the State’s economic development and public safety objectives. These reservoirs constituted the principal response to the mid-century recognition that extreme floods that were much larger than those that guided design of the levee system were reasonably foreseeable.

The latter half of the twentieth century has been marked by a growing awareness of the effects of the levee system and the multipurpose reservoirs on the environmental health of the Central Valley’s rivers and streams and their associated seasonal wetland and riparian habitats. The reduction of these habitats to accommodate the levee system and the reservoirs has impacted the populations of salmon, steelhead, sturgeon, Swainson’s hawks, bank swallows, giant garter snakes, and many other wildlife species in the Central Valley. As a result, preservation and enhancement of the valley’s remaining wetland and riparian habitat has become an increasingly important consideration in the design, construction, operations, and maintenance of the flood management system.

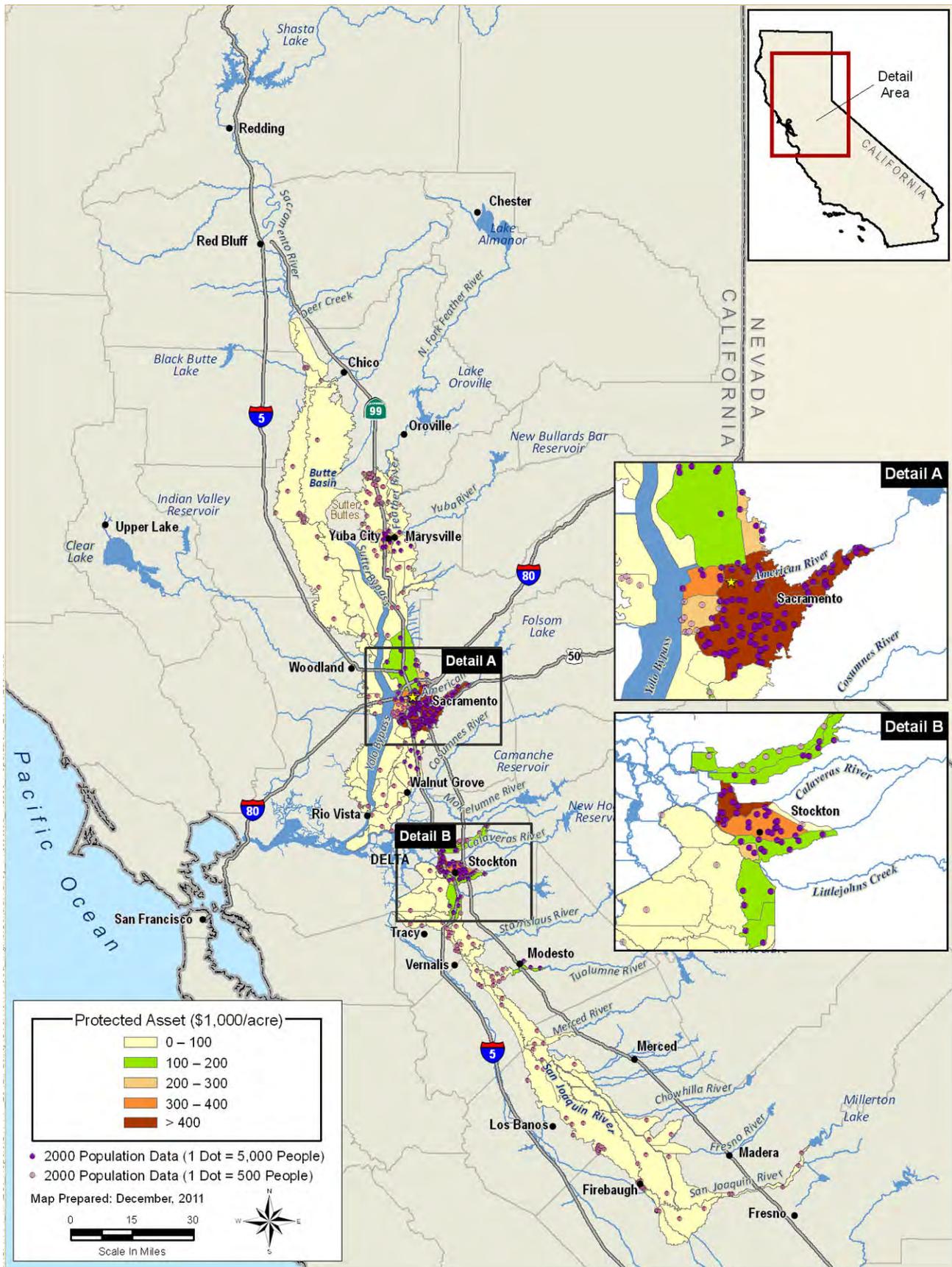


Figure 1-6. Geographic Distribution of Assets and Population Protected by State Plan of Flood Control Facilities

Although the SPFC has prevented billions of dollars in flood damages since its construction, a better understanding of the risk assessment and engineering standards has made it clear that some SFPC facilities face an unacceptably high chance of failure. This, combined with continued urbanization in the floodplains, has increased the estimated level of flood risk. While the chance and frequency of flooding have decreased since construction of the SPFC and multipurpose reservoirs, the damages that would occur if a levee were to fail in one of the urban areas are much greater, resulting in a net long-term increase in cumulative damages if no action is taken to improve the flood management system and limit further development in these areas.

UNDERSTANDING FLOOD RISK

As used in this report, flood risk is the product of the chance of flooding multiplied by the consequences. Thus, flood risk increases with storm frequency and severity, as well as with floodplain development. The potential for flooding is often underrated and misunderstood. For this reason, not enough focus is placed on flood preparedness. An ongoing challenge is to fully inform floodplain residents and businesses of the importance of understanding and preparing for flooding, especially in levee-protected areas.

The overall physical condition of SPFC levees is summarized in Figure 1-7. To simplify representation of levee conditions, the figure includes Urban Levee Evaluations and Non-Urban Levee Evaluations results that are not directly comparable because different evaluation methodologies were used for each project. The figure is intended to show broadly which levee reaches are of relatively higher, medium, and lower concern, based on physical conditions of the levees. Levees shown as purple (higher concern) on the map generally display more performance problems than those shown in green (lower concern). Results do not reflect economic or life safety consequences of flooding, which are key factors in planning system repairs and improvements.

Including the overall condition of SPFC levees shown in Figure 1-7, an overview of the condition of urban levees, nonurban levees, channels, and flood control structures of the SPFC is as follows:

- Approximately half of about 300 miles of SPFC urban levees evaluated do not meet current engineering design criteria³ at the design water surface elevation.
- Approximately 60 percent of about 1,230 miles of SPFC nonurban levees evaluated have a high potential for failure at the assessment water surface elevation⁴. Nonurban levees were evaluated based on systematic, consistent, repeatable analyses that correlated geotechnical data with levee performance history, not relative to any current design criteria⁵.

3 The design criteria used were based on *the Design and Construction of Levees Engineering Manual 1110-2-1913* (USACE, 2000) and *Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento Valley*, Version 4 (DWR, 2010).

4 Where available, 1955/57 design water surface elevations were used as the assessment water surface elevations. In the absence of 1955/57 design water surface elevations, the assessment water surface elevations were based on freeboard requirements for each levee segment (i.e., generally 3 feet below the levee crest).

5 This approach was selected because the extent of the Non-Urban Levee Evaluations Project is significantly greater than that of the Urban Levee Evaluations Project, making it difficult to conduct the same level of field explorations and geotechnical data collection performed for Urban Levee Evaluations levees.

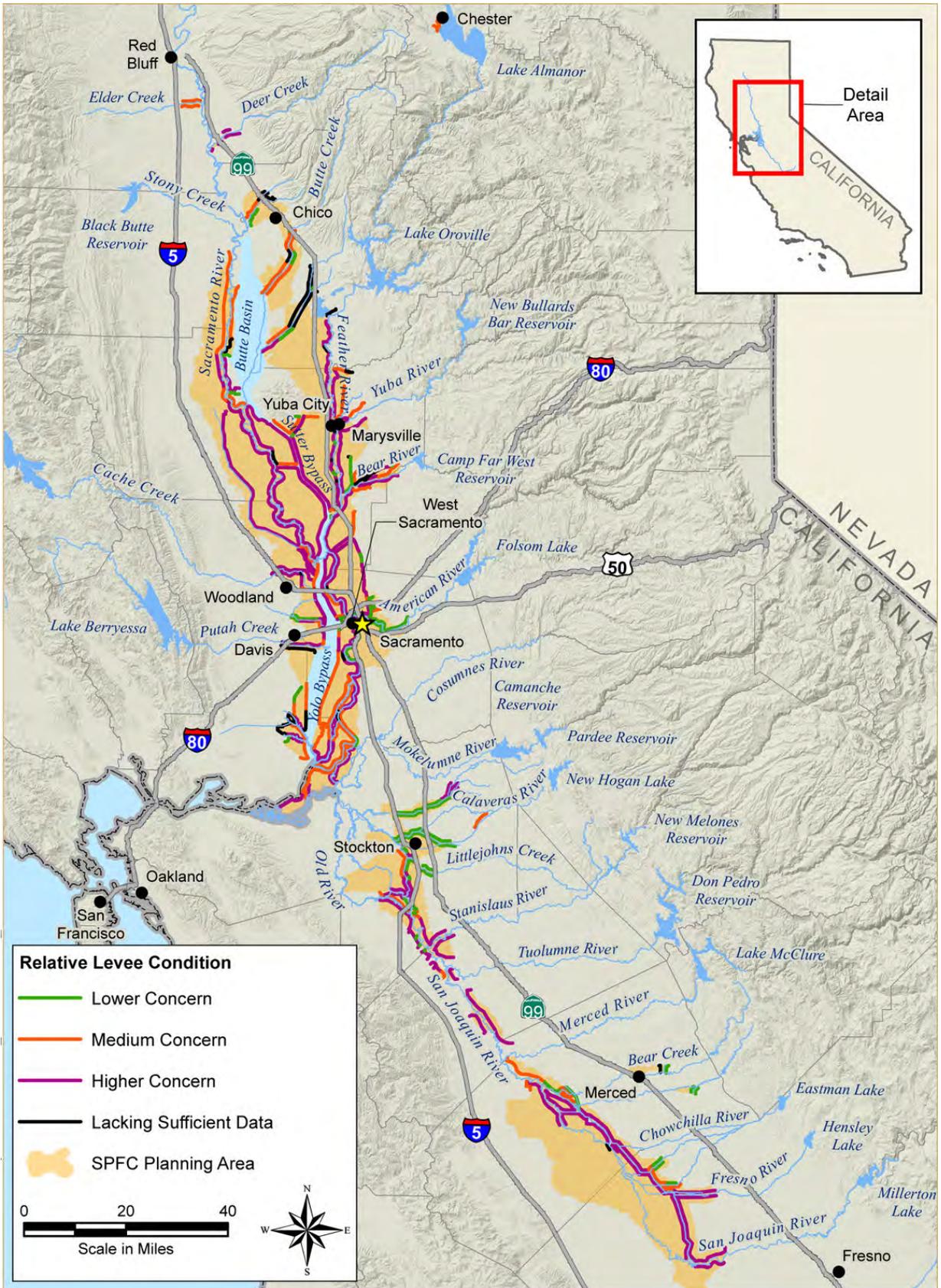


Figure 1-7. Summary of Physical Levee Conditions Based on Levee Evaluations Program Results

- Approximately half of the 1,016 miles of channels evaluated in the SPFC have a potentially inadequate capacity to convey design flows, and require additional evaluation to confirm conditions.
- None of the 32 hydraulic structures or 11 pumping plants inspected by DWR for the SPFC were rated “Unacceptable” during the 2009 inspections; however, many are approaching the end of their design life. Of the 10 SPFC bridges inspected by DWR in 2009, 2 were in need of repairs.

**MANAGING FLOODS VERSUS
MANAGING FLOOD RISK**

Managing floods means building and operating facilities such as dams, weirs, levees, and pump stations to safely store and convey flood flows within designated channels to reduce the chance of flooding. Such improvements can greatly reduce, but not entirely eliminate, the flood risk. Often, floodplains are subsequently developed because of the perception that the chance of flooding has been eliminated. As a result, the overall flood risk can (paradoxically) increase following construction of flood control facilities.

Flood risk is the combined effect of the chance of flooding and the property that would be damaged if flooded. Managing flood risk means either reducing the chance of flooding or the population and property exposed to flooding, or doing a combination of both. Thus, managing flood risk can include flood control facilities, as well as limiting floodplain development, elevating structures above flood elevations, creating natural flood storage and groundwater recharge areas, and using flood risk notification, flood insurance, and flood preparedness.

The regional and system improvements considered in the CVFPP are intended to address a number of potential physical threats to the existing flood management system. These threats are described in the *Flood Control System Status Report* (DWR, 2011). For levees in the system, threats include problems associated with geometry, seepage, structural instability, erosion, settlement, penetrations, vegetation, rodent damage, and encroachments. For channels of the system, threats include inadequacies in overall conveyance capacity. For necessary flood management structures such as weirs, pumping plants, and bridges, threats primarily include inadequate hydraulic capacities. The Board continues to address encroachments on a site-by-site basis.

The physical and cultural landscape of the Central Valley has changed dramatically since the flood management system was initially constructed. Population growth and economic development behind levees have increased flood risk. In many areas, development has outpaced the ability of flood managers to implement structural and nonstructural solutions needed to control flood damages. Among floodplain residents, flood risk is often poorly understood. Flood risk management tools such as flood insurance and disaster preparedness are often underused.

Development behind levees is often incompatible with periodic flooding, to the detriment of public safety and floodplain ecosystems, unless special measures, such as elevating or floodproofing buildings, are implemented to limit damages.

Riverine habitats and ecosystem functions have been degraded over time through changes in land use, construction of dams and levees, water pollution, and other causes. The geographic extent, quality, and connectivity of native habitats along Central Valley rivers have all declined. Today, less than 4 percent of the historical riparian forests that lined valley streams remain, with a significant portion of this forest growing on, or close to, levees of the SPFC.

The historical practice of constructing SPFC levees close to the river channels to induce sediment scour has, in many cases, interfered with the natural stream meandering process. Where meandering channels begin to erode SPFC levee slopes, erosion protection is required to protect the integrity of the system. The result has been the placement of several hundred miles of rock revetment protecting about 30 percent of SPFC stream banks and waterside levee slopes. Stream banks require costly, ongoing maintenance and repairs. The Sacramento River Bank Protection Project has provided the authority and mechanism for placing the majority of rock revetment along SPFC facilities.

Faced with limited funding, increasing regulatory constraints, and changing expectations for the multiple uses of the flood management system, it is increasingly difficult for State and local agencies to maintain levees and channels. This has jeopardized eligibility for federal levee rehabilitation funds under Public Law 84-99, administered by USACE, and levee accreditation under the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program.



Typical rock revetment along Sacramento River

A recent change in the USACE approach towards woody levee vegetation also poses new challenges for those who operate and maintain the existing system of levees. Since the levee system failures along the Gulf Coast caused by Hurricane Katrina in 2005, USACE has taken the position that no woody vegetation should be tolerated on or near federal project levees and, through a series of administrative actions, has moved to promulgate and enforce this approach. For the California Central Valley, woody vegetation is of great ecological and aesthetic value and would be extremely costly to remove. Consequently, the State, local maintaining agencies, and environmental groups have been working with USACE to encourage development of a flexible levee vegetation management approach that would achieve public safety goals without sacrificing environmental quality and misallocating scarce public funds. (This issue is discussed in greater detail in Section 3 with regard to retention of Public Law 84-99 Disaster Recovery eligibility, in Section 4 with regard to management vegetation on the levees, and at length in Attachment 2 – Conservation Framework).

Operations and maintenance and repairs of the flood management system are difficult to execute and often deferred for many reasons. These include original system designs that do not meet existing engineering standards, inadequate funding, encroachments, inconsistent levee maintenance practices among maintaining agencies, and challenges in complying with a variety of State and federal environmental permitting and mitigation requirements.

Responsibilities for flood management and land use decisions in the Sacramento-San Joaquin Valley are dispersed among many agencies, and flood risk is often poorly understood among the floodplain residents. Land use decisions, such as those involv-

“100-Year Flood” is a shorthand expression for a flood that has a 1 in 100 chance of being exceeded in any given year. This may also be expressed as the 1 % annual chance of exceedence flood, or “1 % annual chance flood” for short. Similarly, a 200-year flood has a 1 in 200 (or 0.5 %) chance of being exceeded in any given year.

ing development in floodplains, are typically made at the local level by counties and cities. Local jurisdictions often have economic incentives to support and encourage such development. On the other hand, when levees fail, resulting in flood damages and loss of life, the costs associated with floodfighting, rescue, recovery, and rehabilitation are shared by local, State, and federal agencies.

Overlapping jurisdictions across various federal and State agencies involved in flood management can lead to inconsistent policies and regulations. Coordinating activities within this fragmented jurisdictional landscape can be challenging, particularly for local entities.

Population increase and distribution will likely drive changes in land use patterns, potentially increasing the population at risk from flooding and possibly further reducing existing agricultural land and wildlife habitat. Continued urban development within major floodplains will also make future changes to the footprint of the flood management system progressively more costly, and increase consequences and risks (life safety and damages) when the flood management system is overwhelmed. Two factors are likely to slow this process in the future. First, FEMA’s flood risk map digitizing and risk reassessment efforts will result in remapping of much of the SPFC-protected areas with less than 100-year (1% annual chance) flood protection. As a result, development in these areas will be more expensive, difficult to insure,

and subject to flood-proofing or elevation requirements. The passage of Senate Bill 5⁶ has set an even higher threshold for urban areas by requiring that they ultimately be provided with at least 200-year (0.5% annual chance) flood protection as a condition for further development.



Climate change is expected to reduce snowpack coverage in the Sierra

Climate change will lead to a greater fraction of seasonal precipitation occurring as rain rather than snow and sea levels will rise. These trends appear to be already established and, if they continue as expected, they will put increasing stress on California’s flood management system. Floodplain risk assessments and development constraints will likely be adjusted accordingly. For example, the 100-year and 200-year (1 % and 0.5 % annual chance) flood events, calculated based on historical flood events may become larger for many watersheds, with long-term effects on National Flood Insurance Program map ratings, flood insurance costs, floodplain development, and the economic viability of floodplain communities. In addition, as the moderating effects of snowpack on runoff decrease, there will be a need for more water supply storage, putting greater pressure on California’s multipurpose flood control reservoirs. Increased temperatures and altered runoff patterns also directly impact the health of California’s natural ecosystems and habitats.

ance Program map ratings, flood insurance costs, floodplain development, and the economic viability of floodplain communities. In addition, as the moderating effects of snowpack on runoff decrease, there will be a need for more water supply storage, putting greater pressure on California’s multipurpose flood control reservoirs. Increased temperatures and altered runoff patterns also directly impact the health of California’s natural ecosystems and habitats.

6 2007 Senate Bill No. 5, Machado. Flood management.

In some portions of the Central Valley, levees are subsiding because of several causes, including groundwater extraction, natural gas extraction, and the gradual compression or oxidation of weak, organic, or clay foundation soils. Project levees in the Delta, in the Knights Landing area of Yolo County, and in other areas, have subsided up to several feet over the past century. Such subsidence decreases the flood-carrying capacity, and sometimes the structural integrity, of these levees.

Over the past 40 years, State and federal environmental laws and regulations have been developed to reduce environmental impacts of human activities, such as those related to endangered species, fisheries, wetlands, and water quality. While progress has been made in achieving the goal of reducing environmental impacts of human activities, more can be achieved in terms of reducing impacts, and restoring some of what has been lost. One challenge is that these laws and regulations have added to the complexity, cost, and time required to plan, design, construct, operate, and repair portions of the flood management system. Future flood management practices will need to continue to adapt to current and new environmental regulations.

Collaboration between flood system managers and resource and regulatory agencies will be critically important in developing approaches that support long-term integrated management of the flood management system that serves public safety and environmental needs. This type of collaboration, which is discussed below, has been occurring. While not an exhaustive list, following are some of the challenges to address that will improve the ability to manage the system for multiple benefits:

- Addressing the needs of special-status species while also providing for the needs of multiple species that may use the habitat in the flood management system.
- Existing laws set relatively short time limits for some environmental permits given that flood management systems need to be managed in perpetuity.
- The process for developing management agreements for flood control projects under the multitude of federal and State environmental laws can be costly and complex and, in some cases, has been the responsibility of the project proponent, even when the actions provide multiple benefits. Increased partnering and leveraging of multiple funding sources will expand the opportunities for implementing multi-benefit projects.
- Work windows for species protection can challenge flood system managers in completing required annual maintenance. If habitat is improved and increased in and near the flood system, an intended outcome is increases in population sizes and, potentially, populations of new species using restored areas, which could increase limitations on maintainers and thereby increase flood risks. Refining work windows that meet the needs for species protection and flood activities, both of which can be very constrained by seasonal events and conditions, will support integrated management of the flood system.
- Improving habitat in ways that reduce, or at least do not substantially increase, needs for maintenance of flood facilities will be important. Additional long-term funding may be needed where such improvements substantially increase maintenance needs.

- Regulatory coverage under the federal Endangered Species Act and the California Endangered Species Act will be needed for a broad range of flood system management activities. Flood management, resource, and regulatory agencies will need to continue to work together to apply the most appropriate mechanisms for given areas and types of work from the variety of tools available (e.g., Habitat Conservation Plans, Incidental Take authorizations, Safe Harbor Agreements).

Effective interagency collaboration to address some of the issues noted above, and others, has been occurring. One example of this is the Interagency Flood Management Collaborative Program. Started in 2005 at the request of DWR and including local, State, and federal flood control, regulatory, and resource agencies, this program was instrumental in accelerating the 29 critical Central Valley levee repairs ordered by Governor Arnold Schwarzenegger in early 2006. This program also helped create and is supporting development of the Small Erosion Repair Program and the Corridor Management Strategy (both discussed in more detail in Attachment 2 – Conservation Framework), and continually provides technical support and assistance to the Division of Flood Management in the programs and projects it implements. The activities and successes reflect the program’s underlying commitment that effective flood system management and healthy ecosystems can both be supported in the ongoing effort to protect public safety.

Land ownership underlying the facilities of the SPFC is a patchwork of private and public parcels. A variety of easements cover many private parcels and these easements have been established for a variety of different and often site-specific purposes. The types and terms of these easements relate to, for example, periodic flooding, conservation of agricultural land, and habitat restoration. This patchwork of land ownership and easement terms both constrains and complicates the potential for providing flood or environmental improvements over areas greater than individual parcels.

Impacts of modifications to facilities and environmental restoration on adjacent properties must also be carefully considered and mitigated, where feasible. For example, where wildlife habitat is proposed in proximity to existing agricultural lands, the impacts of plowing, spraying, and harvesting of agricultural lands on nearby wildlife habitat and, conversely, the impacts of protected species on agricultural lands, must both be carefully addressed to successfully implement long-term environmental enhancement projects.

There are several important connections between flood management and water quality. Most importantly, floods are capable of mobilizing enormous sediment loads and their contaminants, carrying them downstream, and then sorting and redepositing them. Many of the streams of the Sierra and the Coast Range have large amounts of mercury, mainly due to its use in capturing gold from sluice boxes during the Gold Rush, and also due to erosion from natural deposits. Mercury poses major obstacles to sediment management and ecosystem restoration where it occurs in large concentrations, such as in Cache Creek and the Cache Creek Settling Basin.

When levees fail, the inundation of homes, farms, businesses, and industries often results in the release and dispersion of highly toxic chemicals, which can have far reaching health and economic effects. All of these water quality concerns will continue to affect flood management programs by requiring that contaminants and toxics be addressed in the planning, design, construction, and maintenance phases of flood management projects, most likely intensifying in the future.

Major capital improvement and routine maintenance of the flood management system are primarily dependent on public funding generated by State, federal, and local sources. Flood risk management programs must compete with numerous other pressing funding needs such as education, transportation, health, and welfare. Major infusions of funding for flood risk management have historically followed major floods, when public attention is focused on the catastrophic damages they cause. For example, Propositions 1E and 84⁷, with a combined bond funding capability of \$4.9 billion, were approved by California voters little more than a year after Hurricane Katrina flooded and destroyed much of New Orleans, killing over 1,200 people. However, flood risk reduction programs and infrastructure need steady, long-term funding to achieve and sustain the requisite level of protection. Governments at all levels struggling with heavy debt burdens, recession-damped revenue projections, and rising construction costs all add uncertainty for fully funding the flood risk management programs and projects described in this report.

1.4.1 Future of State Plan of Flood Control Without Comprehensive Action

In the absence of the CVFPP, current trends would likely continue. Among the most notable trends are the following:

- FEMA's ongoing flood risk mapping program, conducted in coordination with State and local communities, will remap the floodplains protected by the SPFC with less than 100-year (1% annual chance) flood protection. This will impose significant long-term burdens on farms, homeowners, and businesses in these areas, including higher flood insurance premiums and limitations on repairing, reconstructing, and expanding structures.
- The existing partnership among the federal government, the State, and local entities for implementing flood risk reduction projects will continue. Current federal regulations strongly favor flood management projects in urban areas. Primarily in order to demonstrate a federal interest, flood damage reduction benefits of a project must exceed project costs. In other words, the benefit-to-cost ratio must be greater than one. To be recommended for funding in the President's budget, a more robust benefit-to-cost ratio is generally required. Although each of these projects is implemented taking into consideration its effects on the system as a whole, this process is by its very nature a piecemeal approach. These regulations also do not take into account the long-term

⁷ Proposition 1E = Disaster Preparedness and Flood Prevention Bond Act of 2006; Proposition 84 = Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006.

benefit of integrating environmental restoration projects, thus undervaluing the importance of rural projects. The historical federal/State/local partnership has created a dichotomous system in which urban areas have a much higher level of protection than rural-agricultural areas and receive the majority of available funding. Since the passage of Propositions 1E and 84, the State has taken a stronger leadership role in the project delivery process, including project formulation, design, and advancing of funds to cover much of what traditionally has been the federal cost share, with the hope of obtaining credit against future State cost-sharing obligations.

- System maintenance will continue to be challenged by the need to complete annual maintenance activities such as mowing grass, trimming trees and brush, filling burrows, clearing sediment, and restoring patrol roads while at the same time minimizing impacts on migrating fish, nesting birds, and hibernating snakes. The result is a combination of rapidly rising costs, shortening maintenance windows, high mitigation costs, and uncertainty.
- Without improved approaches to improve the effectiveness and efficiency of the environmental regulatory process, the complexity of meeting the variety of environmental regulations may continue to result in project delays and costs and inadequate environmental improvements. Continued collaboration

at local, State, and federal levels will be important in navigating regulatory complexities and crafting approaches that will support the shift to long-term integrated management of the system that serves both public safety and environmental needs.

SOME IMPORTANT TERMS USED IN THE CENTRAL VALLEY FLOOD PROTECTION PLAN

Integrated Flood Management. This is an approach for addressing flood risk that recognizes the interconnection of flood management actions within broader water resources management and land use planning; the value of coordinating across geographic and agency boundaries; the need to evaluate opportunities and potential impacts from a system perspective; and the importance of environmental stewardship and sustainability.

Sustainable. A project is considered “sustainable” when it is socially, environmentally, and financially feasible for an enduring period. For the CVFPP, a sustainable project will also have flexibility to adapt to potential future changes such as climate change.

Systemwide. Evaluations on a “systemwide” basis consider how all the parts of the river basin and flood protection facilities interrelate in the movement of floodflows from rim reservoirs through the Delta. In other words, the evaluations consider the workings of the entire system rather than more traditional approaches that may only evaluate short reaches of levee along a river.

1.5 State’s Interest in Integrated Flood Management

The CVFPP is drafted with careful consideration of the well-represented interests of involved local, State, and federal agencies, and special interest, nongovernmental organizations. The CVFPP also takes into consideration the interests of the State as a whole, which are typically not represented by any special interest group, in promoting the wise stewardship of public funds and natural resources.

The State has a fundamental interest in promoting the health and safety of its people, robust and sustainable economic growth, and a healthy ecosystem.

Specific to flood management, the State has a responsibility for, and primary interest in, building and maintaining flood management facilities

along the Sacramento and San Joaquin rivers and their tributaries to preserve the welfare of the residents and landowners within reclaimed overflow basins in the Central Valley (California Water Code Sections 8532 – 8533). This responsibility is inextricably linked to the State’s obligation to comply with environmental laws, policies, and directives. As the agency primarily charged with this dual responsibility, DWR has played a leadership role in developing environmentally sound project designs and maintenance practices. Therefore, environmental enhancements are fully integrated into formulation of the flood management approaches presented in the CVFPP.

The State is also responsible for responding to emergencies and public threats; thus, it is in the State’s interest to invest funds proactively to avoid and mitigate for known risks to reduce costly emergency response and recovery.

1.6 Formulation of 2012 Central Valley Flood Protection Plan

The 2012 CVFPP is built on the foundation of Central Valley flood risk management efforts dating back to 1850, as documented in the previous sections. In 2006, DWR consolidated and coordinated its various flood risk management programs under the FloodSAFE California (FloodSAFE) initiative, which incorporates emergency preparedness, flood operations, flood risk reduction and ecosystem restoration projects, flood project maintenance, and comprehensive, systemwide assessment and planning to deliver improved flood protection as quickly and efficiently as possible.

This long-term planning document will address the flood management challenges discussed in the previous section as part of a sustainable, integrated flood management approach. The CVFPP is a descriptive document. It is not a systemwide feasibility study of sufficient detail to support project-specific actions such as authorizing legislation, design, and construction. It is intended to provide a foundation for prioritizing Central Valley flood risk reduction and ecosystem restoration investments, including feasibility studies on appropriate scales – from valleywide to project-specific.

The CVFPP was prepared in coordination with local flood management agencies, the Board, USACE, FEMA, and Reclamation. It is supported by data, analyses, and findings from related FloodSAFE efforts. These include the *State Plan of Flood Control Descriptive Document*, the *Flood Control System Status Report*, and the *CVFPP Program Environmental Impact Report* (DWR, anticipated 2012), being prepared in parallel with the CVFPP and documented in interim products and reference documents (Figure 1-8).

CENTRAL VALLEY FLOOD PROTECTION ACT OF 2008

California Water Code Section 9603 (a)
 “The Central Valley Flood Protection Plan shall be a descriptive document, and neither the plan nor anything in this part shall be construed to expand the liability of the state for the operation or maintenance of any flood management facility beyond the scope of the State Plan of Flood Control, except as specifically determined by the board pursuant to Section 9611. Neither the development nor the adoption of the Central Valley Flood Protection Plan shall be construed to constitute any commitment by the state to provide, to continue to provide, or to maintain at, or to increase flood protection to, any particular level.”

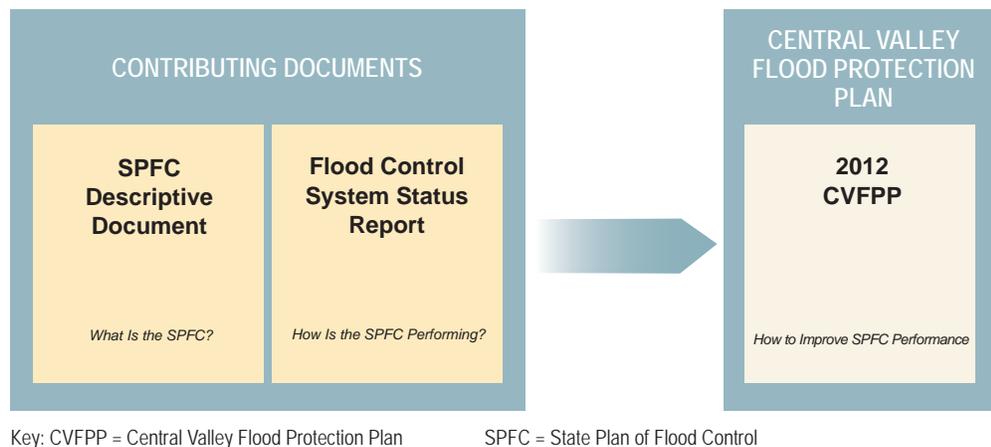


Figure 1-8. Contributing Documents

Collectively, this body of work fulfills the intent and requirements of the Central Valley Flood Protection Act of 2008, embedded in Senate Bill 5 and codified in Sections 9600 through 9625 of the California Water Code. Detailed specifications for the plan formulation process and its contents are provided for reference in Attachment 1 – Legislative Reference.

In accordance with the requirements of the act, the Board is expected to adopt the CVFPP on or about July 1, 2012. The CVFPP will subsequently be updated every five years by DWR and submitted to the Board for adoption.

The 2012 CVFPP focuses on improving integrated flood management and flood risk reduction for areas protected by facilities of the SPFC (Figure 1-9). While the CVFPP focuses on the areas protected by SPFC facilities, the flood emergency response and operations and management of facilities in tributary watersheds that influence SPFC-protected areas are also considered.

The CVFPP recognizes the connection of flood management actions to water resources management, land use planning, environmental stewardship, and long-term economic, environmental, and social sustainability. Integrated flood management also recognizes the importance of evaluating opportunities and potential impacts from a systemwide perspective, and the importance of coordinating across geographic and agency boundaries to treat entire hydrologic units.

The CVFPP provides an opportunity to mitigate some of the negative effects of current trends while promoting wise investments of federal, State, and local funds, as in the following examples:

- The CVFPP will emphasize wise floodplain management, which, in concert with FEMA’s National Flood Insurance Program, will limit excessive floodplain development and promote continued sustainability of the current rural-agricultural economy and small communities.
- Investments in levees and other flood protection infrastructure will be considered on a systemwide basis. It is likely that urban communities, with the greatest concentrations of population and damageable property, will continue

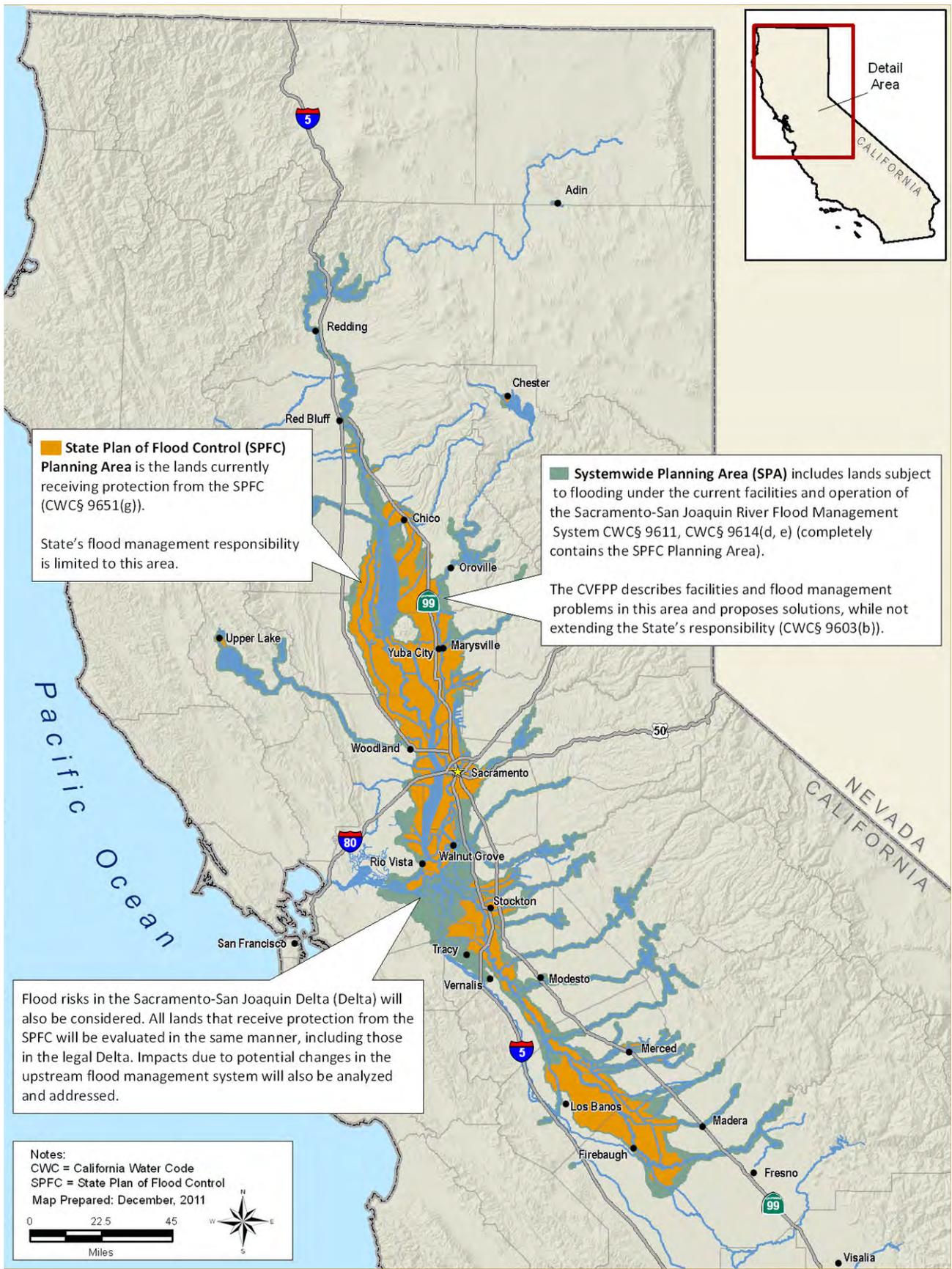


Figure 1-9. Geographic Scope of Central Valley Flood Protection Plan

to receive the greatest share of available federal and State funds. However, the CVFPP gives careful attention to fixing known weaknesses in the rural-agricultural levee system and also protecting small communities. Because rural-agricultural areas are less developed, the State is interested in seeing more nonstructural improvements, as these often can have lower long-term annual operations and maintenance costs and greater system benefits. With this in mind, the CVFPP provides a framework for a much broader benefit analysis than the traditional approach, which relies almost entirely on the benefit-to-cost ratio and net economic development indicators to guide investments. The CVFPP considers potential system improvements, such as expanded bypasses and associated ecosystem enhancements, which are beyond the sponsorship capabilities of even the most robust local agencies.

- The CVFPP proposes to take an integrated system approach to maintenance and ecosystem restoration. In practice, this means an approach that promotes implementation of a future flood management system footprint that provides additional habitat area to help support recovery of listed species and other State conservation goals while reducing flood risk by reducing long-term maintenance needs.
- The CVFPP focuses on implementation and considers the sequential phasing of incremental elements of the programs. This approach relies on development of a firm technical foundation to inform implementation actions in future CVFPP phases, with an initial focus on the most urgent flood management system needs. It also supports development of a sound funding strategy to pursue effective, long-term flood management in the Central Valley.

1.6.1 Outreach Activities Informing Central Valley Flood Protection Plan

DWR initiated an extensive communications and engagement process for the 2012 CVFPP by reaching out to partnering agencies, interested parties, and the public, allowing them to share and solicit information and offer input and recommendations. The intent was to facilitate open communication and provide opportunities to participate in CVFPP development in a variety of ways, depending on interest and availability.

A comprehensive, multiphase, public engagement planning process was essential in developing the CVFPP. Figure 1-10 depicts the phases and major components of the engagement process. In addition, all public engagement activities are detailed in Attachment 5 – Engagement Record.

CENTRAL VALLEY FLOOD PROTECTION ACT OF 2008

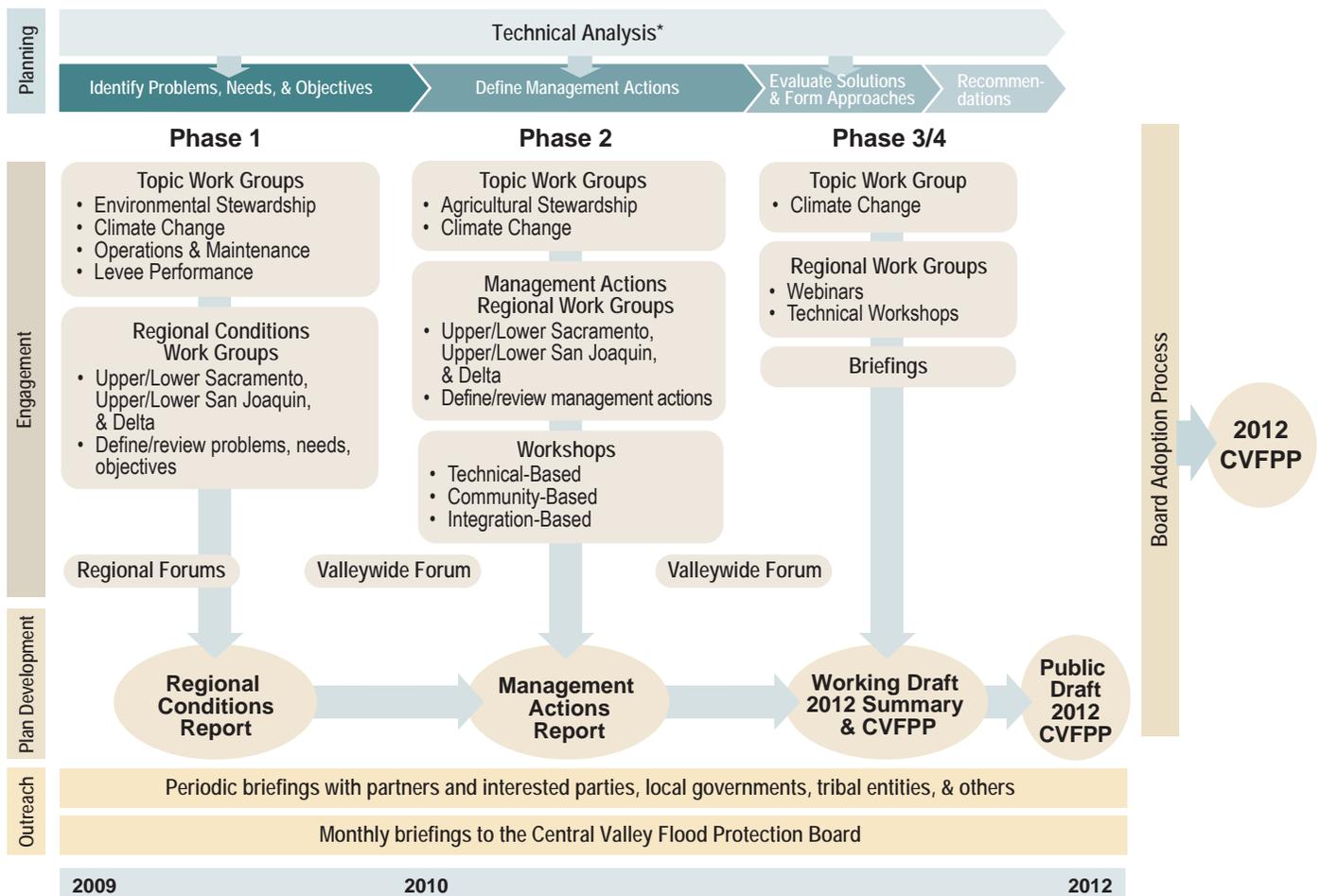
California Water Code Section 9615. "For the purposes of preparing the plan, the department shall collaborate with the United States Army Corps of Engineers and the owners and operators of flood management facilities."

Throughout the planning process, many different venues promoted open and transparent communication about important integrated flood management issues and provided partners and interested parties with opportunities to participate in CVFPP development. DWR staff also communicated and met with many local maintaining agencies to solicit feedback on levee performance issues and confirm preliminary results of DWR levee assessments (for both urban and nonurban levee evaluations). Using this information, DWR, USACE, the Board, and their partners worked together to characterize problems and future trends, shape and define goals and planning principles, formulate management actions, and evaluate possible solutions for integrated flood management. These efforts will also be vital to implementation of the CVFPP.

ENGAGING CALIFORNIA'S TRIBAL COMMUNITIES IN FLOOD MANAGEMENT IMPROVEMENTS

The State respects the perspectives and opinions held by California's Tribal communities. To that end, the CVFPP communication and engagement approach included regular communication with Tribal representatives, and utilized the California Water Plan Tribal Communications Committee to share and receive information relevant to the CVFPP.

It will be important and necessary for local, regional, State, and federal government agencies to collaborate with Tribal governments during the planning and implementation of flood management actions. The local implementation approach will help ensure that historical and valued Tribal lands are respected and considered as planning for flood management improvements continues.



* State Plan of Flood Control Descriptive Document and Flood Control System Status Report inform technical analysis

KEY: Board = Central Valley Flood Protection Board CVFPP = Central Valley Flood Protection Plan

Figure 1-10. Communication and Engagement Process

COMMUNICATION AND ENGAGEMENT

DWR has gone through considerable effort in getting stakeholder feedback and informing a variety of groups and individuals across the CVFPP planning area. Subjects have been as varied as the interest groups themselves. With nearly 300 meetings and more than 40 publications, in addition to a Web site and webinars, the CVFPP has focused on including interested parties and the public.

Initial meetings with organizations and individuals, January and February 2009

- 113 meetings with individuals and organizations across the planning area

Regional and Valleywide forums, June 2009, 2010, and December 2010

- 7 Forums in various areas valleywide

Work groups covering regional conditions and management actions, August 2009 – November 2010

- 55 meetings with stakeholder participation across the planning area

Special Topic work groups and subcommittees, August 2009 – November 2011

- 36 meetings covering a variety of subjects and attended by a variety of stakeholders

Workshops on Flood Management Actions and levee design criteria, July 2010 – September 2011

- 20 workshops focusing on technical issues

Briefings to and coordination with local government, Legislature, interest groups, work groups, and media, January 2010 – May 2011

- 46 briefings on specific subjects of concern and general information to individual groups

Tribe and tribal organization briefings, October 2009 – February 2011

- 17 briefings for various Tribes and Tribal organizations on a variety of subjects

Numerous newsletters, fact sheets, flyers, posters, and reports were distributed to stakeholders via e-mail and in meetings and workshops from May 2009 to the present on a variety of flood topics, including technical and environmental work associated with the CVFPP.

1.6.2 Central Valley Flood Protection Plan Goals

Primary Goal

- **Improve Flood Risk Management** – Reduce the chance of flooding, and damages once flooding occurs, and improve public safety, preparedness, and emergency response through the following:
 - » *Identifying, recommending, and implementing structural and non-structural projects and actions that benefit lands currently receiving protection from facilities of the SPFC.*
 - » *Formulating standards, criteria, and guidelines to facilitate implementation of structural and nonstructural actions for protecting urban areas and other lands of the Sacramento and San Joaquin river basins and the Delta.*

Supporting Goals

- **Improve Operations and Maintenance** – Reduce systemwide maintenance and repair requirements by modifying the flood management systems in ways that are compatible with natural processes, and adjust, coordinate,

and streamline regulatory and institutional standards, funding, and practices for operations and maintenance, including significant repairs.

- **Promote Ecosystem Functions** – Integrate the recovery and restoration of key physical processes, self-sustaining ecological functions, native habitats, and species into flood management system improvements.
- **Improve Institutional Support** – Develop stable institutional structures, coordination protocols, and financial frameworks that enable effective and adaptive integrated flood management (designs, operations and maintenance, permitting, preparedness, response, recovery, and land use and development planning).
- **Promote Multi-Benefit Projects** – Describe flood management projects and actions that also contribute to broader integrated water management objectives identified through other programs.

CVFPP Goals, described above, provide guidance for the formulation of its specific policies and physical elements. The goals also capture guidance and objectives provided in the authorizing legislation (California Water Code Section 9616), summarized in the sidebar.

1.6.3 Plan Formulation Process

Plan formulation for the 2012 CVFPP was a multi-step process. First, DWR, the Board, and participants in the outreach process worked together to define flood risks and related problems in the Central Valley and articulate the CVFPP Goals. Basic principles to guide how the plan was to be developed and implemented were also collaboratively developed.

A wide range of individual management actions were identified as possible ways to address the goals and planning principles. Management actions are individual tactics or strategies, including physical improvements and policy changes, that address the CVFPP Goals while adhering to the planning principles.

The California Central Valley Flood Protection Act of 2008 (Senate Bill 5) defined objectives, codified in California Water Code Section 9616, for reducing the risk of flooding in the Central Valley. Per California Water Code Section 9616, the CVFPP is to describe both structural and nonstructural means for improving the performance and eliminating the deficiencies of levees, weirs, bypasses, and other SPFC facilities. Wherever feasible, these actions should meet multiple objectives, including the following:

- Reduce the risk to human life, health, and safety from flooding, including protection of public safety infrastructure.
- Expand the capacity of the flood management system in the Sacramento-San Joaquin Valley to either reduce floodflows or convey floodwaters away from urban areas.
- Link the flood protection system with the water supply system.
- Reduce flood risks in currently nonurbanized areas.
- Increase the engagement of local agencies willing to participate in improving flood protection, ensuring a better connection between State flood protection decisions and local land use decisions.
- Improve flood protection for urban areas to the urban level of flood protection.
- Promote natural dynamic hydrologic and geomorphic processes.
- Reduce damage from flooding.
- 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.
- Minimize flood management system operations and maintenance requirements.
- Promote the recovery and stability of native species' populations and overall biotic community diversity.
- Identify opportunities and incentives for expanding or increasing use of floodway corridors.
- Provide a feasible, comprehensive, and long-term financing plan for implementing the CVFPP.
- Identify opportunities for reservoir reoperation in conjunction with groundwater flood storage.

Given the large geographic scope and range of perspectives affecting flood management solutions in the Central Valley, thousands of potential solutions could have been formed by combining the management actions in different ways. Instead, the management actions were combined to create a manageable range of flood management approaches. Evaluation of these preliminary approaches identified trade-offs between benefits, costs, and other decision making factors, and identified the most promising elements of each approach.

Computer models were used to evaluate the hydrologic and hydraulic performance of the flood management system, comparing the existing system to preliminary approaches with various combinations of levee improvements, expanded bypasses, and additional reservoir storage. These models simulated storm precipitation, runoff, reservoir operations, and flows moving downstream through the system to the Delta. The models took into account levee heights and fragility, weir spills, levee failures, and other dynamic processes that can occur during major floods. The output from these hydrologic and hydraulic models was used in additional models to estimate flood damages in the protected floodplains.

This suite of computer models made it possible to evaluate flood system performance and the potential systemwide effects (both benefits and impacts) of various improvements in terms of flows, velocities, and stages.

Costs of capital improvements and programs were also evaluated on a reconnaissance level for the purpose of comparing preliminary approaches. Cost estimates used in this report were based on 2011 dollars. More detailed cost evaluations, taking into account financing costs, inflation, and implementation time, will be developed as part of a Financing Plan for the CVFPP and during subsequent feasibility study analyses.

Section 2 discusses the preliminary approaches and summarizes how each approach meets the legislative objectives and goals of the CVFPP. The State Systemwide Investment Approach (SSIA), described in Section 3, was formulated after evaluation of the preliminary approaches and determining that the most reasonable and cost-effective approach to reducing flood risks, while addressing other key goals, was to combine key elements from each of the three preliminary approaches.

1.6.4 Central Valley Flood Protection Plan Implementation

The CVFPP will guide State, federal, and local actions for improving flood management in areas currently protected by facilities of the SPFC. The CVFPP addresses the unique responsibilities of the State, as they relate to the SPFC.

The 2007 flood legislation requires cities and counties in the Sacramento-San Joaquin Valley to incorporate information from the CVFPP into local land use plans and projects after the CVFPP is adopted. Subsequently, cities and counties will also be required to make findings related to the urban level of flood protection (California Government Code Sections 65865.5, 65962, and 66474.5).

COORDINATION WITH OTHER PROGRAMS AND PROJECTS

DWR will continue to coordinate with other flood management and ecosystem enhancement work during CVFPP implementation. Following are a few key examples:

Statewide Flood Management Planning Program. The comprehensive Statewide Flood Management Planning Program is assessing flood risk statewide to inform development of the State's flood management policies and investment decisions over the next 15 – 20 years. This is a program complementary to the CVFPP that focuses on areas outside the SPFC, including the Delta.

Delta Stewardship Council's Delta Plan. The Delta Plan is driven by coequal goals of providing a more reliable water supply for California and protecting, restoring, and enhancing the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place. The plan also includes policies and recommendations to reduce risk to people, property, and State interests in the Delta.

Bay Delta Conservation Plan. When complete, the Bay Delta Conservation Plan will provide the basis for issuing of endangered species permits for operation of State and federal water projects. The plan would be implemented over the next 50 years. The heart of the Bay Delta Conservation Plan is a long-term conservation strategy that sets forth actions needed for a healthy Delta and making modifications to the conveyance of the State and federal water projects. Ecosystem enhancement activities may extend into areas protected by the SPFC (e.g., the Yolo Bypass); therefore, those activities are incorporated into the CVFPP.

Coordination with Other Flood Management and Ecosystem Restoration Programs. DWR will continue coordination with other programs to improve synergy among various flood management and environmental restoration investments, including programs such as the San Joaquin River Restoration and Fish Passage Improvement projects.

Other Ongoing Activities. DWR will continue to coordinate with many other ongoing activities within the watersheds of the Sacramento River and San Joaquin River basins. Many of the ongoing flood protection improvements have been incorporated into the SSIA and are expected to eventually become part of the SPFC. DWR will coordinate CVFPP activities with the Integrated Regional Water Management Plans, California Water Plan Updates, and other activities to integrate flood management in these programs.

Future updates to the 2012 CVFPP will incorporate new and revised information and also review and realign goals and actions as specific projects are implemented and conditions in the Central Valley evolve. Additional activities, such as local and regional studies, federal feasibility studies, and environmental compliance evaluations, will occur to support implementation of physical elements or features of the CVFPP.

Section 4 describes the framework for formulating the implementation and financing strategy for the CVFPP. DWR recognizes that funding provided by Propositions 1E and 84 will not be sufficient to realize all of the improvements to flood management in the Central Valley envisioned over time. The 2012 CVFPP includes a financing strategy to support implementation; however, a detailed implementation schedule and financing plan will be prepared after the CVFPP is adopted.

In mutual recognition of the importance of close collaboration and coordination on Central Valley flood risk reduction measures, USACE, DWR, and the Board are

conducting a parallel planning process, the Central Valley Integrated Flood Management Study (CVIFMS), with a scheduled completion date of 2017. It is anticipated that CVIFMS will make recommendations leading to Congressional authorization and federal participation in future flood risk reduction projects, including the CVFPP.

1.6.5 2012 Central Valley Flood Protection Plan Organization

The CVFPP is organized as follows:

- **Section 1 – Responding to the Need for Improved Flood Management in the Central Valley** presents historical flood context, existing and future flood management problems, and an overview of the 2012 CVFPP plan formulation process, including next steps.
- **Section 2 – Preliminary Approaches** discusses actions considered during the planning process for further policy development and investment approach formulation.
- **Section 3 – State Systemwide Investment Approach** details SSIA policy directives, systemwide and regional elements, and anticipated outcomes and costs.
- **Section 4 – Implementing and Managing the State Systemwide Investment Approach** discusses the projects, programs, and actions that will be needed to implement the CVFPP.
- **Attachment 1 – Legislative Reference** outlines legislative requirements fulfilled by the 2012 CVFPP and the supporting analyses and documentation.
- **Attachment 2 – Conservation Framework** describes how environmental stewardship is integrated into flood management activities, directs the reader to relevant environmental elements in the CVFPP, and provides additional detail on environmental planning elements.
- **Attachment 3 – Documents Incorporated by Reference** summarizes documents incorporated by reference in the 2012 CVFPP that may also fulfill other legislative requirements.
- **Attachment 4 – Glossary** defines key terms used in the CVFPP.
- **Attachment 5 – Engagement Record** catalogues and describes the approaches and accomplishments of communication and engagement activities to support and complement technical planning processes implemented through the CVFPP and other related FloodSAFE programs and studies.
- **Attachment 6 – Contributing Authors and Work Group Members List** indexes those who provided substantive comments on and/or content for development of each of the CVFPP documents as well as members of each of the CVFPP work groups.

2.0 PRELIMINARY APPROACHES

Development of the CVFPP included formulation and evaluation of three significantly different preliminary approaches to address the CVFPP Goals. The preliminary approaches were primarily used to explore different potential physical changes to the existing flood management system and to assist in highlighting the need for policy or other management actions. Evaluation of these preliminary approaches displayed information on differences in costs, benefits, and overall effectiveness for use in preparing a preferred approach – the State Systemwide Investment Approach (SSIA).

This section describes formulation and evaluation of the three preliminary approaches and resulting basic considerations used in developing the SSIA, described in detail in Section 3.

2.1 Management Actions

Given the large geographic area covered by the existing flood protection system in the Central Valley, and the resources and problems being addressed, a wide range of different management actions can be considered for inclusion in the CVFPP. Each action represents a discrete feature or process to contribute to one or more of the goals described in Section 1. Through a collaborative process, more than 90 individual management actions were identified and grouped into the following categories:

- Additional floodplain and reservoir storage
- Storage operations
- Flood protection system modifications
- Operations and maintenance
- Ecosystem functions
- Floodplain management
- Disaster preparedness and flood warning
- Floodfighting, emergency response, and flood recovery
- Policy and regulations
- Permitting
- Finance and revenue

The management actions generally encompass broad tactics or strategies, rather than location-specific projects, and vary in their level of detail. They range from physical and operational improvements to the flood management system to residual risk management and overall program implementation considerations.

No single management action can achieve all of the CVFPP goals. Each management action is an individual building block that may be used with other management actions for flood risk reduction on systemwide and regional scales, and for managing residual risk. Each preliminary approach provides a different overall strategy towards flood management that affects which management actions are included.

2.2 Purposes of Preliminary Approaches

DWR formulated and evaluated three preliminary approaches to inform flood management policy development and explore the potential accomplishments of different combinations of physical investments in the flood management system. The preliminary approaches highlight different ways to focus future flood management investments and contribute to the CVFPP Goals in different ways, both in magnitude and geographic scope.

CENTRAL VALLEY OF FLOOD PROTECTION ACT OF 2008

California Water Code Section 9614

“The Plan shall include...

(g) An evaluation of the structural improvements and repairs necessary to bring each of the facilities of the State Plan of Flood Control to within its design standard. The evaluation shall include a prioritized list of recommended actions necessary to bring each facility not identified in subdivision (h) to within its design standard.”

CENTRAL VALLEY OF FLOOD PROTECTION ACT OF 2008

California Water Code Section 9614

“The Plan shall include...

(i) A description of both structural and non-structural methods for providing an urban level of flood protection to current urban areas. The description shall also include a list of recommended next steps to improve urban flood protection.”

An urban area means the same as set forth in Section 5096.805 (k) of the California Public Resources Code.

The three preliminary approaches are as follows:

- **Achieve State Plan of Flood Control Design Flow Capacity.** This approach focuses on improving existing SPFC facilities so that they can convey their design flows with a high degree of reliability based on current engineering criteria. Levee improvements would be made regardless of the areas the levees protect. This approach provides little opportunity to incorporate benefits beyond flood management.
- **Protect High Risk Communities.** This approach evaluates improvements to levees to protect life safety and property for high risk population centers, including urban and small communities. Levees in rural-agricultural areas would remain in their existing configurations. This approach provides minor opportunities to incorporate benefits beyond flood management.
- **Enhance Flood System Capacity.** This approach would seek opportunities to achieve multiple benefits through enhanced flood system storage and conveyance capacity, to protect high risk communities, and to fix levees in place in rural-agricultural areas. This approach combines the features of the above two approaches and provides more room within flood conveyance channels to lower flood stages throughout most of the system, with additional features and functions for ecosystem restoration and enhancements.

These preliminary approaches are not alternatives from which a single, superior alternative can be selected. Rather, these approaches display a range of potential physical and operational flood management actions and allow exploration of potential trade-offs in benefits, costs, and other factors, including corresponding needs for residual risk management actions and

necessary policy directives. The three preliminary approaches are intended to bracket the potential range of future flood management in the Central Valley and address flood problems in fundamentally different ways, not to achieve the CVFPP Goals to the same degree. Information provided through evaluations allowed DWR to select the better performing characteristics and avoid the poorer performing characteristics of each preliminary approach to assemble the SSIA.

To effectively evaluate the preliminary approaches, DWR used available technical tools to judge how changes to SPFC facilities would affect systemwide performance while also reducing flood damages, protecting public safety, and restoring degraded ecosystems. As part of this approach evaluation, DWR developed key quantitative indicators. Indicators used to assess the performance of the preliminary approaches include changes to riverine and Delta flood stages, structure and content damages, crop flood loss damages and associated business income losses, and potential for life loss.

Findings from evaluation of the three preliminary approaches, combined with necessary systemwide policies, informed development of the SSIA as the State's proposal for balanced, sustainable flood management in the Central Valley. Parts of the physical actions contained in the three preliminary approaches, along with insight on policies and guidance, were combined to form the SSIA.

Although policies are not specifically identified in a separate policy section of this report, policies are imbedded in duties of the management programs and in the initiatives outlined in Section 4. In addition, policy statements are within the description of management actions in Section 3.

2.3 Preliminary Approach: Achieve State Plan of Flood Control Design Flow Capacity

This approach focuses on reconstructing SPFC facilities to meet current engineering criteria without making major changes to the footprint or operation of those facilities. Engineering risk assessment, design, and construction methods have greatly evolved since the original construction of the SPFC facilities. The system was largely constructed based on geometric criteria using available soil materials without extensive investigation of foundation conditions. Subsequent construction of a series of multipurpose reservoirs benefited the SPFC facilities by reducing peak floodflows. Nevertheless, the majority of the SPFC levees are not capable of carrying their design flows with the degree of reliability based on current engineering criteria because of problems with levee and foundation reliability. In addition, portions of the levee system have experienced erosion damage.

This approach was formulated to address legislation that required DWR to consider structural actions necessary to reconstruct SPFC facilities to their design standard (California Water Code Section 9614 (g)). This approach also addresses requests from stakeholders to consider reconstructing the existing flood management system in place, or without major modification to facility locations. This approach does not

consider improving SPFC facilities to carry floodflows greater than project design flows, nor other enhancements (e.g., to levee height, width, footprint). Also, this approach does not seek a specific level of protection in any area.

2.3.1 Major Components

This approach includes major remedial actions to address medium and high threats to facilities of the SPFC. These threats are identified and described in the *Flood Control System Status Report*. Remedial actions include major reconstruction of SPFC facilities. Medium and high threat factors are those judged to pose the most significant potential threat to SPFC facility integrity. These factors include inadequate levee freeboard, inadequate levee geometry, structural instability, and excessive seepage, as well as inadequate channel capacity to convey design flows.

To address these threats, this approach includes remediation of about 170 miles of urban SPFC levees and 1,400 miles of nonurban SPFC levees. This approach does not include remediation of non-SPFC levees, although it is recognized that some non-SPFC levees can affect flooding within the SPFC Planning Area. Figure 2-1 illustrates the general location of levees for which some kind of SPFC levee remediation would be needed.

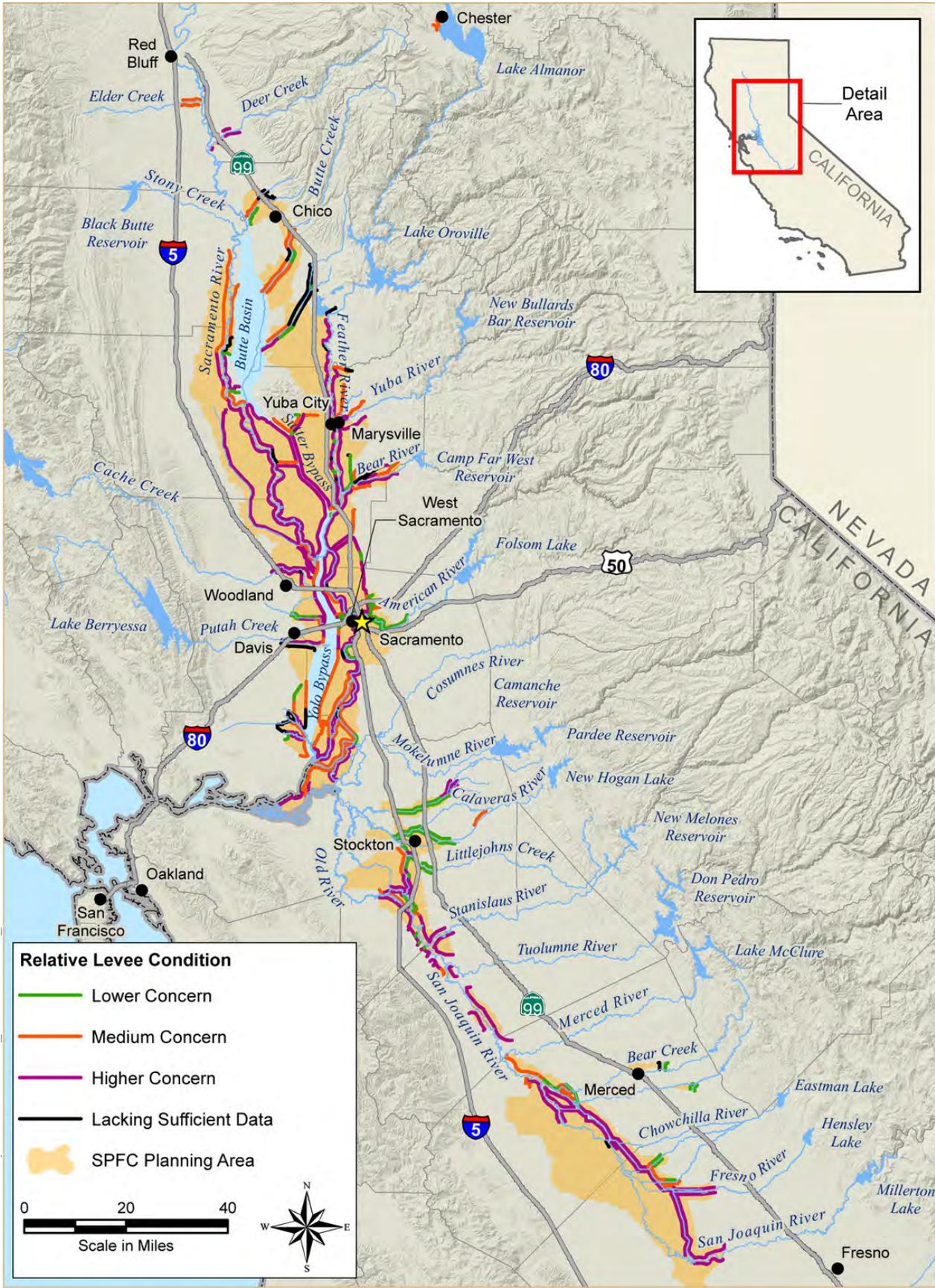
The primary objective of these remedial actions is to improve the levee system to convey SPFC design flows with a high degree of reliability, based on current engineering design and construction criteria. Levees shown as purple in Figure 2-1 (“higher concern”) or orange (“medium concern”) generally display more performance problems than those shown in green (“lower concern”). This approach would address all concerns shown in Figure 2-1.

Remedial actions would primarily include modifications of levees in their current locations, as follows:

- SPFC levees would be modified or reconstructed to address identified adverse geotechnical conditions to provide a high reliability of accommodating design flows.
- Levee height would be increased to achieve design freeboard, where needed, to accommodate the design water surface elevation.

Remedial actions would include different types of stability and seepage berms, cutoff walls, rock slope protection, increased levee height and/or geometry, and replacement levees needed for the system to convey design flows.

Operations of existing weirs, bypasses, and other structures within the flood management system would generally continue as under current conditions. Some short-term changes in reservoir operations (see Section 3) would be made in anticipation of, and during, flood events.



Key: SPFC = State Plan of Flood Control

Figure 2-1. Levee Conditions Considered in Achieve State Plan of Flood Control Design Flow Capacity Approach

2.3.2 Initial Assessment

Based on an initial assessment, the Achieve SPFC Design Flow Capacity Approach is estimated to cost approximately \$19 billion to \$23 billion and take 30 to 35 years to implement. This approach would provide an approximate 47 percent reduction in annual flood damages compared to current conditions.

This approach would improve the reliability of SPFC facilities compared with existing conditions. Since the original designs did not consider geotechnical and other risk factors addressed by current engineering criteria, reconstruction would significantly improve reliability of the levee system and the level of protection provided by the SPFC over that of existing conditions. However, the level of protection would be highly variable throughout the system and not linked to the land uses at risk within the floodplain.

ACHIEVE SPFC DESIGN FLOW CAPACITY APPROACH

- Reconstruction of approximately 1,600 miles of levee.
- Reconstruction of levees in their current footprint to safely pass design flows would contain more floodflows within channels, thus increasing peak floodflows and stages throughout the system.
- Reduction of approximately 47 percent in annual flood damage estimates includes structure values and contents and crops.
- Estimated capital costs are higher for the Sacramento River Basin because of the greater number of levees in the basin.

In many locations, levee reconstruction would result in increased peak flows and stages compared with current conditions because of the reduction in levee failures. Consequently, this approach would only partially address the primary CVFPP goal of improving flood risk management.

Investments in SPFC reconstruction would initially reduce SPFC operations and maintenance costs. However, the long-term cost to maintain the system would remain high (similar to current conditions) because reconstruction alone would not address chronic erosion, sedimentation, and other geomorphic conditions inherent to the current system configuration. This approach would only partially contribute to the goal of improving operations and maintenance.

Because the footprint and operation of an SPFC facility would remain largely unchanged under this approach, opportunities to integrate ecosystem restoration and enhancement would be

limited and would not contribute to improved ecosystem functions on a systemwide scale. Therefore, existing conflicts between environmental stewardship and levee maintenance practices would continue to hamper the improvement of ecosystem conditions and public safety. There would also be few opportunities to incorporate new groundwater recharge or other water-related benefits. Consequently, this approach would contribute in only a minor way to the supporting goals of promoting ecosystem functions and multi-benefit projects.

2.4 Preliminary Approach: Protect High Risk Communities

This approach focuses primarily on physical improvements to facilities of the SPFC to address the highest threats to public safety and property. These threats predominate in densely populated areas, including urban areas and small communities subject to deep or rapid flooding.

2.4.1 Major Components

This approach includes a variety of physical actions to reduce the chances of flooding in urban areas and small communities where substantial threats to public safety exist from flooding from major rivers and tributaries with SPFC facilities. This approach does not include improvements that may be needed to address interior drainage or other local sources of flooding. Also, this approach does not include improvements to non-SPFC levees that protect some urban areas.

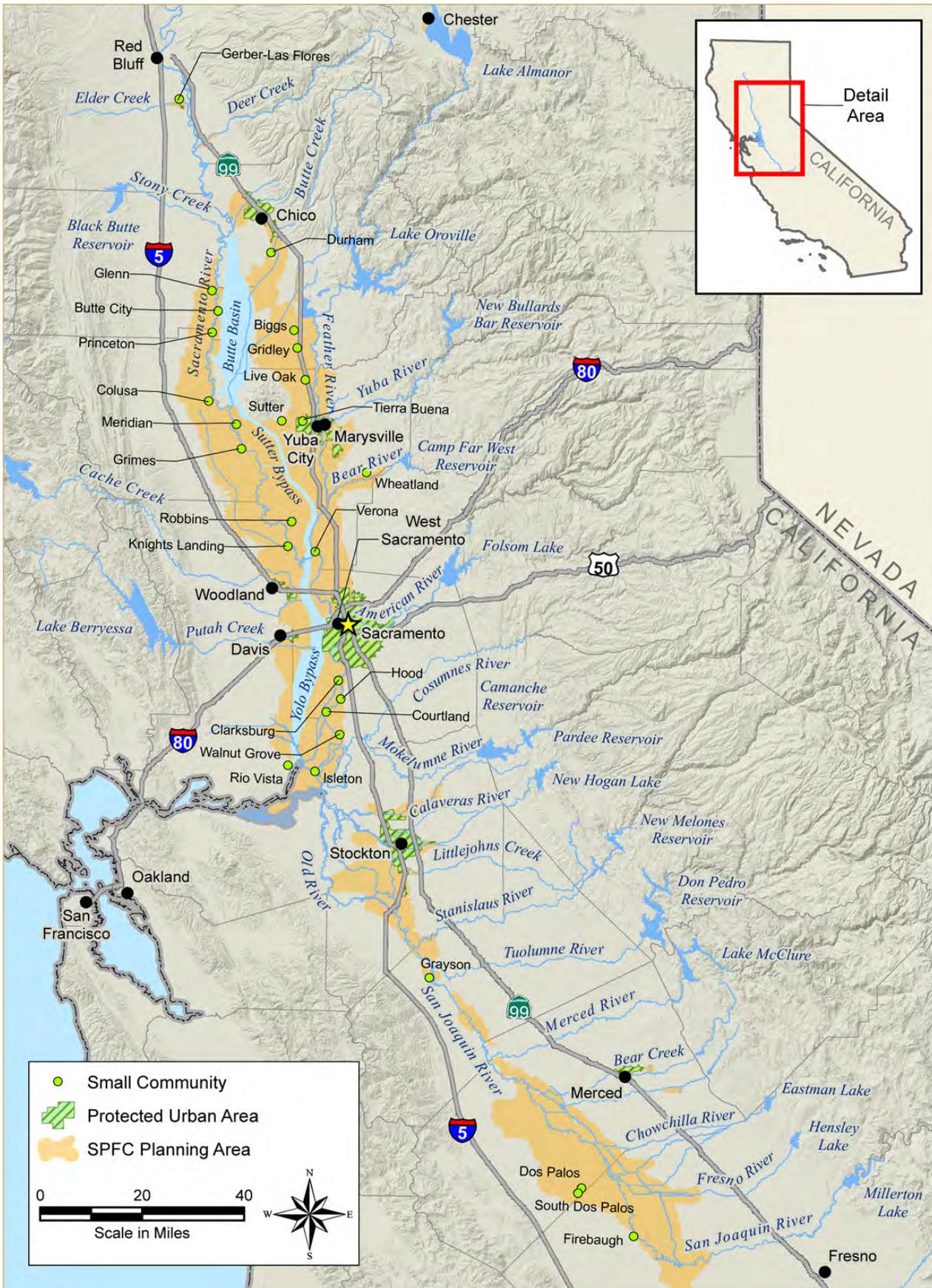
DWR assessed flood threat levels based on the population at risk, population density, flood frequency, flood depth, and proximity to river or tributary flood sources. This approach focused on reducing flooding from major rivers and waterways associated with the SPFC; flooding from small drainages, local sources, and interior storm drainage were not included in the formulation of this approach.

Figure 2-2 shows the urban areas and small communities considered in the Protect High Risk Communities Approach.

Urban areas in the floodplain (with populations greater than 10,000) are considered to have high threat levels because of the potentially significant public safety consequences of floods occurring in these densely populated areas within the SPFC Planning Area. In general, this approach considered structural options for protecting small communities.

The targeted level of flood protection and the types of flood management improvements considered for urban areas and small communities are summarized below:

- Urban areas would achieve protection from a 200-year (0.5% annual chance) flood event, consistent with the urban level of flood protection requirement. This would be accomplished via structural repairs, reconstruction, or improvements to about 160 miles of urban SPFC levees to protect a population of about 1 million. This includes work for Chico, Yuba City, Marysville, Sacramento, West Sacramento, Woodland and Davis, Stockton, and Merced. Repairs and improvements would typically be implemented within current facility footprints (in-place fixes) because of the proximity of existing development and infrastructure.
- Small communities would achieve protection from a 100-year (1% annual chance) flood event, corresponding to the existing federal standard for developed areas. This would be accomplished primarily via structural repairs or reconstruction of existing nearby SPFC levees. Construction of new training levees, ring levees, or floodwalls immediately adjacent to the communities may also be required. The total length of levee improvement and construction of new levees is approximately 120 miles to protect a population of about 47,000. The targeted level of protection for small communities is considered for planning purposes only, and does not represent a State requirement or target. A total of 27 small communities were included in this approach.



Key: SPFC = State Plan of Flood Control

Figure 2-2. Urban Areas and Small Communities Included in Protect High Risk Communities Approach

Weirs, bypasses, and other control structures would remain unchanged. Some short-term changes in reservoir operations (see Section 3) would be made in anticipation of, and during, flood events.

2.4.2 Initial Assessment

Based on an initial assessment, the Protect High Risk Communities Approach is estimated to cost between approximately \$9 billion to \$11 billion and take 15 to 20 years to implement. This approach would provide an approximate 63 percent reduction in annual flood damages compared to current conditions.

The potential for loss of life and economic damages in urban areas, which would achieve an urban level of flood protection, would be reduced substantially. Improved flood protection for small communities would also reduce the potential for loss of life and economic damages, while preserving the important resources these communities provide to surrounding rural-agricultural areas. However, levels of protection elsewhere in the valley, particularly rural-agricultural areas, would generally not improve. Consequently, this approach only partially addresses the primary goal of improving flood risk management. Because of the limited extent of levee improvements, relatively minor changes in peak floodflows and stages would occur systemwide.

Although limited, this approach would include the opportunity to improve operations and maintenance of SPFC facilities in the vicinity of a number of urban areas and small communities, including provisions for local erosion monitoring and problem corrections. However, the long-term cost to maintain the system would remain high (similar to current conditions) because this approach would not address chronic erosion, sedimentation, and other geomorphic conditions associated with the majority of rural SPFC facilities. Consequently, this approach would only partially contribute to the goal of improving operations and maintenance.

There would be some opportunities to integrate environmental features into small community and urban area protection actions, including the construction of waterside berms or incorporation of native vegetation or habitat. However, because these opportunities would largely be site-specific, and because the footprint and operation of the SPFC facilities would remain largely unchanged, this approach would not significantly contribute to the restoration of ecosystem functions. Also, there would be few opportunities to incorporate groundwater recharge or other water-related benefits. Consequently, this approach would contribute in only a minor way to the supporting goals of promoting ecosystem functions and multi-benefit projects.

PROTECT HIGH RISK COMMUNITIES APPROACH

- Levee improvements limited to urban areas and small communities, resulting in minimal change to how the system functions and to peak floodflows and stages.
- Significant improvement in public safety over existing conditions.
- Reduction of approximately 63 percent in annual flood damage estimates includes structure values and contents and crops.
- Estimated capital costs for improving SPFC facilities to achieve urban level of protection and for protection of small communities are higher for the Sacramento River Basin because of the greater magnitude of population at risk.

2.5 Preliminary Approach: Enhance Flood System Capacity

This approach focuses on enhancing flood system storage and conveyance capacity to achieve multiple benefits. This approach incorporates all elements included in the prior two approaches to reduce flood risks in urban areas and small communities and at least restore SPFC system capacity in rural areas. Flood system capacity enhancements would be designed on a systemwide scale to integrate multiple benefits, including environmental restoration and water supply reliability.

2.5.1 Major Components

This approach includes modifying the existing footprint and function of the flood management system primarily to increase the overall conveyance capacity and floodwater storage, and to provide opportunities for ecosystem restoration and water resources benefits. This approach also protects high risk communities and fixes levees in place in rural-agricultural areas to achieve design flow capacity. This approach does not include improvements that may be needed to address interior drainage or other local sources of flooding. Also, this approach does not include improvements to non-SPFC levees that protect some urban areas.

In general, flood system capacity can be increased through widening floodways and bypasses, setting back levees away from the active river channel, and increasing floodwater storage. Floodwater storage can be increased through a combination of operational changes to existing reservoirs, new reservoir storage, and modified or new floodplain storage. Widening floodways and setting back levees along some reaches of major rivers and tributaries also provides significant opportunities to restore native habitat quantity, quality, and connectivity and to restore natural processes necessary to support healthy ecosystems.

In addition to the elements included in the prior two approaches, major elements of the Enhance Flood System Capacity Approach are shown in Figure 2-3 and include the following:

- The existing bypass system in the Sacramento River Basin – including the Sutter and Yolo bypasses and associated inflow weirs – forms the central backbone of the Sacramento River Flood Control Project, forming a corridor for conveying floodflows to the Delta. This approach would increase the capacity of the existing bypass system to enhance its efficiency and ability to convey large flood events. Initial analyses indicate that the following combination of features could effectively enhance the performance of the existing bypass system:
 - » *Widening the Sutter Bypass by up to 1,000 feet to increase its capacity by 50,000 cubic feet per second*
 - » *Widening the Colusa Weir and Bypass and the Tisdale Weir and Bypass by up to 1,000 feet*

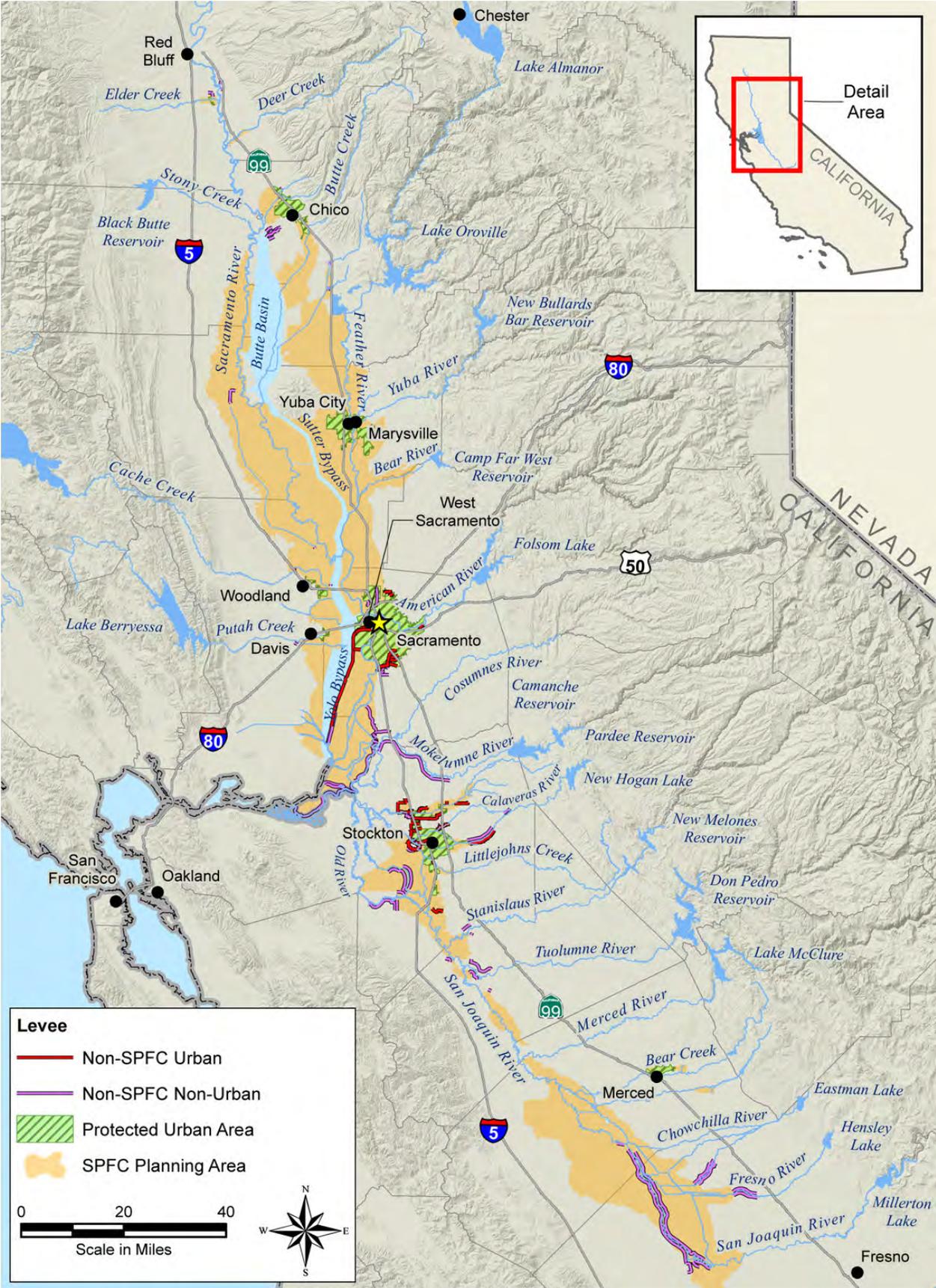


Figure 2-3. Improvements Included in Enhance Flood System Capacity Approach

- » *Widening the Fremont Weir by about one mile, and widening portions of the Yolo Bypass to increase its capacity by 40,000 cubic feet per second*
- » *Widening the Sacramento Weir and Bypass by about 1,000 feet*
- This approach also includes a potential new bypass to divert flows from the Feather River downstream from Oroville Dam along the alignment of Cherokee Canal into Butte Basin. Initial analyses indicate that a bypass with a capacity of 32,000 cubic feet per second could reduce peak flood elevations along the Feather River and help convey floodflows into the existing bypass system.
- In the lower portion of the San Joaquin River Basin, this approach includes a new bypass to divert flows from the San Joaquin River into the south Delta. Preliminary analyses indicate that a new bypass at Paradise Cut, or in its vicinity, with a capacity of about 4,000 cubic feet per second could effectively reduce peak flood stage along the San Joaquin River in the Stockton metropolitan area.
- This approach includes floodway widening along smaller sections of the river by setting back SPFC levees as follows:
 - » *Along the right bank of the Feather River (below the Bear River confluence) to allow opportunities for ecosystem restoration and to provide continuity with the Sutter Bypass*
 - » *Along intermittent sections of the Sacramento River upstream from the Tisdale Weir to provide a more continuous corridor for environmental restoration and to address levee conditions*
 - » *Along the San Joaquin River between the Merced and Stanislaus rivers*
- This approach includes modification to the reservoir release schedule and flood storage allocation at Oroville Dam and Reservoir (equivalent to an additional 200,000 acre-feet of flood storage), and coordinated operation with New Bullards Bar Reservoir, to reduce flood stages on the Feather River during a 200-year (0.5% annual chance) flood event. Also, in the San Joaquin River Basin, the State would partner with interested reservoir operators to increase the flood storage allocation at New Don Pedro, Friant, and New Exchequer dams by about 400,000 acre-feet to effectively manage the 100-year (1% annual chance) flood event at these reservoirs. These features help manage the timing and magnitude of peak floodflows before they enter the Sacramento and San Joaquin rivers.
- This approach includes approximately 200,000 acre-feet of transitory storage in the floodplains of the Sacramento River Basin and approximately 100,000 acre-feet of transitory storage in the floodplains of the San Joaquin River Basin. Floodplain storage effectively works with bypass and floodway expansion to attenuate flood peaks and provide opportunities for conservation of agricultural lands and native floodplain habitats.

2.5.2 Initial Assessment

Based on an initial assessment, the Enhance Flood System Capacity Approach is estimated to cost between approximately \$32 billion to \$41 billion and would take 35 to 40 years to implement. This approach would provide an approximate 80 percent reduction in annual flood damages compared to current conditions.

The expansion of system storage and conveyance capacity would reduce peak flood stages throughout the system. This would result in increased levels of flood protection throughout the system, although levels would continue to vary from location to location. Urban areas would achieve an urban level of flood protection, or higher, through the combination of conveyance, storage improvements, and in-place levee improvements. Flood damages would be significantly reduced to various degrees throughout the system. Accordingly, this approach would address the primary goal of improving flood risk management, although at a high cost.

This approach would provide opportunities to address chronic erosion, geomorphic conditions, and levee foundation conditions that make operations and maintenance of the current system costly and unsustainable. Hence, this approach would significantly address the supporting goal of improving operations and maintenance.

This approach would also provide opportunities to restore native habitats (including aquatic, riparian, and floodplain habitats) and improve the quality and connectivity of environmental resources within the flood management system. In addition, there would be opportunities to improve (1) water supply reliability through multipurpose reservoir storage projects, (2) conjunctive management of groundwater and surface water resources, and (3) groundwater recharge within floodplain storage areas. Accordingly, this approach would address the supporting goals of promoting ecosystem functions and multi-benefit projects.

ENHANCE FLOOD SYSTEM CAPACITY APPROACH

- Expansion of storage and conveyance capacity to attenuate flood peaks, resulting in reduced peak flood stages throughout the system. However, peak floodflows may increase locally in certain reaches as a result of the proposed expansion of bypasses.
- Reduction of approximately 80 percent in annual flood damage estimates includes structure values and contents and crops.
- Higher estimated capital costs for the Sacramento River Basin because of the greater number of levees, and magnitude of assets and population at risk.
- Enlarging the area within the levees, providing more room for floods and habitat and promoting natural hydrologic and geomorphic processes.

2.6 Comparison of Preliminary Approaches

To illustrate the potential tradeoffs among benefits, costs, and other factors relevant to formulation of the SSIA, the three preliminary approaches are compared according to their effectiveness in contributing to the CVFPP Goals and other performance measures.

The following sections show comparisons among the three approaches. These comparisons assisted DWR in selecting superior elements of each preliminary approach when assembling the SSIA.

2.6.1 Major Elements

Table 2-1 shows major elements of the three preliminary approaches. The first two approaches differ significantly regarding improving SPFC facilities. The third approach includes all of the elements of the first two approaches plus many additional elements.

Table 2-1. Major Elements of Preliminary Approaches

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Bypasses				
New Bypass Construction and Existing Bypass Expansion	<ul style="list-style-type: none"> • Feather River Bypass • Sutter Bypass Expansion • Yolo Bypass Expansion • Sacramento Bypass Expansion • Lower San Joaquin River Bypass (Paradise Cut) Components potentially include land acquisition, levee improvements, and new levee construction			YES
Reservoir Storage and Operations				
Forecast-Coordinated Operations/ Forecast- Based Operations	Fifteen reservoirs with Sacramento River Basin and San Joaquin River Basin	YES	YES	YES
Reservoir Storage/Enlarge Flood Pool	<ul style="list-style-type: none"> • Oroville • New Bullards Bar • New Don Pedro • McClure • Friant 			YES
Easements	<ul style="list-style-type: none"> • Sacramento River Basin – 200,000 acre-feet • San Joaquin River Basin – 100,000 acre-feet 			YES
Flood Structure Improvements				
Major Structures	<ul style="list-style-type: none"> • Intake structure for Feather River Bypass • Butte Basin small weir structures • Upgrade and modification of Colusa and Tisdale weirs • Sacramento Weir widening and automation • Gate structures and/or weir at Paradise Cut • Upgrade of structures in Upper San Joaquin Bypasses • Low-level reservoir outlets at New Bullards Bar Dam • Fremont Weir widening and improvement • Other pumping plants and small weirs 			YES
System Erosion and Bypass Sediment Removal Project	<ul style="list-style-type: none"> • Cache Creek Settling Basin sediment management • Sacramento System Sediment Remediation Downstream from Weirs 			YES

Table 2-1. Major Elements of Preliminary Approaches (cont'd.)

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Urban Improvements				
Target 200-Year Level of Protection	Selected projects developed by local agencies, State, federal partners		YES	YES
Target SPFC Design Capacity	Urban Levee Evaluations Project results	YES ²		
Non-SPFC Urban Levee Improvements	Includes approximately 120 miles of non-SPFC levees that are closely associated with SPFC urban levees. Performance of these non-SPFC levees may affect the performance of SPFC levees	YES	YES	YES
Small Community Improvements				
Target 100-Year Level of Protection	Small communities protected by the SPFC		YES ³	YES ³
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES ²		YES ²
Rural-Agricultural Improvements				
Site-Specific Rural-Agricultural Improvements	Based on levee inspections and other identified critical levee integrity needs			
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES ²		YES
Ecosystem Restoration				
Fish Passage Improvements	<ul style="list-style-type: none"> • Sutter Bypass and fish passage east of Butte Basin • Fremont Weir fish passage improvements • Yolo Bypass/Willow Slough Weir fish passage improvements • Deer Creek 			YES
Ecosystem Restoration and Enhancement	For areas within new or expanded bypasses, contributing to or incorporated with flood risk reduction projects			YES
River Meandering and Other Ecosystem Restoration Activities	At selected levee setback locations in Sacramento and San Joaquin river basins			YES

Notes:

¹ All approaches include Folsom Dam Raise, as authorized.² Actual level of protection varies by location.³ Includes all small communities within the SPFC.

Key:

SPFC = State Plan of Flood Control

State = State of California

Residual Risk Management

In addition to the major physical elements shown above, each approach would require different levels of ongoing annual management of residual risk. Emergency response, flood system operations and maintenance, and floodplain risk management depend on the configuration and reliability of the physical features included in the system. Table 2-2 shows residual risk management for each of the three preliminary approaches. Each column shows the residual risk management actions included for a preliminary approach. The scale of the risk management actions vary among the ap-proaches. For example, the Protect High Risk Communities Approach would

Table 2-2. Residual Risk Management

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Enhanced Flood Emergency Response	All-weather roads on levee crowns	(included in rural levee repairs)	(no rural levee repairs)	(included in rural levee repairs)
	Flood information collection and sharing	YES (small)	YES (large)	YES (small)
	Local flood emergency response planning	YES	YES	YES
	Forecasting and notification		YES	
	Rural post-flood recovery assistance program		YES (large)	
Enhanced Operations and Maintenance	Identify and repair after-event erosion	YES (small)	YES (large)	YES (small)
	Develop and implement enhanced O&M programs and regional O&M organizations	YES	YES	YES
	Sacramento channel and levee management, and bank protection	YES	YES	YES
Floodplain Management	Raising and waterproofing structures and building berms	YES ¹	YES ¹	YES ¹
	Purchasing and relocating homes in floodplains	YES ¹	YES ¹	YES ¹
	Land use and floodplain management	YES	YES	YES

Note:
¹ Ongoing FEMA programs, implementation based on available funding and conformance with federal criteria
 Key:
 FEMA = Federal Emergency Management Agency
 O&M = operations and maintenance
 SPFC = State Plan of Flood Control

RESIDUAL RISK MANAGEMENT

Even with the realization of major physical improvements to the flood management system, the risk of flooding can never be completely eliminated. Unanticipated facility failures or extreme flood events may cause flooding. This remaining flood threat is called “residual risk.”

DWR manages residual risk through programs governed by DWR’s existing organization for FloodSAFE implementation. These programs are responsible for specialized work in the following:

- Flood emergency response
- Flood operations and maintenance
- Floodplain risk management

Areas protected by levees that receive major improvements will generally require lower levels of residual risk management compared with levees that are not improved.

require a “large” effort to identify and repair after-event erosion because rural levees are not improved with this approach. The Enhance Flood System Capacity Approach would require a “small” effort since all levees are improved and many are set back from the rivers. See Section 4 for more discussion of residual risk management.

Costs and Time to Implement

The estimated costs and time to implement the preliminary approaches are shown in Table 2-3.

Cost estimates in the table are for initial costs to imple-

ment physical on-the-ground improvements and ongoing annual costs over 25 years to manage the residual risk for each approach. These estimates are based on 2011 dollars and will differ in the future. Because the approaches are not complete alternatives, the cost estimates are likely low, but suitable for comparison of the preliminary approaches. In addition, actual implementation costs would likely be higher than the estimates because of inflation and the length of time needed to implement the work. The cost estimates allow for planning studies, design, and permitting. The estimates also include costs for ecosystem mitigation for the first two preliminary approaches. For the Enhance Flood System Capacity Approach, the goal in integrating ecosystem restoration and enhancement is to achieve overall habitat improvement, thereby reducing or eliminating the need to mitigate for most ecosystem impacts. However, depending on the timing of improvements and implementation, some ecosystem mitigation may be required.

Table 2-3. Estimated Cost of Approaches

PRELIMINARY APPROACH	LOW COST (\$ BILLION)	HIGH COST (\$ BILLION)	IMPLEMENTATION (YEARS)
Achieve SPFC Design Flow Capacity	19	to 23	30 – 35
Protect High Risk Communities	9	to 11	15 – 20
Enhance Flood System Capacity	32	to 41	35 – 40

Key:
SPFC = State Plan of Flood Control

The estimates of time to implement are based on experience with past flood projects, but with assumptions of more efficient execution of planning and design, engaged federal and local partners, streamlined permitting, and timely funding. In the past, many flood protection projects have remained in the feasibility study phase for a decade or more. Large, complicated projects have often taken several decades to progress from initial concept to completion. Maintaining focus to complete projects in a timely manner is often difficult, especially given changing commitments from State, federal, and local partners over long periods of time.

Peak Flow and Stage Changes

The three preliminary approaches result in different peak flows and stages. Hydrologic and hydraulic modeling for the three preliminary approaches provides estimates of peak flow and stage compared to current conditions (No Project) at key SPFC locations. Modeling considers levee condition and probability of levee failures, which influence floodwater surface elevations. Figure 2-4 shows peak 100-year (1% annual chance) floodflows at several of these locations within the Sacramento River Basin for current conditions (No Project) and the three preliminary approaches. The figure also shows the corresponding peak stage change for each preliminary approach compared to current conditions.

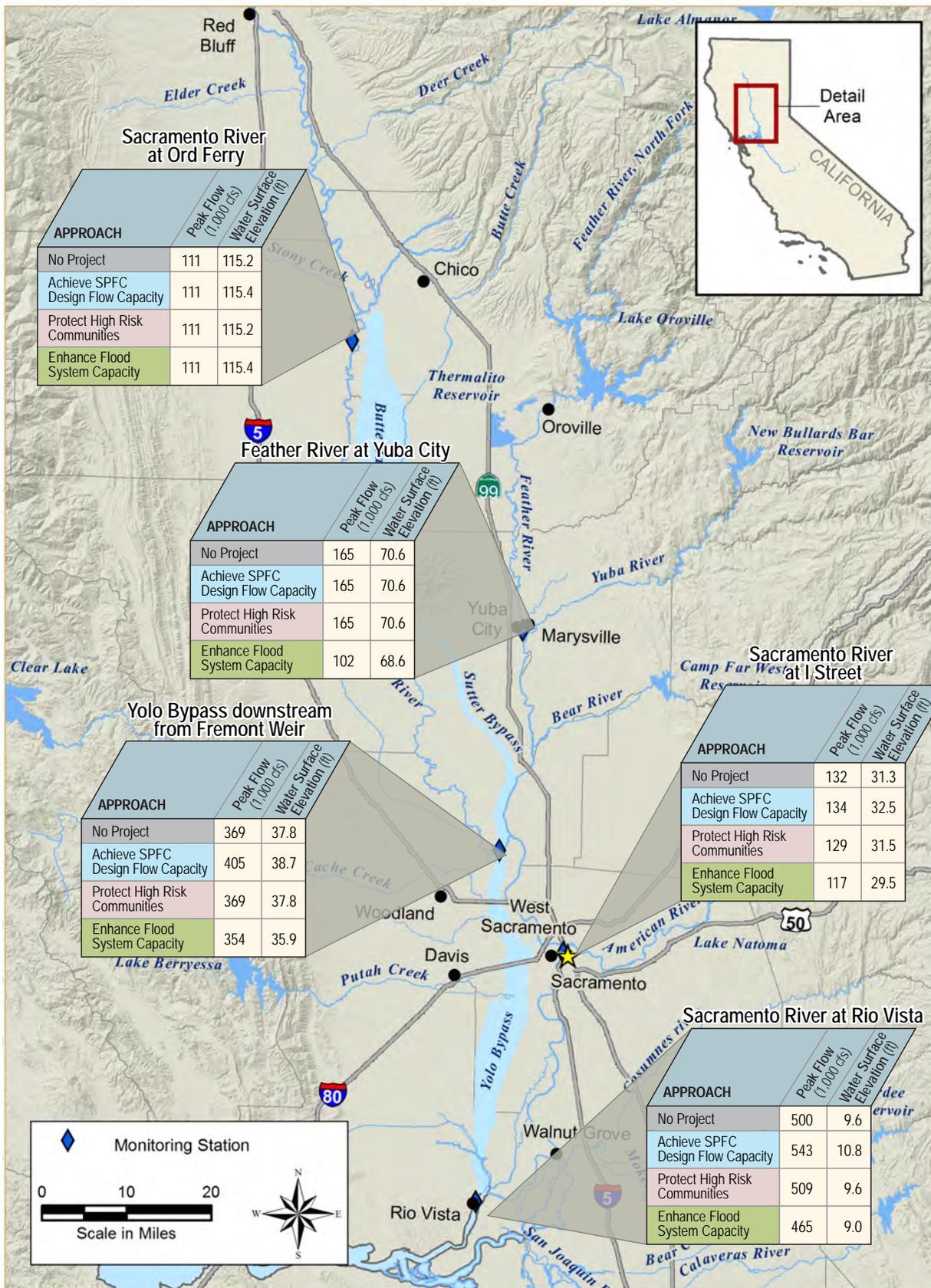
Figure 2-5 shows peak 100-year (1% annual chance) floodflows at several of these locations within the San Joaquin River Basin for current conditions and the three preliminary approaches. The figure also shows the corresponding peak stage for each preliminary approach compared to current conditions.

In general, the Achieve SPFC Design Flow Capacity Approach results in higher river stages than for existing conditions (No Project) because levee rehabilitation occurs in place and levee failures are reduced. A separate detailed analysis beyond the scope of the CVFPP would be needed to identify whether any increased river stage would cause a significant hydraulic impact. The Protect High Risk Communities Approach results in relatively little stage change compared with existing conditions because levee improvements are focused in small areas, and much of the levee system remains in its current condition. The Enhance Flood System Capacity Approach generally provides for lower flood stages, except in the upper San Joaquin River Basin Bypass, because flood peaks are lowered by storage, and bypasses provide wider flow areas that reduce stages.

Performance in Meeting Goals

Table 2-4 compares the relative contributions of the preliminary approaches to the CVFPP primary goal of improving flood risk management. Contributions to the primary goal are described in terms of level of flood protection, public safety, and economic damages.

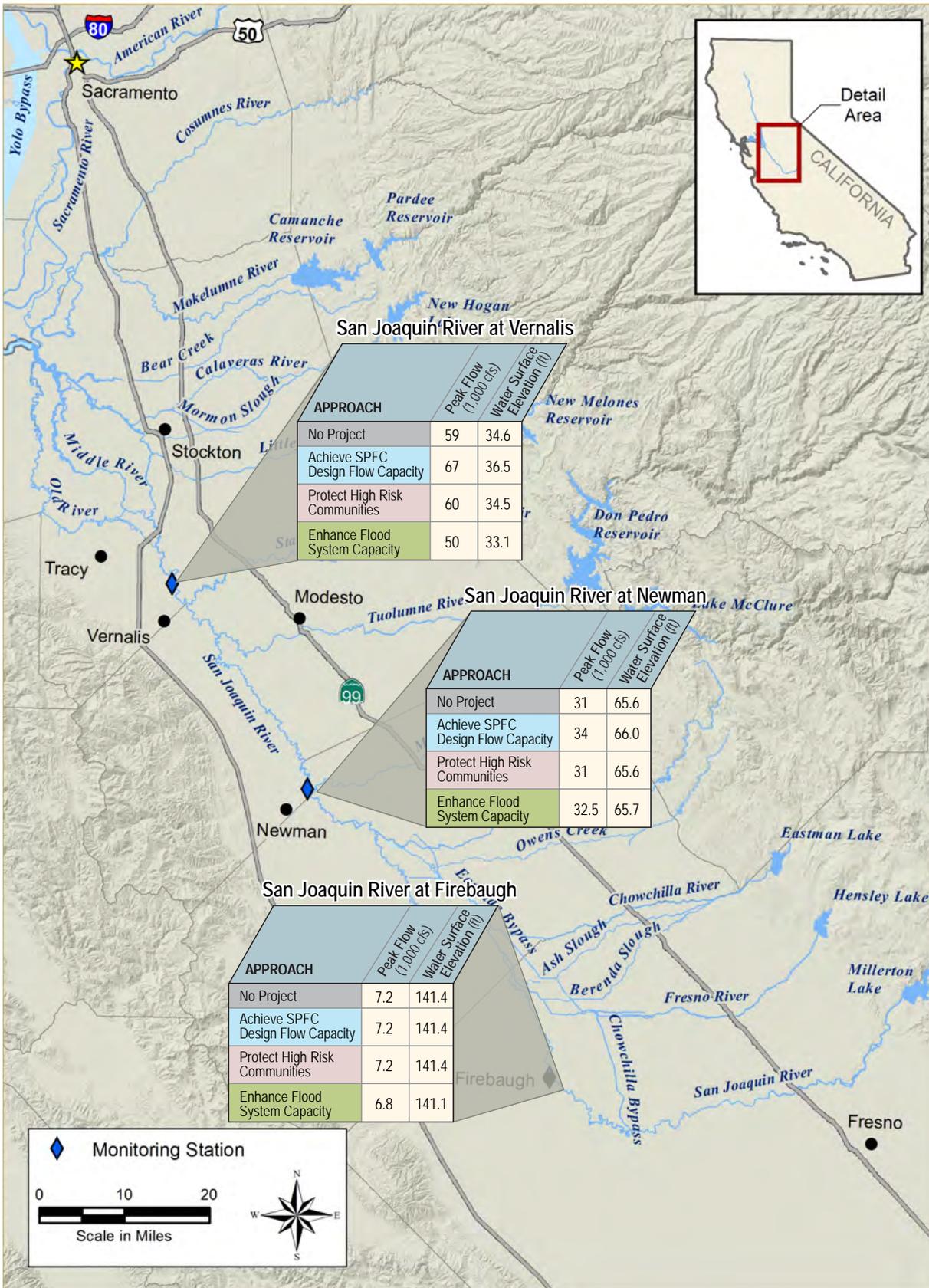
Table 2-5 compares the relative contributions of the preliminary approaches to the CVFPP supporting goals of Improve Operations and Maintenance, Promote Ecosystem Functions, and Promote Multi-Benefit Projects. Table 2-5 also assesses the relative completeness of the preliminary approaches described as the ability to meet the various objectives described in the authorizing legislation.



Location of Peak Flow and Water Surface Elevation Estimates for 100-Year Storm Event at selected monitoring locations in the Sacramento River Basin.

Key: cfs = cubic feet per second ft = feet SPFC = State Plan of Flood Control

Figure 2-4. Simulated Peak Flow and Stage Changes in Sacramento River Basin for 100-year Storm Events



Location of Peak Flow and Water Surface Elevation Estimates for 100-Year Storm Event at selected monitoring locations in the San Joaquin River Basin.

Key: cfs = cubic feet per second ft = feet SPFC = State Plan of Flood Control

Figure 2-5. Simulated Peak Flow and Stage Changes in San Joaquin River Basin for 100-year Storm Events

Table 2-4. Relative Comparison of Preliminary Approach Contributions to Central Valley Flood Protection Plan Primary Goal

METRIC	EXISTING SYSTEM (NO PROJECT)	PRELIMINARY APPROACHES		
		ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Contributions to Primary Goal – Improve Flood Risk Management				
– Level of Flood Protection	Varies throughout system <ul style="list-style-type: none"> Most urban areas do not have urban level of flood protection Protection to rural-agricultural areas and small communities varies widely 	Varies throughout system <ul style="list-style-type: none"> Substantial improvement in rural-agricultural areas and partial improvement in urban areas SPFC facilities reliably pass design flow capacities Levels of flood protection associated with SPFC design flow capacities vary throughout the system 	High in urban areas and small communities, varies elsewhere <ul style="list-style-type: none"> Urban areas achieve 200-year flood protection Small communities achieve 100-year flood protection 	Overall higher protection, but varies throughout system <ul style="list-style-type: none"> Urban areas achieve 200-year flood protection Small communities achieve 100-year flood protection Overall increased levels of flood protection throughout system
– Public Safety (focused on population at risk)	Varies throughout system <ul style="list-style-type: none"> Public safety threat is high for many communities, particularly those in deep floodplains 79% of population with less than 100-year protection 	Some improvement <ul style="list-style-type: none"> Improvement in urban areas Improvement in some small communities protected by SPFC facilities 46% of population with less than 100-year protection 	Highest improvement <ul style="list-style-type: none"> Substantial improvement in urban areas Improvement in small communities 6% of population with less than 100-year protection 	Improvement varies <ul style="list-style-type: none"> Improvement in urban areas Improvement in small communities and rural-agricultural areas 5% of population with less than 100-year protection
– Economic Damages ¹	Very high potential for damages <ul style="list-style-type: none"> Economic damages, particularly in urban areas, are very high \$329 million/year in EAD 	Reduction in rural-agricultural area damages <ul style="list-style-type: none"> Substantial reduction throughout rural areas; some reduction in urban areas 47% reduction in total EAD 	Reduction in urban and small community damages <ul style="list-style-type: none"> Substantial reduction due to focus on protecting urban areas and small communities 63% reduction in total EAD 	Reduction in urban and rural-agricultural area damages <ul style="list-style-type: none"> Substantial reduction due to increased storage and conveyance 80% reduction in total EAD

Note:

¹ Structure and content values used parcel data from the 2010 June ParcelQuest with an October 2010 price index. Parcel data were updated based on information (including depreciation, construction quality, construction class, occupancy type, etc.) in reconnaissance-level field surveys collected from summer 2010 to summer 2011.

Crop data acreages were from the May 2010 DWR GIS land use datasheet. Crop damage unit costs were originated from the *Sacramento and San Joaquin River Basins Comprehensive Study* (USACE, 2002) and were adjusted to an October 2010 price index. Expected annual damages include structure and content, crop, and business income loss.

Key:

DWR = California Department of Water Resources
EAD = expected annual damages
GIS = geographic information system

SPFC = State Plan of Flood Control
USACE = U.S. Army Corps of Engineers

Table 2-5. Comparison of Preliminary Approach Contributions to Central Valley Flood Protection Plan Supporting Goals and Completeness

GOAL/METRIC	EXISTING SYSTEM (NO PROJECT)	PRELIMINARY APPROACHES		
		ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Contributions to Supporting Goals				
Improve Operations and Maintenance	Ongoing and long-term O&M requirements remain very high	Initial decrease in O&M costs, but remain high long-term <ul style="list-style-type: none"> • SPFC reconstruction would initially decrease O&M requirements • Long-term O&M costs would remain high because of potential conflicts with natural geomorphic process 	Increase in long-term O&M requirements <ul style="list-style-type: none"> • Potential cost increase due to the construction of approximately 120 miles of new levees to protect small communities 	Decrease in long-term O&M requirements <ul style="list-style-type: none"> • Decrease in long-term costs due to modifications that make the system more compatible with natural geomorphic processes and facilitate vegetation management and removal of facilities
Promote Ecosystem Functions	Limited opportunities for ecosystem restoration <ul style="list-style-type: none"> • Native habitat may be integrated into SPFC facility repair projects, primarily through mitigation 	Limited opportunities for ecosystem restoration <ul style="list-style-type: none"> • Limited opportunities to integrate ecosystem restoration into in-place repairs to SPFC facilities 	Limited opportunities for ecosystem restoration <ul style="list-style-type: none"> • Limited opportunities to integrate restoration into in-place repairs in urban areas, and new facilities protecting small communities 	Substantial opportunities for ecosystem restoration <ul style="list-style-type: none"> • Floodplain expansion improves ecosystem functions, fish passage, and the quantity, quality, and diversity of habitats
Promote Multi-Benefit Projects	Limited opportunities for multi-benefit projects <ul style="list-style-type: none"> • Limited opportunities to integrate other benefits into repairs to SPFC facilities 	Limited opportunities for multi-benefit projects <ul style="list-style-type: none"> • Limited opportunities to integrate other benefits into repairs to SPFC facilities 	Limited opportunities for multi-benefit projects <ul style="list-style-type: none"> • Limited opportunities to integrate other benefits into repairs, improvements, and new levees 	Enhanced opportunities for multi-benefit projects <ul style="list-style-type: none"> • Increased opportunities to integrate water quality, groundwater recharge, recreation, power, and other benefits
Completeness (ability to meet legislative objectives)				
Ability to Meet Objectives in Flood Legislation	Do not meet <ul style="list-style-type: none"> • Varied level of protection throughout the system and high potential for risks to public safety and economic damages 	Partially meets <ul style="list-style-type: none"> • Limited contributions to environmental and water supply objectives; does not achieve high level of urban flood protection 	Partially meets <ul style="list-style-type: none"> • Limited contributions to environmental and water supply objectives 	Mostly meets <ul style="list-style-type: none"> • Contributes to all objectives, but at highest cost and with substantial impacts to existing land uses (potentially low acceptability)

Key:
 O&M = operations and maintenance SPFC = State Plan of Flood Control

Sustainability

Table 2-6 compares the sustainability aspects of the preliminary approaches. Sustainability relates to the overall financial, environmental, social, and climate change adaptability aspects of the flood management system under a given approach.

Table 2-6. Relative Comparison of Preliminary Approach Sustainability

METRIC	EXISTING SYSTEM (NO PROJECT)	PRELIMINARY APPROACHES		
		ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY ¹
Sustainability (financial, environmental, and social)				
Social	<ul style="list-style-type: none"> Significant risk to public safety and high economic consequences of flooding 	<ul style="list-style-type: none"> Chance for redirected growth outside floodplain from where currently planned due to extensive levee improvements in nonurban areas Some land use impacts due to acquisition/easements to accommodate SPFC reconstruction 	<ul style="list-style-type: none"> Some potential to encourage new development in floodplains within and adjacent to urban area and small community improvements 	<ul style="list-style-type: none"> Considerable impacts to existing land uses due to floodway expansion Some potential to encourage new development in floodplains due to improved level of flood protection
Climate Change Adaptability	<ul style="list-style-type: none"> Low system resiliency (i.e., ability to adapt to climate change) 	<ul style="list-style-type: none"> Does not improve flood system resiliency 	<ul style="list-style-type: none"> Does not improve flood system resiliency 	<ul style="list-style-type: none"> Improves flood system resiliency by enhancing storage and conveyance

Key:

SPFC = State Plan of Flood Control

Qualitative Comparison

Considering evaluation information available for the preliminary approaches, including information shown on the preceding pages, DWR prepared a qualitative comparison to show broad differences in potential performance of the approaches. Figure 2-6 shows estimated relative performance for each preliminary approach. For example, an open circle indicates the lowest performance and a full circle indicates the highest performance.

PERFORMANCE CATEGORY	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY
Flood Risk Reduction Benefit			
Level of Flood Protection			
Life Safety			
Reduction in Economic Damages			
Regional Economics			
Integration and Sustainability			
Promote Ecosystem Functions			
Promote Multi-Benefit Projects			
Sustainable Land Uses			
Cost	\$\$\$	\$\$	\$\$\$
Capital Costs	\$\$\$	\$	\$\$\$\$
Operations & Maintenance	\$\$	\$\$\$\$	\$

BENEFIT KEY

- Low
- Low-Moderate
- Moderate
- Moderate-High
- High

COST KEY

- \$ Low-Moderate
- \$\$ Moderate
- \$\$\$ Moderate-High
- \$\$\$\$ High

Key: SPFC = State Plan of Flood Control

Figure 2-6. Performance Comparison for Preliminary Approaches

Another view of the relative performance of the three preliminary approaches is shown in Figure 2-7. The figure shows estimated performance in terms of secondary benefits (supporting goals from Section 1) against the performance for the primary goal of flood risk reduction. For example, the Achieve SPFC Design Flow Capacity Approach and the Protect High Risk Communities Approach perform similarly for secondary benefits, but the Protect High Risk Communities Approach performs better for flood risk reduction. The figure also plots the size of the approaches (circles) in proportion to their estimated costs.

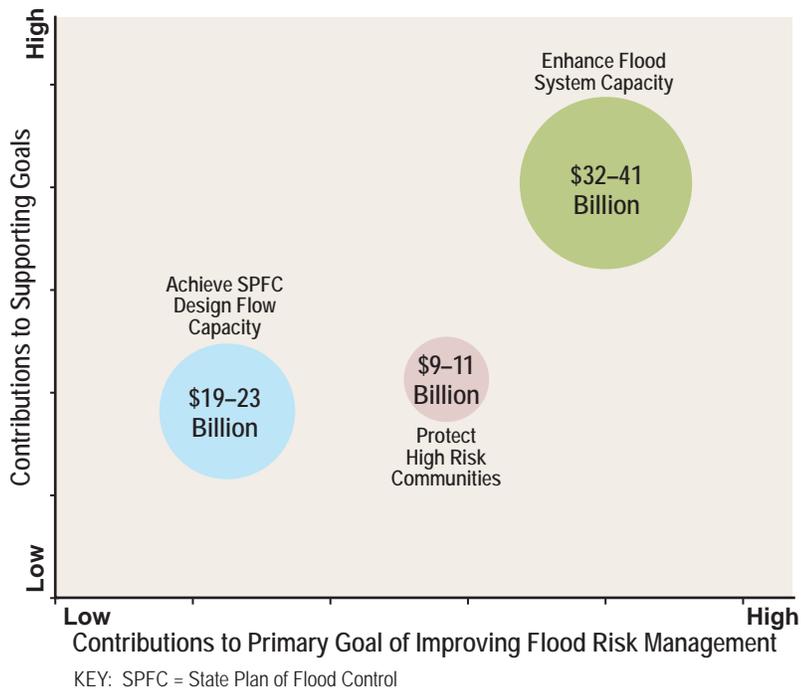
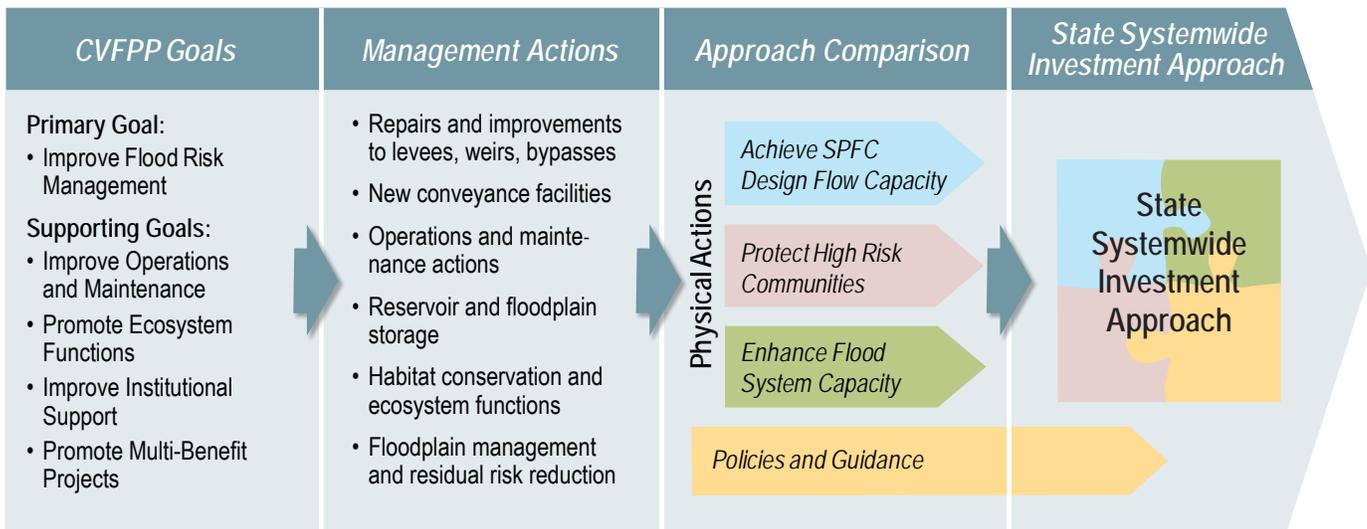


Figure 2-7. Relative Cost and Performance of Three Preliminary Approaches

2.7 Preferred Approach – Meeting Central Valley Flood Protection Plan Goals

Based on relative comparisons of the three preliminary approaches, the Enhance Flood System Capacity Approach best meets and exceeds the CVFPP Goals, but requires the highest level of investment and significant institutional changes. As shown in Tables 2-5 and 2-6, among the three preliminary approaches the Enhance Flood System Capacity Approach is the only approach that substantially improves resiliency to climate change while meeting the objectives delineated in the authorizing legislation in the highest degree. However, each approach highlights opportunities to achieve the goals in different ways, to different degrees, and at different costs. The Enhance Flood System Capacity Approach has a substantially high capital cost, but lower levee operations and maintenance costs compared to the other approaches. The Protect High Risk Communities Approach is the least costly approach, and would result in substantial reduction in flood risks to urban areas and small communities.

Figure 2-8 shows a schematic of the process to assemble the SSIA. CVFPP Goals show what needs to be accomplished to solve problems with the SPFC and address existing challenges to managing the complex flood protection system. Management actions are the building blocks that are used in various ways to develop the preliminary approaches. Comparison of the preliminary approaches helps articulate the trade-offs among various physical actions and also helps develop policies and guidance for the SSIA.



KEY: CVFPP = Central Valley Flood Protection Plan SPFC = State Plan of Flood Control

Figure 2-8. Formulation and Comparison of Approaches to Flood Management in Central Valley

Examination of the performance of preliminary approaches highlights the need to develop a State flood management strategy that combines the strengths of each of the three preliminary approaches into a single approach – the SSIA. The examination considered five distinguishing characteristics that are important from a State investment perspective: (1) life safety, (2) vibrant agricultural economy, (3) reduction in economic losses, (4) ecosystem restoration and enhancements, and (5) cost to implement.

The three preliminary approaches presented above contributed to these characteristics in different degrees. For example, the Achieve SPFC Design Flow Capacity Approach would provide protection for rural-agricultural areas, with less emphasis on an urban level of flood protection and ecosystem benefits. The Protect High Risk Communities Approach would achieve 200-year (0.5% annual chance) urban protection and associated life safety benefits, but would not contribute to rural-agricultural flood risk reduction. The Enhance Flood System Capacity Approach would provide multiple benefits, but at a high cost. The SSIA also incorporates evolving State policies and guidance on a number of issues important to effective flood management in the Central Valley.

The SSIA begins with the Protect High Risk Communities Approach, but encompasses aspects of each of the initial approaches, to balance achievement of the CVFPP Goals from a systemwide perspective. The SSIA would also improve rural-agricultural levees, where feasible. Some rural-agricultural levees would be integrated into system improvements (bypasses) presented in the Enhance Flood System Capacity Approach. As configured, the SSIA is rooted in the vision for the CVFPP and is designed for efficient conveyance of floodflows from existing watershed reservoirs through the Delta. The SSIA has many beneficial features that were included in the three preliminary approaches and the cost and time to implement would be more reasonable.

Following are additional observations on the performance of the preliminary approaches that contributed to formulation of the SSIA.

Achieve SPFC Design Flow Capacity – Improving the existing flood management system to meet current engineering criteria within its existing footprint:

- Is very expensive considering that it primarily addresses the Improve Flood Risk Management goal and does little for supporting goals, especially for promoting multi-benefit projects
- Level of flood protection is significantly improved throughout the system, but is spatially highly variable
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 54 percent compared with existing conditions
- May initially improve operations and maintenance conditions, but long-term benefits are questionable
- Does little to improve ecosystem functions
- May increase flood risks (residential development) in rural-agricultural areas
- Would create significant increases in downstream flood stages over existing conditions by reducing the chance of levee failures upstream
- Would reduce potential flood damages by about 47 percent compared to existing conditions
- Need for residual risk management would be reduced from existing conditions

Protect High Risk Communities – Improving levees in urban areas and small communities:

- Protects, with the least investment, the majority of the population
- Does little to address supporting goals of improving operations and maintenance and promoting ecosystem functions
- Would do little to contribute to adaptive flood management
- Urban areas would achieve 200-year (0.5% annual chance) level of flood protection
- Small communities within the area protected by facilities of the SPFC would achieve 100-year (1% annual chance) of flood protection
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 94 percent compared with existing conditions
- Level of flood protection for rural-agricultural areas would remain unchanged
- Relatively few increases in downstream flood stages from upstream improvements

- Would reduce potential flood damages by about 63 percent compared to existing conditions
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 25 percent to over 90 percent compared with existing conditions
- Need for residual risk management would be the highest among the preliminary approaches

Enhance Flood System Capacity – Improving urban, small communities, and rural-agricultural levees along with expanded flow capacity:

- Is by far the most expensive approach
- Significantly meets all CVFPP Goals
- Urban areas would likely exceed 200-year (0.5% annual chance) level of flood protection
- Many small communities would likely exceed 100-year (1% annual chance) level of flood protection
- Most areas, including rural-agricultural areas, would benefit from lower flood stages, improved levee conditions, and improved levees constructed for bypass expansion
- Would reduce potential flood damages by about 80 percent compared to existing conditions
- Would increase the population receiving at least a 100-year (1% annual chance) level of flood protection from about 21 percent to about 95 percent compared with existing conditions
- Need for residual risk management would be the lowest among the preliminary approaches
- Includes significant ecosystem features and multipurpose projects

2.8 Key Implications for State Systemwide Investment Approach

Evaluation and comparison of the preliminary approaches highlighted various findings and implications that informed preparation of the SSIA, described in more detail in Section 3. Key implications are summarized below:

- Levels of flood protection should be commensurate with risk within the floodplains.
- Investments should not result in increased flood risk.
- Investments should promote actions that increase system flexibility and the ability to accommodate and attenuate large flood peaks.
- High operations and maintenance costs are driven in part by the current footprint of the levee system, which in many locations is at odds with natural geomorphic processes.

- To fully realize efficient and sustainable operations and maintenance over the long term, the State should consider changes to institutional arrangements, practices, and funding.
- A comprehensive SSIA should develop and implement policies and programs that help manage residual risks that remain after improvement projects are implemented.
- Systemwide and regional (urban areas, small communities, and rural-agricultural areas) elements representing proposed flood management system improvements both have roles in the SSIA.
- Central Valley cities and counties that wish to continue to develop in urban areas are required to achieve an urban level of flood protection (200-year flood), defined in California Government Code Section 65007(1) and California Water Code Section 9602(i). The State supports achieving an urban level of flood protection, at a minimum, for all existing urban and urbanizing areas in the Systemwide Planning Area. Where feasible, the State supports consideration of higher levels of flood protection, particularly for urban/urbanizing areas in deep floodplains (greater than 3 feet of flooding during a 200-year flood).
- From a systemwide perspective, it is in the State's interest to support the continued viability of small communities within the Systemwide Planning Area to preserve cultural and historical continuity and important social, economic, and public services to rural-agricultural populations, agricultural enterprises, and commercial operations.
- New development in nonurbanized areas, including small communities, must meet the national FEMA standard of flood protection, per California Government Code Sections 65865.5, 65962, and 66474.5. This corresponds to the minimum level of flood protection (100-year flood) required for participation in the National Flood Insurance Program.
- Many rural-agricultural areas would benefit from systemwide elements of the SSIA, which provides direct flood risk reduction benefits by lowering flood stages and more efficiently moving floods through the system.

KEY ELEMENTS OF STATE SYSTEMWIDE INVESTMENT APPROACH

The vision of an integrated systemwide and sustainable flood management plan for the Central Valley is to develop a flood management system that provides for the following:

- Minimum of 200-year level of protection for urban communities protected by facilities of the SPFC
- Lower peak flood stage through much of the system, especially for the Feather, lower Sacramento, and lower San Joaquin rivers
- 100-year level of protection for small communities, where feasible
- Proactive floodplain management, including a program to flood-proof and/or relocate structures in the floodplains where building ring levees and other flood structures is not feasible
- Enhancing rural-agricultural area flood protection by repairing known localized problems that cause the highest risk of exposure and by restoring all-weather roads on levee crests
- Leveraging flood system improvements to create habitat through levee setbacks, waterside planting berms, and extension and expansion of bypass systems and to connect riparian habitat from the Delta to Butte Basin and Oroville and to the San Joaquin River
- Connecting fishery habitat from the Delta to Yolo and Sutter bypasses and to Butte Creek
- Supporting policies, implementation programs, and financing strategy

- While the State supports improving rural-agricultural flood protection to foster and support economic viability, it should be done in a way that minimizes the potential for being growth inducing.
- The State supports corridor management planning approaches to develop integrated, multi-benefit projects.
- State and local-proposed changes and reforms to FEMA's National Flood Insurance Program are expected to promote a vibrant agricultural economy in the rural-agricultural areas that do not have protection from a 100-year flood.
- The State supports implementing integrated projects to achieve multiple benefits, including environmental conservation and restoration, agricultural conservation, water supply and quality, and related benefits.
- Recognizing the benefits to both public safety and the ecosystem, the State has a great interest in integrated environmental stewardship and flood management to leverage investments and associated benefits.
- All levels of project planning and development need to consider opportunities to integrate ecosystem enhancements with flood damage reduction projects.
- The State should encourage programs that provide incentives for including ecosystem improvements and other multi-benefits to projects, as outlined in California Water Code Section 12585.7.

3.0 STATE SYSTEMWIDE INVESTMENT APPROACH

The State Systemwide Investment Approach (SSIA) reflects the State's strategy for modernizing the SPFC to address current challenges and affordably meet the CVFPP Goals described in Section 1. The preliminary approaches, described in Section 2, suggested a broad range of physical and institutional flood damage reduction actions to improve public safety and achieve economic, environmental, and social sustainability. The SSIA is an assembly of the most promising, affordable, and timely elements of the three preliminary approaches.

The State Systemwide Investment Approach provides guidance for future State participation in projects and programs for integrated flood management in the Central Valley.

Physical elements for the SSIA are organized into regional and system elements:

- **Urban, small community, and rural-agricultural improvements** – These are physical actions or projects to achieve local and regional benefits.
- **System improvements** – These are projects and modifications to the SPFC that provide cross-regional benefits, improving the overall function and performance of the SPFC, and are generally large system improvements, such as bypass expansions. The State will provide leadership in developing and implementing these components.

The regional and system elements require detailed analyses to refine how elements may complement each other and to develop appropriate justification for future selection of on-the-ground projects. The SSIA reflects a broad vision for SPFC modernization; therefore, element refinements, additions, and deletions can be expected as a result of future feasibility studies.

Section 2 introduced elements of the SSIA. The following sections provide a more detailed description of the SSIA, its estimated cost, residual risk management needs, and a preliminary presentation of expected performance. Section 4 describes how the SSIA is expected to be implemented and managed over the next several decades.

3.1 Major Physical Improvements in Sacramento and San Joaquin River Basins

Existing SPFC facilities in the Sacramento River Basin are much more extensive and protect larger populations and assets than SPFC facilities in the San Joaquin River Basin. In addition, peak floodflows from the Sacramento River Basin can be about 10 times higher than those from the San Joaquin River Basin. Therefore, physical improvements included in the SSIA are more extensive within the

Sacramento River Basin than within the San Joaquin River Basin. Table 3-1 shows important characteristics of the Sacramento and San Joaquin river basins.

Table 3-1. Key Characteristics of Sacramento and San Joaquin River Basins

CHARACTERISTICS	SACRAMENTO RIVER BASIN	SAN JOAQUIN RIVER BASIN
Land Area Within 500-Year (0.2% annual chance) Floodplain (acres)	1,217,883	697,465
Population at risk ¹ (people)	762,000	312,000
Replacement value of assets at risk (\$ millions)	53,000	16,000
Total SPFC Levees (miles)	1,054	448
SPFC Levees with identified threat factors ² (miles)	852	354
Total Potential 2-Year (50% annual chance) Floodplains (acres)	235,000	85,000
Currently connected to river (acres)	93,000	26,000
Currently connected and in native/natural habitat (acres)	50,000	19,000
Total Reservoir Capacity ³ Tributary to Area (thousand acre-feet)	10,477	7,100
Reserved Flood Storage Space	3,066	1,881

Notes:

¹ Estimated population (from 2000 U.S. Census data) within 500-year floodplain.

² Source: *Flood Control System Status Report* (DWR, 2011). Includes Urban Levee Evaluations Project categories “Marginal” and “Does Not Meet Criteria,” and Non-Urban Levee Evaluations Project categories B and C.

³ Only includes reservoirs with dedicated flood storage space.

Key:

SPFC = State Plan of Flood Control

CENTRAL VALLEY FLOOD PROTECTION PLAN OF 2008

California Water Code Section 9614.

“The Plan shall include...

(i) A description of both structural and nonstructural methods for providing an urban level of flood protection to current urban areas where an urban area means the same as set forth in subdivision (k) of Section 5096.805 of the Public Resources Code. The description shall also include a list of recommended next steps to improve urban flood protection.”

Major physical (capital improvement) elements included in the SSIA are shown in Table 3-2 and in the schematics in Figures 3-1 and 3-2 for the Sacramento and San Joaquin river basins. The following sections provide more description of urban, small community, rural-agricultural, and system improvements.

3.2 Urban Flood Protection

Consistent with legislation passed in 2007, the SSIA proposes improvements to urban (populations greater than 10,000) levees to achieve protection from the 200-year (0.5% annual chance) flood, at a minimum. With some exceptions, existing SPFC levees in urban areas are often located immediately adjacent to houses and business, leaving few opportunities for setting levees back or making improvements that enlarge levee footprints. Therefore, reconstruction of existing urban levees is generally the method for increasing flood protection. The State is already supporting many SPFC urban levee improvement projects through its Early Implementation Program grants program and other FloodSAFE efforts, including some setback levees.

Table 3-2. Major Physical and Operational Elements of Preliminary Approaches and State Systemwide Investment Approach

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY		STATE SYSTEMWIDE INVESTMENT APPROACH
Bypasses						
New Bypass Construction and Existing Bypass Expansion	<ul style="list-style-type: none"> • Feather River Bypass • Sutter Bypass expansion • Yolo Bypass expansion • Sacramento Bypass expansion • Lower San Joaquin River Bypass (Paradise Cut) <p>Components potentially include land acquisition, conservation easements, levee improvements, new levee construction</p>			YES	→	YES
Reservoir Storage and Operations						
Forecast-Coordinated Operations/Forecast-Based Operations	Fifteen reservoirs within Sacramento River Basin and San Joaquin River Basin	YES	YES	YES		YES
Reservoir Storage/Enlarge Flood Pool ¹	<ul style="list-style-type: none"> • Oroville • New Bullards Bar • Don Pedro • McClure • Friant 			YES	→	
Easements	<ul style="list-style-type: none"> • Sacramento River Basin – 200,000 acre-feet • San Joaquin River Basin – 100,000 acre-feet 			YES		
Flood Structure Improvements						
Major Structures	<ul style="list-style-type: none"> • Intake structure for new Feather River Bypass • Butte Basin small weir structures • Upgrade and modification of Colusa and Tisdale weirs • Sacramento Weir widening and automation • Gate structures and/ or weir at Paradise Cut • Upgrade of structures in Upper San Joaquin bypasses • Low level reservoir outlets at New Bullards Bar Dam • Fremont Weir widening and improvement • Other pumping plants and small weirs 			YES	→	YES
System Erosion and Bypass Sediment Removal Project	<ul style="list-style-type: none"> • Cache Creek Settling Basin sediment management • Sacramento system sediment remediation downstream from weirs 			YES		YES
Urban Improvements						
Target 200-Year Level of Protection	Selected projects developed by local agencies, State, federal partners		YES	YES	→	YES
Target SPFC Design Capacity	Urban Levee Evaluations Project results	YES ²				

Table 3-2. Major Physical and Operational Elements of Preliminary Approaches and State Systemwide Investment Approach (cont'd.)

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY		STATE SYSTEMWIDE INVESTMENT APPROACH
Non-SPFC Urban Levee Improvements	Includes approximately 120 miles of non-SPFC levees that are closely associated with SPFC urban levees. Performance of these non-SPFC levees may affect the performance of SPFC levees.	YES	YES	YES		YES
Small Community Improvements						
Target 100-Year Level of Protection	Small communities protected by the SPFC		YES ³	YES ³	→	YES ⁴
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES ²		YES ²		
Rural-Agricultural Improvements						
Site-Specific Rural-Agricultural Improvements	Based on levee inspections and other identified critical levee integrity needs				→	YES
Target Design Capacity	Non-Urban Levee Evaluations Project results	YES ²		YES ²		
Ecosystem Restoration						
Fish Passage Improvements	<ul style="list-style-type: none"> Sutter Bypass and fish passage east of Butte Basin Fremont Weir fish passage improvements Yolo Bypass/Willow Slough Weir fish passage improvements Yuba River fish passage and fish screen Deer Creek 			YES	→	YES
Ecosystem Restoration and Enhancement	For areas within new or expanded bypasses, contributing to or incorporated with flood risk reduction projects			YES		YES
River Meandering and Other Ecosystem Restoration Activities	At selected levee setback locations in Sacramento and San Joaquin river basins			YES		YES (at select locations)

Notes:

¹ All preliminary approaches and State Systemwide Investment Approach include Folsom Dam Raise, as Congress authorized.

² Actual level of protection varies by location.

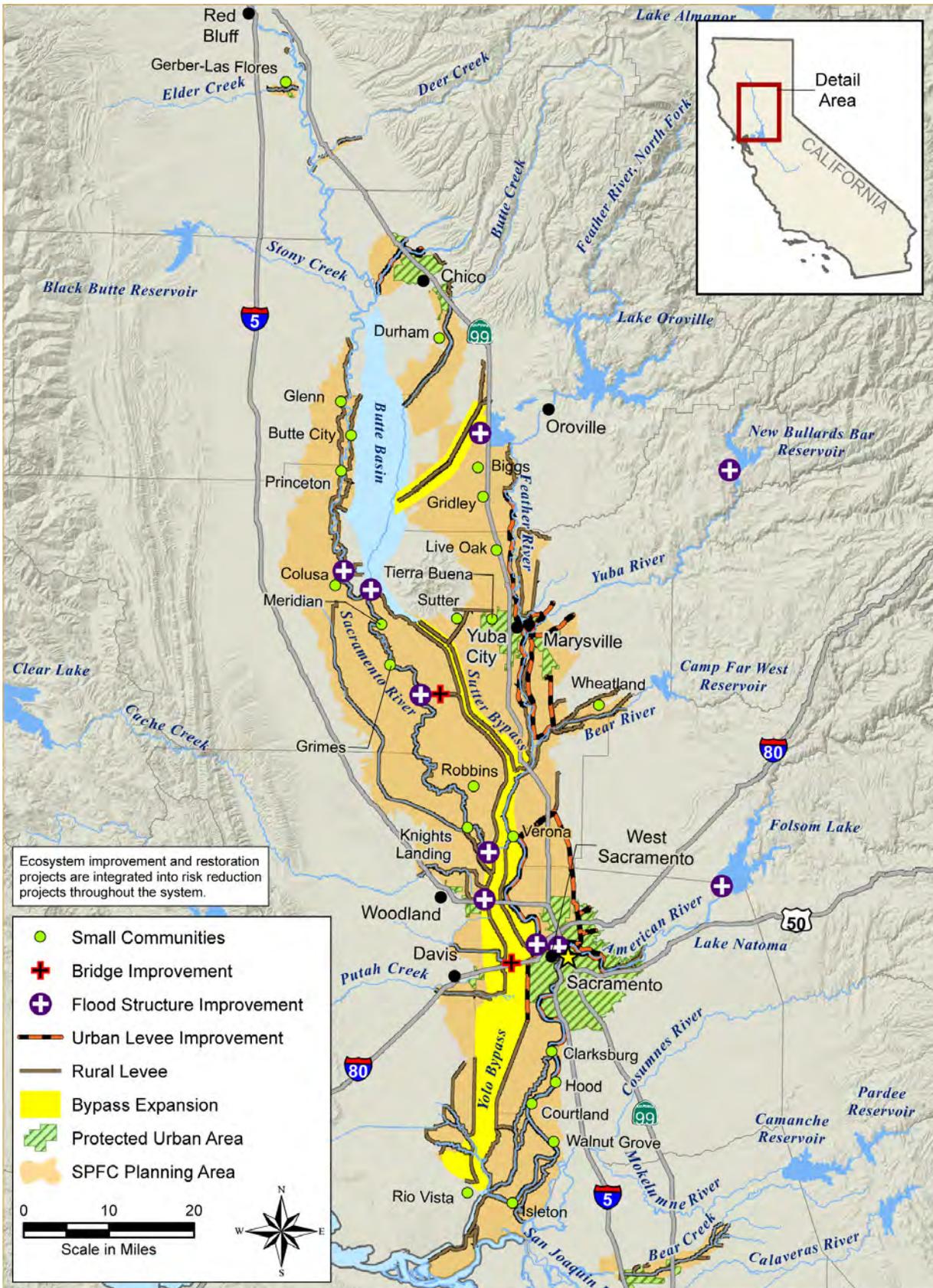
³ Includes all small communities within the SPFC.

⁴ Includes selected small communities within the SPFC.

Key:

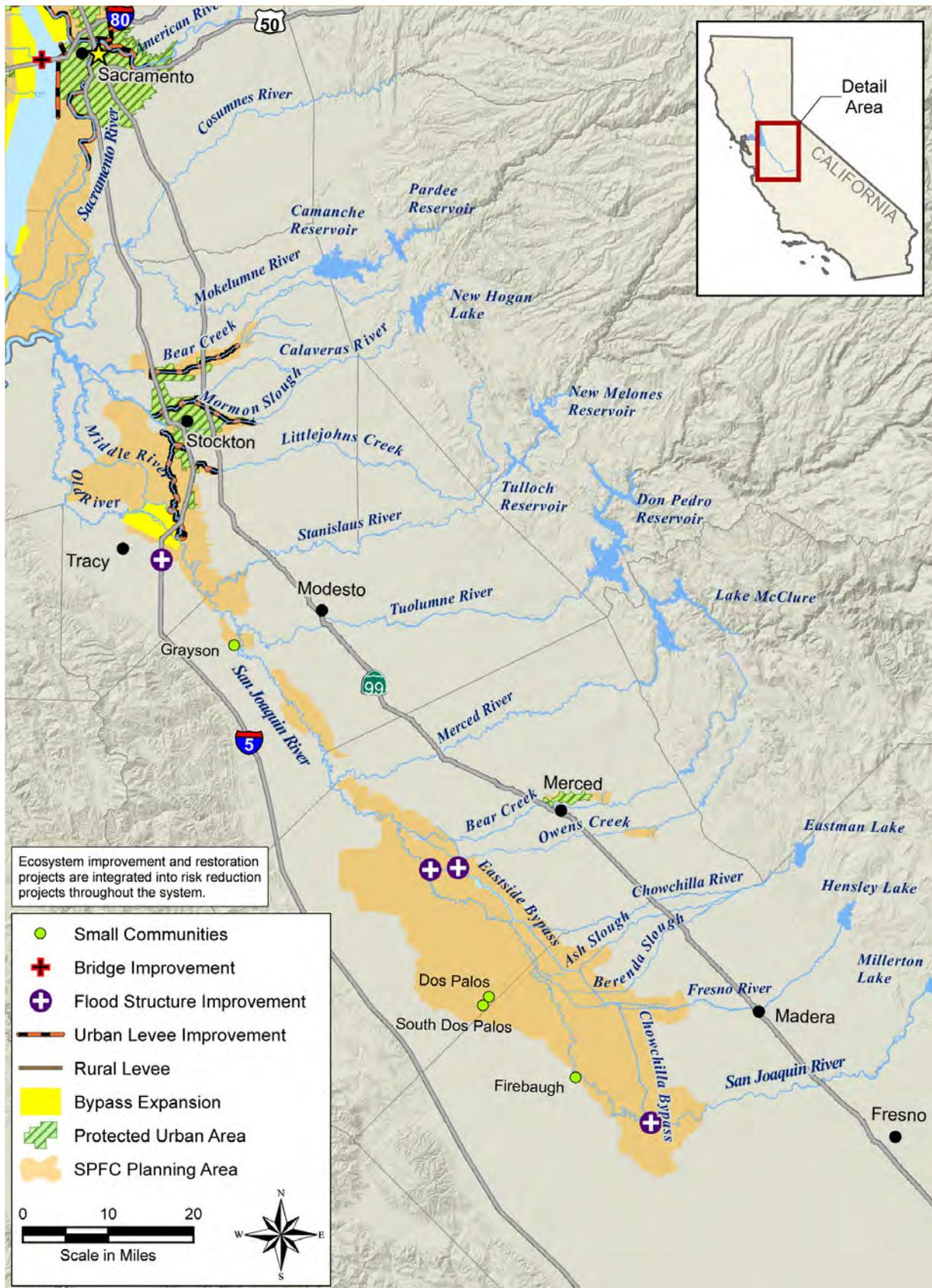
SPFC = State Plan of Flood Control

State = State of California



Key: SPFC = State Plan of Flood Control

Figure 3-1. State Systemwide Investment Approach – Sacramento River Basin Major Capital Improvements



Key: SPFC = State Plan of Flood Control

Figure 3-2. State Systemwide Investment Approach – San Joaquin River Basin Major Capital Improvements

Improvements to urban levees or floodwalls should follow DWR's *Urban Levee Design Criteria* (anticipated 2012), at a minimum. The State strongly supports consideration of features that offer greater system resilience, such as levees that can withstand overtopping without catastrophic breaching. Another example is to build compartmentalized floodplains (the use of secondary levees, berms, or elevated roadways within protected areas to reduce the geographic extent of flooding when a failure occurs).

Levee projects in urban areas should consider setbacks, to the extent feasible, based on the level of existing development and the potential benefits. These projects should also preserve and/or restore, at minimum, shaded riparian habitat corridors along the waterside toe of levees. Other improvements will consider incorporating ecosystem preservation, restoration, and enhancements in project designs. Urban improvements should also be implemented and maintained consistent with the State's vegetation management approach (see Section 4.2 and Attachment 2 – Conservation Framework).

In addition to urban area levees, other system and regional elements included in the CVFPP, such as reservoir operational changes and new or expanded bypasses, have the potential to contribute to achieving an urban level of flood protection. These elements could potentially reduce the need for urban area levee improvements, and/or provide additional system flexibility and resiliency in accommodating hydrologic uncertainty, including climate change.

The CVFPP does not include improvements that may be needed to address interior drainage or other local sources of flooding. The State could pursue improvements to non-SPFC levees (see Section 3.6) that protect some urban areas even though the State has no responsibility over these levees at this time. The decision to add these levees to the SPFC would require Board action. Alternatively, the State may choose to participate in funding levee reconstruction or improvements, if found to be feasible.

DWR will evaluate and participate in projects (in-place and with setbacks, if appropriate) that contribute to achieving an urban level of flood protection through reconstructing, rehabilitating, or improving SPFC facilities for the following urban areas in the Central Valley:

- **City of Chico** – Improvements include reconstruction of existing SPFC urban levees bordering the City of Chico to provide protection from flooding along local tributaries.

LEVEE RESILIENCY

Reducing the risk of catastrophic system failure is an important aspect of flood risk reduction. Levee breaches increase flood losses and recovery costs, and lengthen the time needed to rebuild. USACE estimates that at least half of the direct losses from Hurricane Katrina may have been averted, had catastrophic breaching not occurred (Building a Stronger Corps: A Snapshot of How the Corps is Applying Lessons Learned from Katrina (USACE, 2009). Designing facilities to withstand overtopping and incorporating resiliency into overall system design not only help to reduce flood losses, but also provide flexibility to accommodate changing climate conditions, floodplain uses, and technical standards.

- **Yuba City and City of Marysville** – Improvements for this metropolitan area and adjacent urbanizing corridor (along Highway 99 north of Yuba City, and along Highway 70 within and south of Marysville) include the following:
 - » *Continue work to reconstruct and/or improve SPFC levees to urban design criteria along the Feather and Yuba rivers immediately adjacent to Marysville, consistent with ongoing local efforts. The State is supporting ongoing work to achieve an urban level of flood protection for the City of Marysville as part of the Yuba Basin Project. This project encompasses four phases of levee improvements and other actions, with an ultimate goal of protecting Marysville from a 250-year (0.4% annual chance) flood event.*
 - » *Continue to work with Sutter Butte Flood Control Agency to develop and implement projects to achieve an urban level of flood protection for Yuba City and adjacent urbanizing areas. This includes reconstructing and/or improving SPFC levees to urban design criteria along the right bank of the Feather River, adjacent to and upstream from Yuba City, as part of the Feather River West Levee Project.*
- **Sacramento Metropolitan Area** – Improvements for this area include the following:

- » *Reconstruct and/or improve SPFC levees protecting urban areas along the Sacramento and American rivers to urban design criteria, as needed, to complete ongoing urban flood protection improvements within Sacramento County (includes the Laguna portion of Elk Grove). The State has supported the Sacramento Area Flood Control Agency’s urban flood protection projects through cost sharing and grant funding under the FloodSAFE Early Implementation Program. Completed work that supports the SSIA includes levee improvements along the American River under the American River Watershed Common Features Project, and elements of the South Sacramento County Streams Project. Ongoing work includes levee improvements under the Natomas Levee Improvement Program and construction of an auxiliary spillway at Folsom Dam as part of the Folsom Dam Joint Federal Project.*
- » *Reconstruct and/or improve SPFC levees to complete ongoing urban protection improvements for the City of West Sacramento. The State has supported urban levee improvements by the West Sacramento Area Flood Control Agency through the FloodSAFE Early Implementation Program grants program. Locally planned work, for potential State participation, includes levee reconstruction and raising, cutoff walls, setback levees, and erosion protection features.*



Levee Improvements in Natomas

- » *Evaluate the potential benefits of widening, automation, and operational changes to the Sacramento Weir and Bypass for the purpose of reducing peak flood stage along the Sacramento and American rivers, in combination with expansion of the Yolo Bypass (described later under System Improvements). Weir automation and other improvements have the potential to improve operational safety and flexibility.*
- **Cities of Woodland and Davis** – Continued participation in the Lower Cache Creek, Yolo County Woodland Area Feasibility Study, which considers modifications to the Cache Creek Settling Basin and other facilities to determine their feasibility and contribution toward achieving urban and rural-agricultural flood improvement in the area. Also evaluate the Cache Creek Settling Basin to identify a long-term program for managing sediment and mercury to maintain the flood conveyance capacity of the Yolo Bypass.
- **City of Merced** – Continued support of the Merced County Streams Project, which is contributing to improving flood protection for the City of Merced.
- **Stockton Metropolitan Area** – Improvements for this area include the following:
 - » *Improve SPFC levees along the San Joaquin River and tributary channels.*
 - » *Evaluate the potential benefits of and State interest in local flood-gates and control structures, as they relate to facilities of the SPFC in and around Stockton, and contribute to achieving an urban level of flood protection.*
- **Other Areas** – For urban areas also protected by non-SPFC levees, the State may evaluate its interest in participating in levee improvements under other State programs.

3.3 Small Community Flood Protection

Many small communities in the SPFC Planning Area are expected to receive increased flood protection through implementation of system elements and improvements focused on adjacent urban areas, although some of these improvements may take many years to implement. The State will evaluate investments to preserve small community development opportunities without providing urban level of protection. Additional State investments in small community protection will be prioritized based on relative community flood threat levels, considering factors such as population, likelihood of flooding, proximity to flooding source, and depth of flooding. Other factors considered in prioritizing small community flood improvements include financial feasibility and achievement of the CVFPP Goals with respect to integrating multiple benefits.

In general, the State will consider the following structural and nonstructural options for protecting small communities in the SPFC Planning Area from a 100-year (1% annual chance) flood:

- Protecting small communities “in-place” using ring levees, training levees, or floodwalls when improvements do not exceed a certain predetermined cost threshold. For planning purposes for the SSIA, DWR used a preliminary cost threshold of \$100,000 per house protected, an approximate value for elevating or flood proofing a house. When estimated costs exceed the threshold, nonstructural means for flood protection will be considered. DWR will further evaluate this threshold during future studies.
- Reconstructing or making improvements to adjacent SPFC levees.
- Implementing nonstructural improvements, such as raising/elevating structures, flood proofing, willing seller purchases, and/or relocating structures, when the in-place improvements described above are not feasible.

In some cases, small communities may achieve flood protection as part of adjacent urban area improvements.

Based on planning level estimates, 15 small communities would receive 100-year (1% annual chance) flood protection from about 80 miles of levee improvements or new levee construction. A new levee is one constructed from the ground up, not a levee that has been repaired in place. Another five small communities would receive 100-year (1% annual chance) flood protection, at minimum, through implementation of urban and system improvements included in the SSIA. Seven small communities would receive flood protection through floodplain management actions such as flood proofing or raising structures.

Small communities improvements should also be implemented and maintained consistent with the State’s vegetation management approach (Attachment 2 – Conservation Framework). Other improvements will consider incorporating ecosystem preservation, restoration, and enhancements in project designs.

3.4 Rural-Agricultural Area Flood Protection

Rural-agricultural area levee improvements included in the SSIA are not as extensive as for urban areas and small communities, reflecting the lower levels of development within these floodplains.

3.4.1 State Plan of Flood Control Levees

The State recognizes that federal engineering guidance and design standards may result in cost-prohibitive levee repairs for many rural-agricultural areas. The State will work with rural-agricultural communities to develop applicable repair standards for SPFC levees (see Section 4). The State will also evaluate investments to preserve rural-agricultural activities that discourage incompatible development, and encourage compatible development, within floodplains.

The State's participation in rural-agricultural SPFC facility reconstruction projects may also require inclusion of nonstructural measures to manage risks in adjacent floodplains, such as purchasing agricultural conservation easements from willing landowners, where consistent with local land use plans. In addition to improving flood management, project designs will consider restoring shaded riparian aquatic habitat, wetlands, or other habitat. This includes protection and enhancement of existing healthy ecological communities, in addition to the enhancement/restoration of degraded ecosystem services and functions. Flood risk reduction projects in rural-agricultural areas that can achieve multiple resource benefits will be preferable to single purpose projects, and are likely to be encouraged through enhanced State and federal cost-sharing.

In general, the State will consider the following rural-agricultural flood protection options, with a focus on integrated projects that achieve multiple benefits:

- SPFC levee improvements in rural-agricultural areas will focus on maintaining levee crown elevations and providing all-weather access roads to facilitate inspection and floodfighting.
- Levee improvements, including setbacks, may be used to resolve known performance problems (such as erosion, boils, slumps/slides, and cracks). Projects will be evaluated that reconstruct rural SPFC levees to address identified threat factors, particularly in combination with small community protection, where economically feasible.
- Agricultural conservation easements that preserve agriculture and prevent urban development in current agricultural areas may be purchased, when consistent with local land use plans and in cooperation with willing landowners.

The State, in consultation with local entities, will prioritize available funding among all-weather roads and other important investments, addressing the greatest need first.

3.4.2 Hydraulic Structure Upgrades

In addition to hydraulic structures mentioned as part of urban and system improvements, existing hydraulic structures in the upper San Joaquin River Basin need to be upgraded because of facility age or operational problems. In some cases, gates do not operate properly, new automation is needed, or the structures are otherwise deteriorated.

3.4.3 Local Non-State Plan of Flood Control Levees

During future feasibility studies, the State will evaluate projects to maintain the function of local levees (not part of the SPFC) if they contribute to the effective operations and maintenance of the SPFC. The State may be able to participate through existing programs on feasible projects.

3.4.4 Removal of State Plan of Flood Control Facilities

The State will evaluate potentially removing (physically or administratively) facilities of the SPFC in rural areas, including rock revetment, levees, and other facilities,

consistent with criteria presented in Section 4. Removing small portions of the SPFC that are no longer functioning would reduce the State's responsibility and costs for operations and maintenance. Facilities that may be evaluated for potential removal from the SPFC include the following:

- A two-mile long segment of the Feather River right-bank levee, upstream from the Thermalito Afterbay, which was replaced by an embankment constructed to create Thermalito Afterbay (on its southeast side).
- Approximately seven miles of levee included in the Lower San Joaquin River and Tributaries Project, which is currently being physically breached and removed. This effort is part of a nonstructural project modification, under the authority of Public Law 84-99, following damage during the 1997 floods.



Floodflow over the Moulton Weir

- Intermittent SPFC levees along reaches of the San Joaquin River and in the vicinity of the Mariposa Bypass and Deep Slough. If pursued, removal projects should consider integration of wetland, riparian, and floodplain habitat restoration.
- Some existing, intermittent bank protection sites along the Sacramento River between Red Bluff and Chico Landing, now unconnected with the active river channel and believed to no longer provide a flood management function by erosion control.
- Levees and pumping plants from the Middle Creek Project at the west end of Clear Lake, for which removal is currently underway. Facilities removal was authorized by Congress in the Water Resources Development Act of 2007.

3.5 System Improvements

System elements include physical actions or improvements with the potential to provide benefits across large portions of the flood management system, and improve the overall function and performance of the SPFC in managing large floods. These actions enhance the system's overall ability to convey and attenuate flood peaks through expansion of bypass capacity and storage features. System improvements provide flood protection benefits to urban, small community, and rural-agricultural areas by lowering flood stages.

These actions also present significant opportunities to improve ecosystem functions and continuity on a systemwide level. System improvements should also be imple-

mented and maintained consistent with the State's vegetation management approach (see Section 4.2 and Attachment 2 – Conservation Framework).

The following sections describe system elements included in the SSIA.

3.5.1 Weir and Bypass System Expansion

The Sutter and Yolo bypasses, in combination with their appurtenant control features – the Moulton, Colusa, Tisdale, Fremont, and Sacramento weirs/bypasses – function as the central backbone of the Sacramento River Flood Control Project. This weir and bypass system redirects damaging floodflows away from the main channels of the Sacramento, Feather, and American rivers, conveying up to 490,000 cubic feet per second during large flood events. The considerable capacity of the bypass system also slows the movement of floods, effectively attenuating flood peaks and metering flows into the Delta. For initial planning purposes, technical evaluations are based on construction of all bypass expansions and extensions described below.

Bypass expansions would increase the overall capacity of the flood system to convey large flood events. Peak flood stages would be reduced along the Sacramento River and, to a lesser extent, along its tributaries. The lower stages throughout the system benefit flood management in urban, small community, and rural-agricultural areas. Floods from storms centered within different watersheds of the Sacramento River Basin have different characteristics, and bypass system expansion would contribute to greater system flexibility in managing these different flood events.

Improvements would be designed and operated in consideration of ecosystem restoration features and benefits, including conservation and restoration of aquatic and floodplain habitats and continued compatible agricultural land uses within the bypass. Improvements may include contouring and channelizing to facilitate proper draining and to lessen the possibility of entraining fish. Contouring may also increase the frequency of floodplain activation in places to promote wetland and riparian habitat success. When consistent with local land use plans, and in cooperation with willing landowners, the State will consider purchasing agricultural conservation easements adjacent to the Sutter and Yolo bypasses to preserve agriculture and prevent urban land uses.

Sutter Bypass Expansion

Future studies to refine specific project elements related to bypass expansion should consider increasing the capacity of the Sutter Bypass to convey large flood events. Expansion would likely require building a new levee for about 15 miles along one side of the bypass to widen the bypass for increased flow capacity. Although the required width of the bypass has not been determined, DWR used a 1,000-foot increase in the bypass width for planning purposes. The evaluations for planning purposes were initially based on 75 percent of the new width allocated to agricultural use and 25 percent allocated to habitat restoration.

Modifications to the Colusa and Tisdale weirs and the Butte Basin overflow areas from the Sacramento River will be considered as part of the expansion. The expansion may require rebuilding some SPFC facilities, such as weirs and pumping stations.

Yolo Bypass Expansion

Future studies to refine specific project elements related to bypass expansion should consider the following:

- Lengthening and/or lowering the Fremont Weir and incorporating features to facilitate fish passage through the upper bypass and at the weir.
- Increasing capacity in the upper portion of the Yolo Bypass (upstream from the Sacramento Bypass) by setting back levees and/or purchasing easements.
- As described under Urban Flood Protection above, evaluate the Cache Creek Settling Basin to identify a long-term program for managing sediment and mercury to sustain the flood conveyance capacity of the Yolo Bypass.
- Expanding the lower end of the Yolo Bypass upstream from Rio Vista by setting back levees.

About 42 miles of new levee could potentially be required to expand the Yolo Bypass.

Sacramento Bypass Expansion

As part of urban elements to reduce flood risks to the Sacramento/West Sacramento metropolitan area, future studies to refine specific project elements related to bypass expansion (also mentioned under Urban Flood Improvements) will consider the following:

- Widening the Sacramento Weir
- Automating the weir or eliminating gates
- Widening the Sacramento Bypass by constructing about two miles of new levee
- Making operational changes to the Sacramento Weir and Bypass, as necessary

3.5.2 New Bypasses

Two new bypasses are included in the SSIA. While they primarily provide benefits to the urban areas of Yuba City/Marysville and Stockton, they are described here with other system improvements because of their complexity and long lead time for construction.

Feather River Bypass

Evaluate the feasibility of constructing a new bypass from the Feather River to the Butte Basin to further contribute to improving overall urban, small community, and rural-agricultural flood protection in the planning area. The new bypass would require construction of about 16 miles of new levee on one side of the Cherokee

Canal. A new bypass would have the potential to reduce flood stages by as much as one foot at Yuba City and Marysville during a 100-year (1% annual chance) flood. A new bypass would also provide greater system resiliency in accommodating future hydrologic changes in the planning area, including those due to climate change, and would be a relief path when Feather River flows are greater than 200-year (0.5% annual chance). The State will consider findings of ongoing studies by local entities when evaluating the potential system benefits of the bypass.

Lower San Joaquin Bypass

Evaluate the construction of a new bypass in the south Delta (expansion of Paradise Cut and/or other south Delta waterways), primarily for the purpose of reducing peak flood stages in the Stockton area. A south Delta bypass will include habitat components. A gate structure or weir at Paradise Cut will be considered as part of the project. The new bypass would require construction of about eight miles of new levee. In combination with the bypass, the State will consider purchasing easements in the south Delta from willing sellers to provide floodwater storage and reduce peak flood stages along the San Joaquin River.

3.5.3 Flood System Structures

Several flood system structures will require rehabilitation, rebuilding, or modifications. These structures are primarily associated with the bypass expansions and new bypasses described above. Flood structures and related actions include the following:

- Intake structure for the new Feather River Bypass
- Butte Basin small weir structures
- Upgrade and modification of Colusa and Tisdale weirs
- Modifications to bridges to reduce or eliminate flow constrictions
- Sacramento Weir widening and automation or elimination of gates
- Gate structures and/or weir for new Lower San Joaquin Bypass
- Low-level reservoir outlet at New Bullards Bar Dam to facilitate changes in reservoir operations
- Other pumping plants and small weirs, such as those associated with the Sutter Bypass

In addition, opportunities to expand fish passage at SPFC structures will be considered.

3.5.4 Flood Storage

Preliminary systemwide analyses have identified potential benefits and opportunities for reservoir flood storage and operational changes for flood management in the Sacramento River and San Joaquin river basins.

Flood storage may reduce the need for some types of downstream actions, such as levee improvements, and can offset the hydraulic effects of system improvements on

downstream reaches. Additional flood storage can also provide greater flexibility in accommodating future hydrologic changes, including climate change, and provide greater system resiliency (similar to that provided by freeboard on levees) in the face of changing downstream conditions.

New Reservoir Storage

The only new surface water storage included in the SSIA is the Folsom Dam Raise, which is already authorized. During future feasibility studies, the State may consider partnering with other willing agencies on expanding existing reservoir storage.

Transitory Storage

The SSIA has not identified specific floodplain transitory storage, but may consider such storage on a willing-seller basis where consistent with local land use plans, all affected land owners support such storage, and the new flood storage area can be safely isolated from adjacent areas (easements or fee title).

3.5.5 Conjunctive Use and Groundwater Recharge

Capturing and using floodflows for groundwater recharge has been considered as a component of integrated flood and water management for the SSIA. Conjunctive water management through use of floodwater for recharge has been practiced for many years, especially in the San Joaquin Valley. The State supports programs that use flood flows for groundwater recharge to improve water management throughout California. However, the State also recognizes the limitations of direct groundwater recharge in lowering flood stage and reducing flood risks, especially in the Sacramento River Basin. These limitations are due to inadequate groundwater storage capacity, except in the American River Basin, and low recharge rates in comparison with large floodflows. More substantial recharge capacities cannot be achieved without significant investments in off-stream recharge facilities or regional infrastructure to facilitate in-lieu recharge, such as those North of the American River in the Sacramento metropolitan area. Consistently, these facilities are developed by local agencies with emphases on water supply purposes. Considering these limitations, the SSIA provides opportunities for in-channel groundwater recharge and, although not recommending any specific recharge projects at this time, encourages exploring recharge opportunities in the San Joaquin River Basin, especially for capturing a portion of high flows from snowmelt, where feasible.

3.5.6 Operational Changes

Operational changes to SPFC facilities can benefit both flood risk reduction and the ecosystem. Initial concepts for operational changes are described below for existing reservoirs and bypasses.

Coordinated Reservoir Operations

Most major reservoirs in the Central Valley have been designed and built to meet multiple purposes, including water supply, recreation, and flood control. These multipurpose reservoirs have defined water conservation space for capturing winter and spring runoff for water supply purposes, and designated flood control space to capture, manage floodflows to reduce flood releases downstream.

The Forecast-Coordinated Operations (F-CO) Program seeks to coordinate flood releases from the reservoirs located in various tributaries of a major river to optimize the use of downstream channel capacity, the use of total available flood storage space in the system, and eventually to reduce overall peak floodflows downstream from these reservoirs. The management process and partnerships, formed during early development of the F-CO Program, contribute significantly to enhanced coordination of reservoir operations during flood events.

Implementing Forecast-Based Operations (F-BO) of Central Valley reservoirs is the next logical step in advancing the F-CO Program. The intended F-BO would involve the use of improved long-term runoff forecasting and operating within the parameters of an existing flood control diagram. Proactive reservoir management through the use of a more flexible flood control diagram would require extensive studies of the most feasible diagram, environmental documentation for changing reservoir operations, and Congressional approval for a new dynamic flood control diagrams. The SSIA includes implementation of both F-CO and F-BO for all reservoirs in the Central Valley.

As part of early FloodSAFE implementation, operators at Lake Oroville and New Bullards Bar Reservoir have begun coordinating flood operations to better manage downstream flows on the Yuba and Feather rivers. The coordinated operation of New Bullards Bar Reservoir with Lake Oroville will require construction of an outlet to accommodate early releases of floodflows from New Bullards Bar Dam; preliminary evaluations indicate that a new outlet with a capacity of about 20,000 cubic feet per second should be considered.



Water Flowing from Sacramento River to Yolo Bypass Through Sacramento Weir and Bypass

In addition, DWR will consider willing partnerships with other reservoir operators to accomplish F-BO and overall F-CO program objectives.

Weir and Bypass Operational Changes

The State proposes to investigate modifying the function and operation of weirs that spill floodwater to the bypasses in the Sacramento River Basin. The concept is to physically lower crests of overflow weirs and modify operations so that bypasses carry flows earlier and for longer durations during high river stages. These changes would reduce river stages and flood risks along main rivers. Depending on timing, duration, and a host of related hydraulic factors, the more frequently activated floodplain in the bypasses would potentially provide a more productive rearing habitat for juvenile salmonids and other native fish and may provide riparian habitat.

One potential change in operations is for the Sacramento Weir, which is currently opened when the Sacramento River water surface elevation reaches 27.5 feet at the I Street Bridge. Evaluation may show that opening the weir when the river stage

reaches 25 feet provides improvements in both flood management and ecosystem function. Similarly, the crest of the Fremont Weir may be lowered or other modifications made to provide flow to the Yolo Bypass below its current spill stage. Other structures that would be subject to assessment and potential operational modifications include Moulton, Colusa, Tisdale, and Paradise Cut weirs.

Evaluations would also need to consider the extent of potential impacts from more frequent and longer durations of flooding in the bypasses. For example, some levees along the bypasses may not be as durable as levees along the main rivers – levee reliability could be lowered by longer duration wetting. Longer duration flooding of the bypasses would increase the duration of levee patrols. Also, extending the duration of bypass flooding could interfere with ongoing agricultural practices.

3.5.7 Features to Mitigate Potential Flood Stage Increases

Since future feasibility studies are needed to refine the SSIA, the ultimate configuration of facilities will likely vary from those presented in the SSIA. Only at that time will the State know the potential magnitude and extent of hydraulic impacts from planned improvements, if any, within the system. Cost estimates for the SSIA include an allowance for features to mitigate significant hydraulic impacts caused by project implementation.

A number of mitigation features may be used, depending on the hydraulic impacts throughout the system and downstream from SPFC facilities. Mitigation features may include the following:

- Levee enhancements for affected areas
- New surface storage partnerships with willing reservoir operators
- New transitory storage
- Modification of project designs to limit stage increases
- Other features that appear promising during feasibility studies

3.6 Non-State Plan of Flood Control Levees

Approximately 420 miles of private non-SPFC levees are closely associated with SPFC levees. Non-SPFC levees are those (1) that abut SPFC levees, (2) whose performance may affect the performance of SPFC levees, or (3) that provide flood risk reduction benefits to areas also being protected by SPFC features.

3.6.1 Non-State Plan of Flood Control Urban Levees

A total of about 120 miles of non-SPFC urban levees work in conjunction with SPFC levees to provide protection to urban areas within the SPFC Planning Area. Table 3-3 shows the distribution of non-SPFC levees for the various urban areas. Figure 3-3 shows the locations of these non-SPFC urban levees.

To achieve 200-year (0.5% annual chance) flood protection, improvements to both SPFC and non-SPFC levees will be needed. DWR has estimated that improving these non-SPFC urban levees to achieve this level of protection would cost approximately \$1.2 billion in 2011 dollars. This cost is included in the SSIA costs.

Table 3-3. Non-State Plan of Flood Control Urban Levees

URBAN AREA	NON-SPFC LEVEES (miles)
Chico	0
Yuba City	0
Marysville	0
Sacramento	24
West Sacramento	30
Woodland	1
Davis	0
Stockton	65
Merced	0
Total	120

Key:

SPFC = State Plan of Flood Control

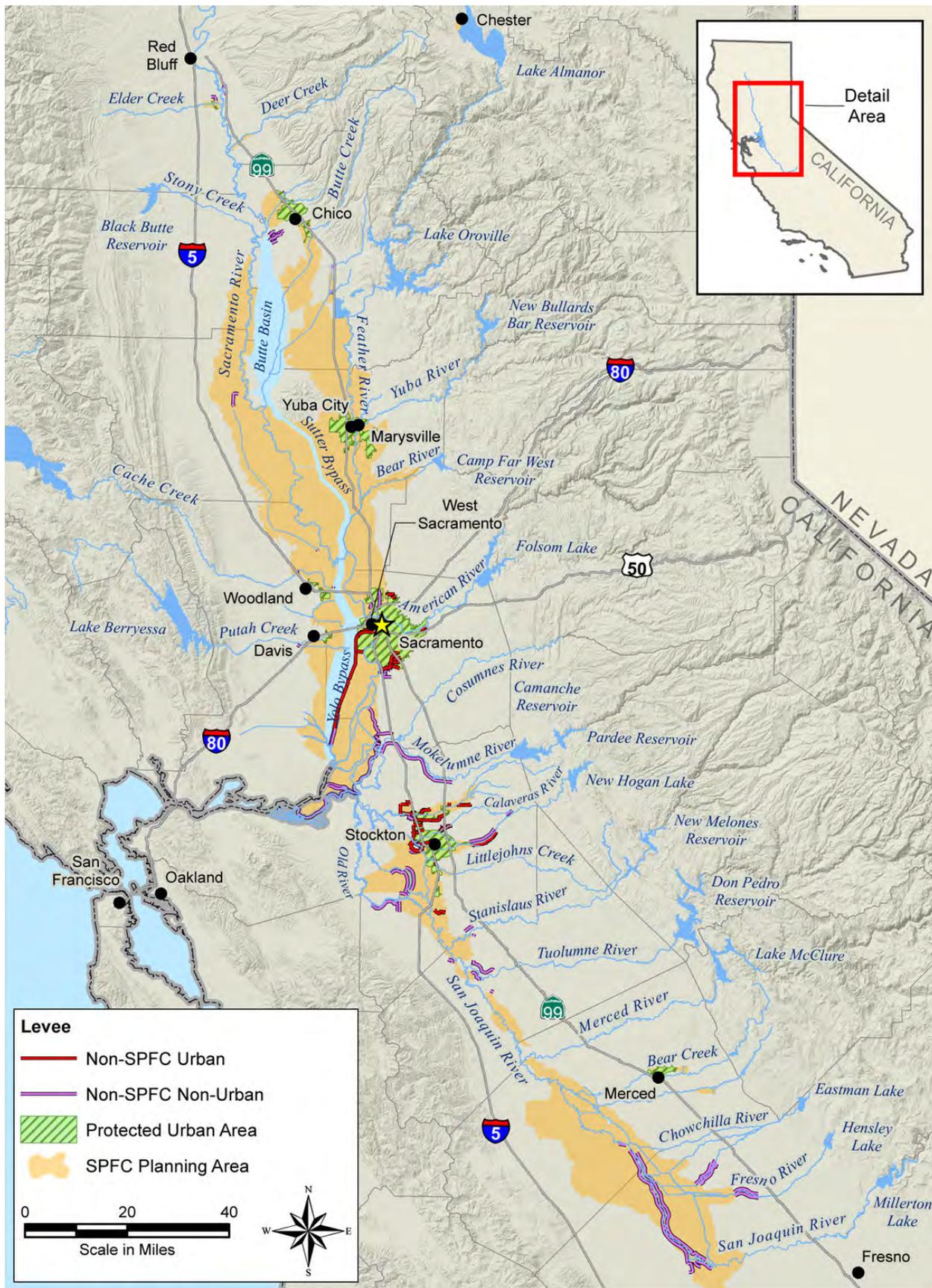
The State recognizes that for an urban area protected jointly by both SPFC and non-SPFC levees, the legislated requirement for an urban level of flood protection (200-year or 0.5% annual chance flood) requires improvement to both types of facilities. The Board may choose to treat some or all these non-SPFC levees in a similar manner to SPFC urban levees for State participation in levee improvements, and potentially add them to the SPFC. Alternatively, if the Board chooses not to add these levees to the SPFC, the State will consider participation in improvements to these levees under other State programs.

In addition, completed and ongoing Early Implementation Projects initiated since bond funding became available in 2007 will likely be added to the SPFC when final documentation is complete.

3.6.2 Non-SPFC Nonurban Levees

About 300 miles of non-SPFC nonurban levees work in conjunction with SPFC levees in rural areas. Most of these levees are along the upper San Joaquin River. Figure 3-3 shows the locations of non-SPFC nonurban levees that protect portions of the SPFC Planning Area. Non-SPFC Delta levees are not included since they do not protect the SPFC Planning Area.

Improving these levees to the same level as SPFC rural levees would cost about \$300 million. This cost is not included in the costs for the SSIA. Portions of these non-SPFC nonurban levees may be candidates for being added to the SPFC after preparation of regional plans and feasibility studies (see Section 4), but DWR has not included them as part of the SSIA.



Key: SPFC = State Plan of Flood Control

Figure 3-3. Non-State Plan of Flood Control Levees Protecting Portions of State Plan of Flood Control Planning Area

3.7 Integrating Ecosystem Restoration Opportunities with Flood Risk Reduction Projects

While flood risk reduction (public safety) remains the primary goal of the CVFPP, early integration of other important resource management goals into the plan formulation process remains a premise of integrated flood management. Those supporting goals, along with the legislative objectives, are described in Section 1.6.2. This will help improve overall flood project delivery and may broaden public support for flood projects.

In taking an integrated flood management approach, the intent of the SSIA is to make progress on improving ecological conditions on a systemwide basis, using integrated policies, programs, and projects. This approach builds upon and advances on-going efforts and successes to incorporate environmental benefits into flood management projects. Integrating environmental stewardship early into policy and project planning, development, and implementation will help 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 public safety. Under the SSIA, ecosystem restoration opportunities are integral parts of system improvements, as well as urban, small community, and rural-agricultural area flood protection projects.

Attachment 2 to the CVFPP, the Conservation Framework, provides a preview of a long-term Central Valley Flood System Conservation Strategy (Conservation Strategy) that DWR is developing to support the 2017 update of the CVFPP. The Conservation Framework focuses on promoting ecosystem functions and multi-benefit projects in the context of integrated flood management for near-term implementation. The Conservation Framework provides an overview of the floodway ecosystem conditions and trends and key conservation goals that further clarify the CVFPP's ecosystem goal. The Conservation Framework also identifies opportunities for integrated flood management projects that can, in addition to improving public safety, enhance riparian habitats, provide connectivity of habitats, restore riparian corridors, improve fish passage, and reconnect the river and floodplain.

The long-term Conservation Strategy will be consistent with the Conservation Framework and provide a comprehensive, long-term approach for the State to achieve the objectives of the Central Valley Flood Protection Act and the

CENTRAL VALLEY FLOOD PROTECTION ACT OF 2008

California Water Code Section 9614.

"The Plan shall include...

(j) A description of structural and nonstructural means for enabling or improving Systemwide riverine ecosystem function, including, but not limited to, establishment of riparian habitat and seasonal inundation of available flood plains where feasible."

California Water Code Section 9616.

"The Plan shall meet...multiple objectives...including...

(7) Promote natural dynamic hydrologic and geomorphic processes.

(9) Increase and improve the quantity, diversity, and connectivity of riparian, wetland, flood plain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands.

(11) Promote the recovery and stability of native species populations and overall biotic community diversity."

FloodSAFE and CVFPP goals. Flood protection projects that are integrated with environmental restoration components have the potential to increase federal and State cost-sharing for flood management projects and make improvements more affordable for local entities.

Consistent with the Conservation Framework, ecosystem restoration and enhancement opportunities of the SSIA include the following:

- **Regional improvements (urban, small community, and rural-agricultural areas)** – Flood protection projects will preserve important shaded riparian aquatic habitat along riverbanks and help restore the regional continuity/connectivity of such habitats. Planning and designs for flood risk reduction projects will consider opportunities to enhance ecosystem functions.
- **System improvements** – DWR, through its multiple programs, will continue to work on integrated flood management projects within the Systemwide Planning Area, and will evaluate and initiate other projects that benefit the SPFC. Sutter and Yolo bypass expansions (described previously) may increase the overall area of floodplain that would support wetland habitats.
- **Fish passage improvements** – Improve fish passage at SPFC weirs, bypasses, and other flood management facilities undergoing modification or rehabilitation to improve access to upstream aquatic habitat and facilitate natural flow routing. Possible candidates for fish passage improvements include the following:
 - » *Big Chico Creek system*
 - » *Tisdale and Colusa weirs*
 - » *Cache Creek Settling Basin*
 - » *Fremont Weir*
 - » *Yolo Bypass*
 - » *Willow Slough Weir in Yolo Bypass*
 - » *Sacramento Weir*
 - » *Sand Slough Control Structure*

DWR's goal in integrating ecosystem restoration and enhancement is to achieve overall habitat improvement, thereby reducing, or eliminating the need to mitigate for most ecosystem impacts. However, depending on the timing of improvements and implementation, some ecosystem mitigation may be required.

3.8 Climate Change Adaption Strategy

As mentioned in Section 1, climate change is likely to generate more extreme floods in the future. Development of flood hydrology that accounts for the potential effects of climate change is a complicated and time-consuming exercise that must account for many uncertainties. DWR, in partnership with the USACE, is in the process of developing new hydrology that includes the effects of climate change, but that hydrology will not be ready for use in system evaluation until late 2012. Therefore,

the new hydrology will be most useful in technical evaluations leading to the 2017 update of the CVFPP.

Even though climate change hydrology was not yet available, development of the SSIA included allowances for potentially higher flows due to climate change. Providing wider bypasses to lower floodwater surface elevations would increase flow-carrying capacity and flexibility to deal with higher flood flows that may occur because of climate change. Changes in reservoir operations from F-CO and F-BO can provide flexibility and adaptability to changes in extreme flood events. In addition, the SSIA includes the potential for the State to participate with others in reservoir expansion projects and in obtaining rights for floodplain transitory storage from willing landowners. These and other strategies to address the effects of climate change will be further evaluated for the 2017 update of the CVFPP.

The effects of sea level rise are important in the Sacramento-San Joaquin Delta, portions of which are protected by SPFC facilities. Sea level rise will affect levees within the Delta and for some distance upstream along the rivers. The estimated average sea level rise is currently under the review of the National Research Council. For the 2012 CVFPP, high tide conditions during the 1997 flood (a strong El Nino event) were used as the boundary conditions for hydraulic analysis and could be considered an initial, surrogate condition under climate change. This tide was about two feet higher than would normally be expected on the basis of solar and lunar gravitational forces that create tides. DWR will continue to coordinate with other DWR programs, Delta Stewardship Council's Delta Plan, and ongoing USACE feasibility studies to collectively address how sea level rise could contribute to potential estuary flooding in the Delta.

For the 2017 CVFPP update, improved sea level rise information will be used. DWR will develop approaches for addressing sea level rise that may vary depending on the expected range and rate of sea level rise. For example, these approaches may vary from abandoning some facilities to raising and strengthening affected levees. Some affected areas may be transformed to ecosystem uses. Other management approaches may be considered, as supported by technical analysis during the preparation of regional plans and feasibility studies.

DWR is developing a new methodology for estimating the impacts of climate change on flood hydrology. Typical climate change impact assessments for long-term water supply needs consider likely changes in average temperature and precipitation. However, climate change impacts on extreme events, such as floods, will not result from changes in averages, but from changes in local extremes. Therefore, DWR collaborated with the National Oceanic and Atmospheric Administration, U.S. Geological Survey, USACE, and Reclamation in developing a new methodology based on the intensity of "Atmospheric Rivers," which are fast-moving, concentrated streams of water vapor that can release heavy rains. Since the moisture source of

CLIMATE CHANGE

Climate change impacts for extreme events, such as flooding and droughts, will result not from changes in averages, but from changes in local extremes. DWR initiated a study to investigate a new approach to assessing impacts based on climate change indices more suitable for flood events – "Atmospheric Rivers."

Preliminary findings are promising for:

- Assessing climate change impacts on flood management and to communities receiving flood protection
- Identifying prudent system improvements that are resilient in climate change conditions

DWR intends to continue methodology development and application for the 2017 CVFPP Update.

water vapors is often the ocean southwest of the Hawaiian Islands, these storm events are often referred to as Pineapple Expresses.

Since available climate change information does not present probabilistic characteristics, DWR is working on the concept of prudent decision making that focuses on investments that could accommodate a broader range of climate change scenarios rather than optimizing investments within a few selective scenarios. The resulting Threshold Analysis Approach was applied to the Yuba-Feather system in a proof-of-concept pilot study. The results of the pilot study suggest that under the F-CO, New Bullards Bar Dam on the Yuba River has inadequate capacity to help respond to climate change, as compared to Oroville Dam on the Feather River, because of limited regulating capacities. This information provides guidance for the overall investment strategy for modifications such as enlarged outlets at New Bullards Bar Dam. DWR intends to fully develop the Threshold Analysis Approach for the 2017 Update with new Central Valley hydrology and improved Atmospheric River indices.

In summary, improved climate change information will allow more detailed evaluation of potential climate change impacts on the SPFC and refinement of approaches to manage higher floodflows and sea levels during preparation of regional plans and feasibility studies.

3.9 Considerations for Sacramento-San Joaquin Delta

Land uses in the Delta outside the SPFC are primarily rural and dominated by agriculture and open space, with several dispersed small communities. Flood management facilities primarily include levees, which often protect lands at or below sea level. Flood management responsibilities in Delta areas outside the SPFC reside with a variety of local agencies, supported by the State's Delta Special Flood Projects Program and Delta Levees Maintenance Subventions Program.

Restoration of ecosystem functions and aquatic habitats in the Delta have been, and continue to be, the focus of various State, federal, and local efforts, in addition to water supply and flood management planning. Major efforts include the Delta Stewardship Council's Delta Plan, the Delta Protection Commission's Economic Sustainability Plan, the Bay Delta Conservation Plan, and the Delta Habitat Conservation and Conveyance Program.

The CVFPP supports a financially and environmentally sustainable Delta. Depending on which elements of the SSIA are eventually implemented in upstream regions, there is a potential for hydraulic impacts in the Delta. The SSIA includes management actions (see Section 3.5.9), and a cost allowance, to lessen or mitigate these impacts compared with current conditions.

The State will continue to support Delta flood management improvements outside the SPFC through existing programs and in coordination with ongoing multiagency Delta planning efforts. Existing programs include the Statewide Flood Management Planning Program, Delta Levees Maintenance Subventions Program, Delta Special

Flood Control Projects program, emergency planning and response support, and other residual risk management programs and support provided by the State.

3.10 U.S. Army Corps of Engineers Levee Vegetation Policy and Public Law 84-99 Eligibility

The USACE levee vegetation management policy affects implementation of the SSIA and its ability to maintain eligibility for federal Public Law 84-99 rehabilitation assistance in the event of flooding. The following provides context for the USACE policy and the State’s resultant levee vegetation management strategy described in Section 4. A more detailed description of the levee vegetation management issue can be found in Attachment 2 – Conservation Framework.

3.10.1 U.S. Army Corps of Engineers Levee Vegetation Policy

In April 2007, USACE released a draft white paper, *Treatment of Vegetation within Local Flood Damage Reduction Systems*, which clarified its nationwide policy regarding the removal of wild growth, trees, and other encroachments as a prerequisite for Public Law 84-99 eligibility. The USACE policy requires removal of all woody vegetation from levee slopes and toe areas. This policy is not consistent with the USACE “vegetation variance letter” dated August 3, 1949, which revised the Standard O&M Agreement to include the following text: “Brush and small trees may be retained on the waterward slope where desirable for the prevention of erosion and wave wash. Where practicable, measures shall be taken to retard bank erosion by the planting of willows or other suitable growth on areas riverward of the levees.” The 2007 policy is also not consistent with the long-standing USACE practice of protecting trees while performing levee repairs on Central Valley levees, and requiring new tree planting in its levee designs, where feasible.

USACE has proposed the new levee vegetation policy to improve levee integrity and reduce flood risk. The *Flood Control System Status Report* includes DWR’s assessment of the safety risks associated with trees and shrubs on, and adjacent to, levees. The report concludes that properly trimmed and spaced levee vegetation poses a low threat to levee integrity in comparison with other risk factors, and can help stabilize soils and reduce nearshore flow velocities. DWR does not believe that the presence of properly maintained woody vegetation on “legacy levees” constitutes a degree of risk that necessarily requires removing vegetation or constructing engineered works to address the perceived risk. Instead, DWR believes such “legacy levee vegetation” needs to be considered in a balanced recognition of its role to the ecosystem and to the levee’s integrity.

A preliminary assessment by DWR has also concluded that the complete removal of existing woody vegetation along the 1,600-mile legacy Central Valley levee system would be enormously expensive, would divert investments away from more critical threats to levee integrity, and would be environmentally devastating. Recent USACE research regarding the risks associated with trees on levees found that trees

can slightly increase or decrease levee safety, depending on their location on the levee slope. While concluding that more research is needed, the research did not characterize levee vegetation as a major risk factor.

In the spirit of cooperation, DWR, USACE, local maintaining agencies, and key federal and State resources agencies, have been engaged in California Levees Roundtable discussions since August 2007. Early discussions regarding ways to address USACE's levee vegetation policy led to the *California's Central Valley Flood System Improvement Framework* (Framework Agreement), dated February 27, 2009. The Framework Agreement allows Central Valley levees to retain accept-

able maintenance ratings and Public Law 84-99 rehabilitation eligibility as long as levee trees and shrubs are properly trimmed and spaced to allow for visibility, inspection vehicles, and floodfight access. The Framework Agreement states that "...the eligibility criteria will be reconsidered based on the contents of the CVFPP."



Erosion along the Sacramento River

While the California Levees Roundtable discussions were underway, USACE issued Engineering Technical Letter (ETL) 1110-2-571, which finalized its *Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures* (April 10, 2009). These guidelines essentially established a woody vegetation-free zone on all levees and the adjoining ground within 15 feet of the levee on both sides, and are at odds with DWR's independent assessment described above. As an implementation directive for the ETL, 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 recommended that USACE formulate a variance process that is workable on a systemwide scale, such as might be required for the Central Valley flood management system. DWR has recommended that such a variance process should allow 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 2011, DWR proposed an alternative variance procedure for USACE consideration. Although USACE has stated their procedural inability to work individually with California (or collectively with several non-federal entities) to collaboratively develop a variance policy that recognizes and accommodates regional differences, DWR remains hopeful that USACE will issue a final vegetation variance PGL that will complement and be consistent with the CVFPP.

It is important to note that the large-scale 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, pose a major threat to fish and wildlife species, including protected species, and to their recovery. Similarly, local agencies are concerned about negative impacts to public safety from 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.

A further complication is the question of shared responsibility for activities to address woody vegetation. The USACE ETL and associated February 2010 draft PGL do not recognize that legacy levee vegetation exists for a wide variety of reasons (in many cases, because USACE itself placed the vegetation or encouraged its placement or retention), and instead treats all legacy levee vegetation as if it were “deferred maintenance” and solely a nonfederal 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 nonfederal partners. The State continues to encourage 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 partner with DWR and local agencies 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 to confer 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.

A critical limitation of the USACE ETL is that it is written strictly in terms of new levee construction. It does not recognize and address the unique engineering and environmental attributes presented by well-established “legacy vegetation” as an integral aspect of many SPFC levees. While the CVFPP proposes to adhere to USACE vegetation policy for new levee construction, compatibility of the CVFPP levee vegetation management strategy with implementation of USACE national vegetation policy for “legacy levee vegetation” needs flexibility to recognize and accommodate regional differences – which could be achieved through a collaboratively developed variance policy that provides such regional flexibility.

3.10.2 Economics of Public Law 84-99 Eligibility for Rural-Agricultural Levees

Noncompliance with USACE vegetation policy may result in Public Law 84-99 ineligibility for rural-agricultural levees. However, compliance with the policy is costly and generally is not affordable for rural-agricultural maintaining agencies, nor is it practicable. Although the Public Law 84-99 Rehabilitation and Inspection Program can be helpful to nonfederal sponsors in rehabilitating damaged levees after a flood, its usefulness is limited in the Central Valley for the following reasons:

- Funding for Public Law 84-99 rehabilitation assistance is generally very limited. Public Law 84-99 rehabilitation assistance for significant damage repairs usually requires a special appropriation by Congress.
- There is no mechanism to obtain reimbursement or credit when a nonfederal sponsor performs the repairs, or pays USACE to perform the repairs.
- Increasingly stringent USACE maintenance requirements, especially for encroachments and vegetation, can be difficult to meet and are unaffordable.
- Rehabilitation projects need to be economically justified with a benefit-to-cost ratio of 1.0 or greater to justify federal involvement. In rural-agricultural areas of the Sacramento and San Joaquin river basins, this requirement can be difficult to achieve.

From a nonfederal perspective, the most critical concerns about implementing the USACE vegetation policy are the environmental impacts, the cost to comply with the policy, and the misallocation of scarce public funds for system improvement.

Based on USACE expenditures under Public Law 84-99 for declared flood events in 1995, 1997, 1998, and 2006, the preliminary estimate of annualized assistance of levee rehabilitation is approximately \$30 million. This estimate is significantly influenced by the \$120 million in assistance provided by USACE following the 1997 flood event – an amount not likely to be duplicated based on subsequent changes in USACE policy, such as their levee vegetation policy.

In April 2010, DWR developed a *Fiscal Impact Report of the U.S. Army Corps of Engineers' Vegetation Management Standards and Vegetation Variance Policy for Levees and Flood Walls*. This report includes the cost estimates of applying the ETL to the 116 critical levee repairs performed from 2006 through 2008 and the cost estimate of applying the ETL to the entire 1,600 miles of project levee system by extrapolation. The estimated order of magnitude cost to comply with the USACE policy ranged from \$6.5 billion to \$7.5 billion. Annualizing this cost of compliance (over a 50-year project life at 6 percent) would yield an annual cost of over \$400 million, more than ten times the \$30 million annual assistance estimated above.

Therefore, the State interest is to follow the vegetation management strategy presented in Section 4. The local maintaining agencies may choose to comply with the USACE vegetation policy to maintain Public Law 84-99 eligibility; however, it would be very challenging for rural-agricultural maintaining agencies because of cost of compliance for eligibility. This is evident by the results of fall 2011 USACE periodic inspections, 39 of 116 local maintaining agencies have lost eligibility for

Public Law 84-99 rehabilitation assistance for reasons other than vegetation. In addition, removal of levee systems from “active status” under Public Law 84-99 based on noncompliant vegetation would be unfortunate and unnecessary. USACE Engineering Regulation 500-1-1 protects the federal government from bearing any of the cost of any levee rehabilitation work associated with “deferred or deficient maintenance.” Thus, to protect the federal investment in SPFC levees, USACE would be justified in retaining “active status” for SPFC levee systems with noncompliant vegetation, assigning to the nonfederal partner any rehabilitation costs attributable to such vegetation.

3.11 Residual Risk Management

As elements of the SSIA are constructed over time, residual flood risk within the Central Valley should decrease. However, the potential for flooding in the Central Valley will always pose risks to life and property, particularly in areas of deep or rapid flooding. Table 3-4 illustrates estimated residual risk management needs for the SSIA. These can be compared with the residual risk needs estimated for the preliminary approaches in Table 2-2.

Table 3-4. Residual Risk Management for State Systemwide Investment Approach

FLOOD MANAGEMENT ELEMENT	PROJECT LOCATION OR REQUIRED COMPONENTS	INCLUDED IN SSIA IMPLEMENTATION
Enhanced Flood Emergency Response	All-weather roads on levee crown	YES
	Flood information collection and sharing	YES
	Local flood emergency response planning	YES
	Forecasting and notification	YES
	Rural post-flood recovery assistance program	YES (small)
Enhanced Operations and Maintenance	Identify and repair after-event erosion	YES
	Developing and implementing enhanced O&M programs and regional O&M organizations	YES
	Sacramento channel and levee management, and bank protection	YES
Floodplain Management	Raising and waterproofing structures and building berms	YES (large)
	Purchasing and relocating homes in floodplains	YES (large)
	Land use and floodplain management	YES
	Agricultural conservation easements	YES

Key:

Large = relatively high level of work to implement

O&M = operations and maintenance

Small = relatively low level of work to implement

SSIA = State Systemwide Investment Approach

Consequently, investments in residual risk management must continue, both during and after implementation of the SSIA. Policies and programs related to residual risk management are described in more detail in Section 4.

3.12 Estimated Cost of State Systemwide Investment Approach

Table 3-5 summarizes the preliminary estimate of costs for the SSIA, assuming all elements are ultimately completed. Estimates include costs for capital improvements and 25 years of ongoing annual work to maintain the system. Estimated costs are in 2011 dollars. Actual costs will vary from those in Table 3-5 because of a wide range of factors, including project justification by feasibility studies, project configuration, implementation time, future economic and contractor bidding conditions, and many others.

STATE INVESTMENTS IN STATE PLAN OF FLOOD CONTROL FLOOD MANAGEMENT, 2007 – 2011

Flood Emergency Response

- Emergency exercises
- New water gaging
- Forecast-Coordinated Operations for Yuba/Feather
- Rock stockpiles in the Delta

Operations and Maintenance

- Over 220 levee sites repaired
- Sediment removal from bypasses
- Rehabilitation of 7 flood structures

Floodplain Management

- Building code revision prepared
- 300,000 flood risk notifications annually, since 2009
- Mapping of Central Valley Levee Flood Protection Zones

Capital Improvements

- 15 ongoing or completed projects

Assessments and Engineering

- 9,000 square miles of topographic data
- Urban and nonurban levee evaluations
- State Plan of Flood Control Descriptive Document
- Flood Control System Status Report
- CVFPP development
- Coordination with USACE on many ongoing evaluations

Ecosystem

- See Section 4 for ecosystem accomplishments

Specific project features ultimately implemented for the SSIA will depend on a host of factors. These factors include detailed project feasibility studies; designs and costs; environmental benefits and impacts; interaction with other local projects and system improvements; local, federal, and State agency participation in project implementation; and changing physical, institutional, and economic conditions.

The table also includes SPFC flood management investments that have already been expended or committed during the 2007 to 2011 period. Since passage of the 2007 flood legislation directing preparation of the CVFPP, the State has made substantial progress in reducing flood risks within the Central Valley by investing bond funds from Propositions 84 and 1E. These efforts encompass urban levee improvements, emergency repair projects, physical and operational changes to flood management reservoirs, emergency response planning, and improvements to operations and maintenance, emergency response, and floodplain management. These accomplishments over the past five years represent significant progress in achieving the CVFPP Goals.

The estimated amounts in Table 3-5 are total combined investments for State, federal, and local agencies. Section 4 provides further detail on cost-sharing proportions, and expenditures prior to adoption of the CVFPP. Consistent with traditional cost-sharing for flood management projects, DWR

Table 3-5. Estimated Costs of State Systemwide Investment Approach (\$ millions)

REGION	SYSTEM IMPROVEMENTS		URBAN IMPROVEMENTS		RURAL-AGRICULTURAL IMPROVEMENTS		RESIDUAL RISK MANAGEMENT		TOTAL COST						
	Low	High	Low	High	Low	High	Low	High	Low	High					
1 – Upper Sacramento	\$109	-	\$180	\$120	-	\$144	\$154	-	\$168	\$95	-	\$114	\$480	-	\$610
2 – Mid-Sacramento	\$234	-	\$340	\$0	-	\$0	\$360	-	\$379	\$261	-	\$333	\$860	-	\$1,050
3 – Feather River	\$1,695	-	\$2,139	\$891	-	\$1,048	\$282	-	\$289	\$170	-	\$212	\$3,040	-	\$3,690
4 – Lower Sacramento	\$1,627	-	\$1,962	\$3,549	-	\$4,283	\$77	-	\$88	\$138	-	\$169	\$5,390	-	\$6,500
5 – Delta North ¹	\$754	-	\$924	\$144	-	\$192	\$604	-	\$634	\$266	-	\$311	\$1,770	-	\$2,060
6 – Delta South ¹	\$427	-	\$549	\$0	-	\$0	\$47	-	\$52	\$110	-	\$135	\$580	-	\$740
7 – Lower San Joaquin	\$7	-	\$8	\$626	-	\$809	\$17	-	\$19	\$82	-	\$97	\$730	-	\$930
8 – Mid-San Joaquin	\$60	-	\$102	\$0	-	\$0	\$48	-	\$55	\$81	-	\$96	\$190	-	\$250
9 – Upper San Joaquin	\$229	-	\$297	\$166	-	\$199	\$183	-	\$189	\$308	-	\$396	\$890	-	\$1,080
TOTAL	\$5,140	to	\$6,500	\$5,500	to	\$6,680	\$1,770	to	\$1,870	\$1,510	to	\$1,860	\$13,920	to	\$16,910

Notes:

¹SPFC Facility costs only

Costs in \$ millions. All estimates in 2011 dollars.

Key:

SPFC = State Plan of Flood Control

estimates that the State's share of costs included in Table 3-5 will be \$6,400 million to \$7,700 million, including already expended or committed investments, if all elements of the SSIA are ultimately constructed. Section 4 also shows cost estimates over a more certain time period of 10 years that will allow near-term projects to be constructed as longer term projects are under additional evaluation.

3.13 Performance of State Systemwide Investment Approach

Based on the evaluations, the SSIA could effectively improve management of flood risk for urban, small community, and rural-agricultural areas given differing population, assets at risk, and other State interests. The SSIA reflects a cost-justifiable approach to effectively meet the legislation requirements and the CVFPP Goals, and provides a road-map for more detailed studies and designs leading to site-specific capital improvements.

The following sections summarize the additional performance benefits that could be achieved through implementing the SSIA. The following sections compare the performance of the SSIA to current conditions for several key parameters: changes in flood stage, sustainability, contributions to the CVFPP Goals, and relative efficiency. For analysis purposes, the current or No Project condition represents conditions consistent with the Notice of Preparation for the PEIR. It is also important to note that Early Implementation Projects and other FloodSAFE initiatives implemented since bond funding became available in 2007, which are considered part of the SSIA, have already provided benefits.

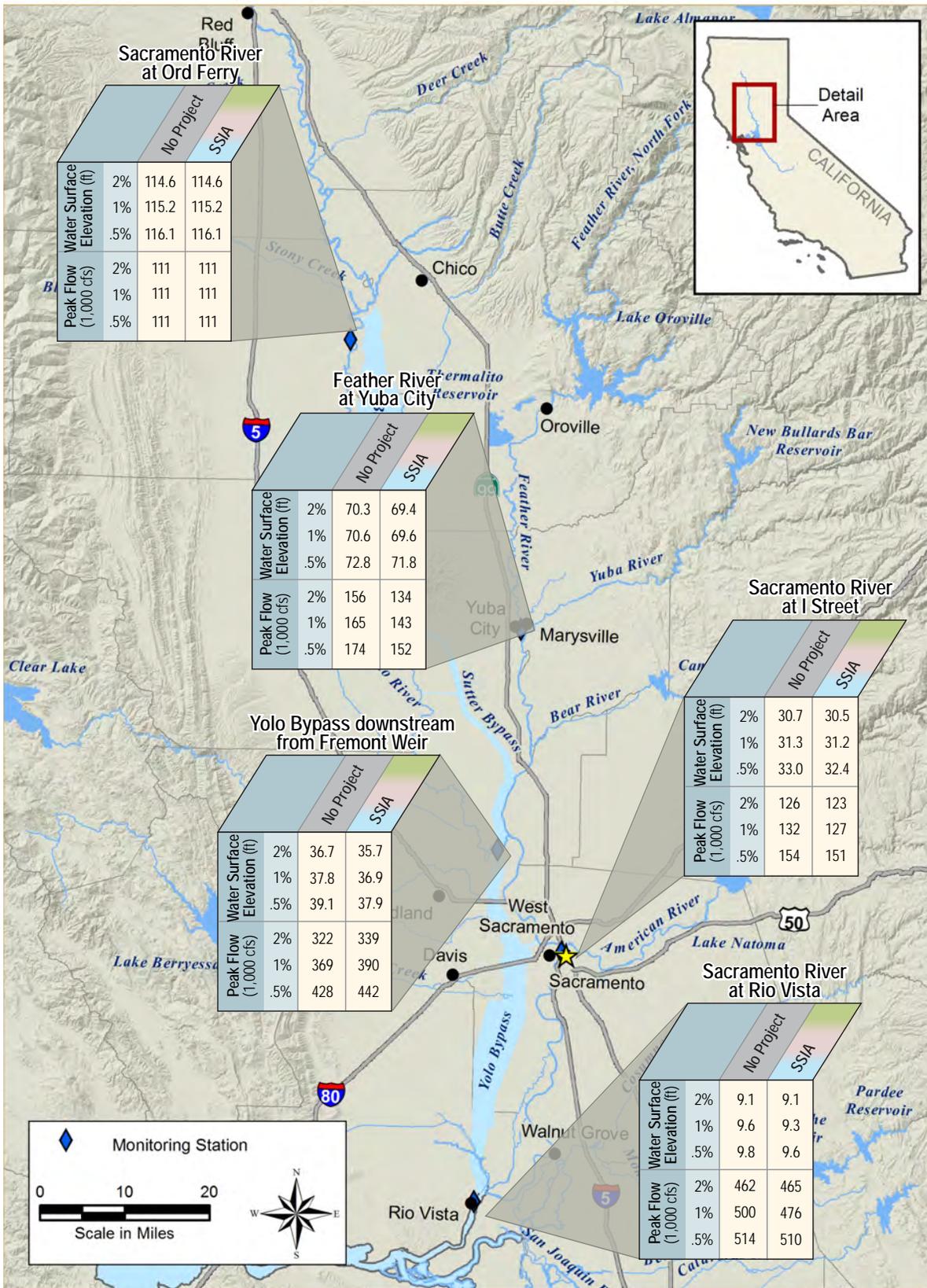
3.13.1 Stage Changes

STATE SYSTEMWIDE INVESTMENT APPROACH STAGE PERFORMANCE

Although peak floodflows may increase locally (over current conditions) in certain reaches, expansion of conveyance capacity proposed by the SSIA would result in reduced peak flood stages throughout the system.

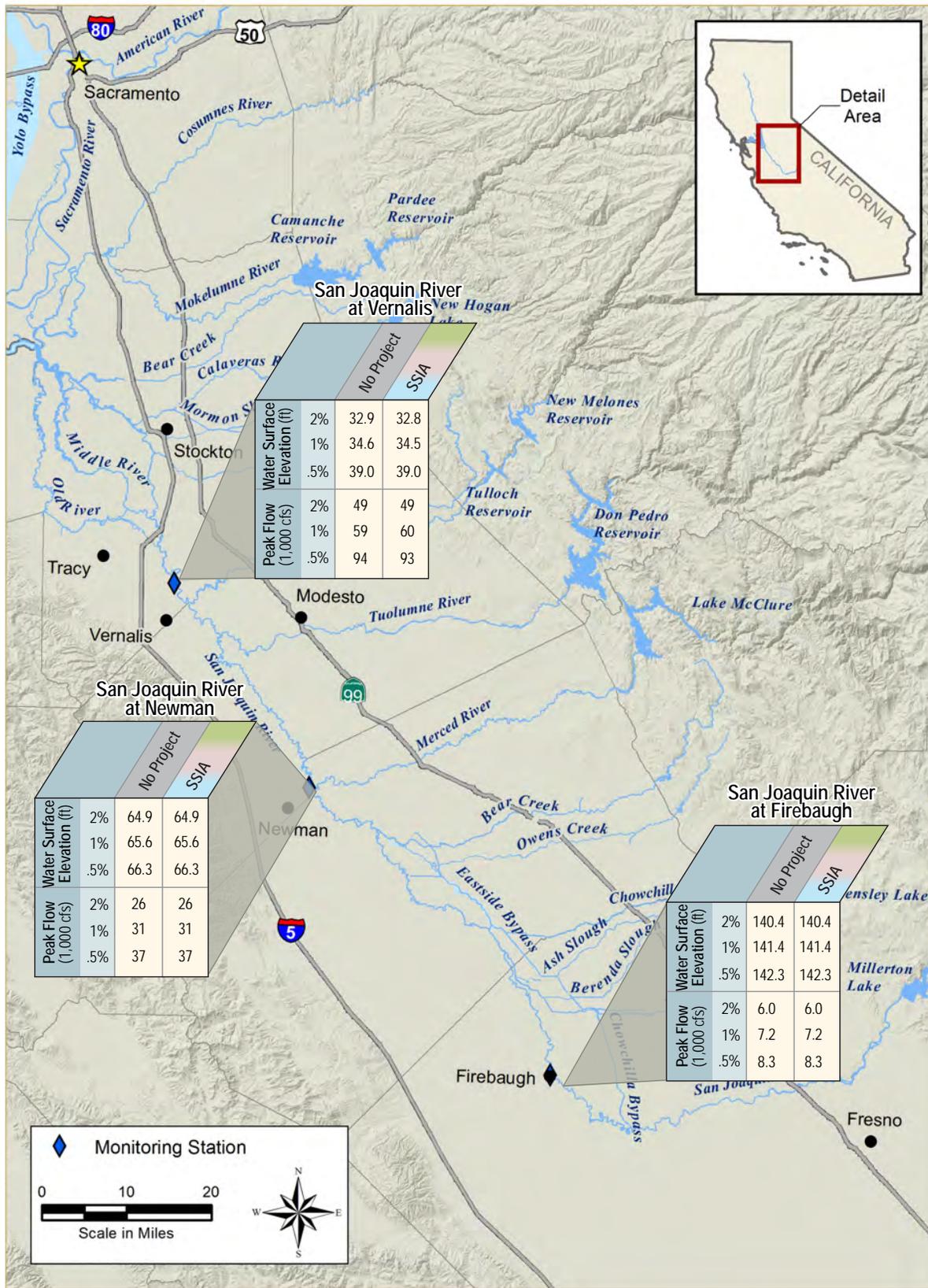
Figures 3-4 and 3-5 illustrate performance of the SSIA with respect to systemwide peak floodwater surface elevations (stages) compared to current conditions. In most areas along the rivers in the Sacramento River Basin, stages are lower than current conditions because of the proposed bypass expansions. Flood stages in the San Joaquin River Basin do not change much with respect current conditions because large bypass expansions were not included, except near the Delta. Flood stages entering the Delta may be higher by a few tenths of a foot. If stage changes result in significant hydraulic impacts, features to mitigate the impacts may be used.

Sequencing improvements along the river corridors may cause temporary water stage impacts and or hydraulic impacts. Sequencing improvements from downstream to upstream may eliminate these temporary impacts, but may not be practical considering the wide range of improvements that need to be made.



Location of Peak Flow and Water Surface Elevation Estimates for 100-Year Storm Event at selected monitoring locations in the Sacramento River Basin. Location of peak flow and water surface elevation estimates for various frequency events at selected monitoring locations in the Sacramento River Basin.
 Key: cfs = cubic feet per second ft = feet SSIA = State Systemwide Investment Approach

Figure 3-4. Changes in Peak Floodflows and Stages – No Project Versus State Systemwide Investment Approach for Various Storm Events – Sacramento River Basin



Location of Peak Flow and Water Surface Elevation Estimates for 100-Year Storm Event at selected monitoring locations in the San Joaquin River Basin. Location of peak flow and water surface elevation estimates for various frequency events at selected monitoring locations in the Sacramento River Basin. Key: cfs = cubic feet per second ft = feet SSIA = State Systemwide Investment Approach

Figure 3-5. Changes in Peak Floodflows and Stages – No Project Versus State Systemwide Investment Approach for Various Storm Events – San Joaquin River Basin

3.13.2 Sustainability

Table 3-6 summarizes the financial, environmental, and social sustainability aspects of the SSIA compared with current conditions.

Table 3-6. Summary of State Systemwide Investment Approach Sustainability Compared with No Project

	NO PROJECT	STATE SYSTEMWIDE INVESTMENT APPROACH
Overall Sustainability	Low	Medium
Financial	Very high ongoing and long-term annual costs	Very high upfront and lower long-term annual costs.
Environmental	Limited opportunities to improve habitat connectivity, quality, quantity, and biodiversity	Enhanced opportunities to improve habitat connectivity, quality, quantity, and biodiversity.
Social	Varied level of protection throughout the system Significant potential for public safety and economic consequences of flooding	Seeks flood protection comparable with assets being protected. Limits cumulative growth of flood risks to State's people and infrastructure due to system improvements. Reduces reliance on compensatory mitigation for project implementation and regular operations and maintenance due to implementation of systemwide conservation strategy. Rebalances institutional arrangement for operations and maintenance responsibilities.
Climate Change Adaptability	Low system resiliency (ability to adapt)	Conveyance improves flood system resiliency by lowering stages, which improves ability to adapt to climate change.

Key:

State = State of California

3.13.3 Central Valley Flood Protection Plan Goals

Table 3-7 summarizes contributions of the SSIA to the five CVFPP Goals, compared with No Project.

3.13.4 Relative Efficiency

DWR prepared a qualitative comparison to show broad differences in potential performance of the preliminary approaches and the SSIA. Figure 3-6 shows these qualitative comparisons of performance for the SSIA with the three preliminary approaches. These comparisons are the same as shown in Figure 2-6, but with the addition of the SSIA.

Another view of the relative performance of the three preliminary approaches and SSIA is shown in Figure 3-7. The figure shows preliminary cost estimates and estimated performance in terms of the relative contributions of each approach to the primary and supporting goals of the CVFPP.

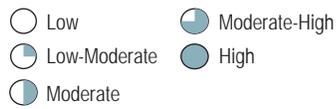
Table 3-7. Summary of Contributions of State Systemwide Investment Approach to Central Valley Flood Protection Plan Goals Compared with No Project

GOAL OR METRIC	NO PROJECT	STATE SYSTEMWIDE INVESTMENT APPROACH
Contributions to Primary Goal – Improve Flood Risk Management		
– Level of Flood Protection	Varies throughout system <ul style="list-style-type: none"> • Most urban areas do not have 200-year level of flood protection • Protection to rural-agricultural areas and small communities varies widely 	Overall higher protection consistent with assets being protected <ul style="list-style-type: none"> • Urban areas achieve protection from a 200-year flood, and for small communities achieve protection from a 100-year flood • Overall increased levels of flood protection throughout the system reflecting improved capacity to manage flood peaks
– Life Safety (focused on populations at risk)	Varies throughout system <ul style="list-style-type: none"> • Public safety threat is high for many communities, particularly those in deep floodplains 	Improvement varies <ul style="list-style-type: none"> • Substantial improvement in urban areas • Improvement in small communities varies
– Economic Damages	\$329 million in expected annual amages <ul style="list-style-type: none"> • Economic damages, particularly in urban areas, are very high 	Reduction of 67 percent in expected annual damages <ul style="list-style-type: none"> • Substantial reduction in damages in urban areas, small communities, and rural areas
Contributions to Supporting Goals		
Improve Operations and Maintenance	Very high current costs <ul style="list-style-type: none"> • Ongoing and long-term O&M costs are very high relative to other approaches 	Decrease in long-term O&M requirements <ul style="list-style-type: none"> • Decrease in long-term costs due to O&M reforms (clarified roles and responsibilities, consistent standards, and revenue generation improvements) and physical modification to reduce geomorphic stressors
Promote Ecosystem Functions	Limited opportunities for ecosystem benefit <ul style="list-style-type: none"> • Native habitat may be integrated into SPFC repair projects, primarily through mitigation 	Enhanced opportunities for systemwide ecosystem benefit <ul style="list-style-type: none"> • Floodway expansion provides substantial opportunity to improve ecosystem functions, fish passage, and the quantity, quality, and diversity of natural habitats
Improve Institutional Support	<ul style="list-style-type: none"> • Continued dispersion of responsibilities and roles for flood management in the Central Valley among many agencies with varying functions and priorities 	<ul style="list-style-type: none"> • Improve flood management functions through changes and/or clarifications in current State policy directives, legislated authority and responsibilities, and partnerships with federal and local partners
Promote Multi-Benefit Projects	<ul style="list-style-type: none"> • Limited opportunities to integrate other benefits into repairs to SPFC facilities 	<ul style="list-style-type: none"> • Enhanced opportunities to integrate water quality, groundwater recharge, recreation, power, and other benefits
Ability to Meet Legislative Objectives (Completeness)		
Ability to Meet Objectives in Flood Legislation	Does not meet <ul style="list-style-type: none"> • Varied level of protection throughout the system and high potential for public safety and economic damages 	Addresses all objectives <ul style="list-style-type: none"> • Contributes to all objectives with proposed system and regional elements, and supporting implementation policies and programs

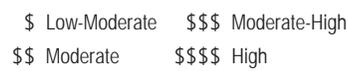
Key:
 O&M = operations and maintenance
 SPFC = State Plan of Flood Control
 State = State of California

PERFORMANCE CATEGORY	ACHIEVE SPFC DESIGN FLOW CAPACITY	PROTECT HIGH RISK COMMUNITIES	ENHANCE FLOOD SYSTEM CAPACITY	STATE SYSTEMWIDE INVESTMENT APPROACH
Flood Risk Reduction Benefit	●	●	●	●
Level of Flood Protection	●	●	●	●
Life Safety	●	●	●	●
Reduction in Economic Damages	●	●	●	●
Regional Economics	●	●	●	●
Integration and Sustainability	○	●	●	●
Promote Ecosystem Functions	○	○	●	●
Promote Multi-Benefit Projects	○	●	●	●
Sustainable Land Uses	○	●	●	●
Cost	\$\$\$	\$\$	\$\$\$	\$\$
Capital Costs	\$\$\$	\$	\$\$\$\$	\$\$
Operations & Maintenance	\$\$	\$\$\$\$	\$	\$\$

BENEFIT KEY



COST KEY



Key: SPFC = State Plan of Flood Control

Figure 3-6. Performance Comparison for All Approaches

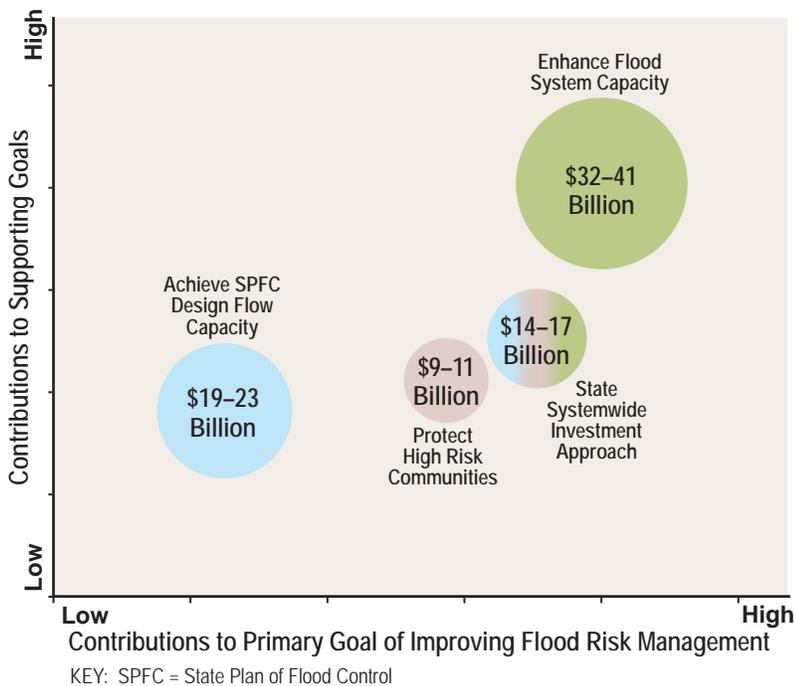


Figure 3-7. Relative Comparison of State Systemwide Investment Approach and Preliminary Approach Efficiency

3.14 State Systemwide Investment Approach Benefits

The SSIA, as a multi-benefit and integrated flood management approach, has many direct and indirect benefits to the Central Valley, State, and nation. This section summarizes the benefits of the SSIA.

Benefits assessed include reduced economic damages, benefits to local and regional economies, improved public health and safety, ecosystem restoration, open space and recreation, increased flood system resiliency and climate change adaptability, water management, and reduced long-term flood system management costs. Some of these benefits are presented quantitatively and some qualitatively, because some of the benefits could not be calculated at this time. These benefits will be further refined and documented during the feasibility study process scheduled to be initiated upon adoption of the CVFPP by the Board.

3.14.1 Reduced Economic Flood Damages

The USACE Hydrologic Engineering Center Flood Damage Analysis (HEC-FDA) model was used to estimate the flood risk reduction benefits of the SSIA. Expected annual flood damages were computed over the array of potential floods, from small to extremely large, compared with the no project condition. The flood damage estimates consider the following:

- Residential, commercial, industrial, and governmental structure and contents damage
- Agricultural/crop losses
- Business production losses

Results of the modeling indicate an overall reduction in total expected annual damages of about 67 percent, with specific reductions in damages and losses as follows:

- Structure and contents flood damages would be reduced by 72 percent
- Crop damages due to flooding would be reduced by 6 percent
- Business production losses would be reduced by 72 percent

3.14.2 Benefits to Local and Regional Economies

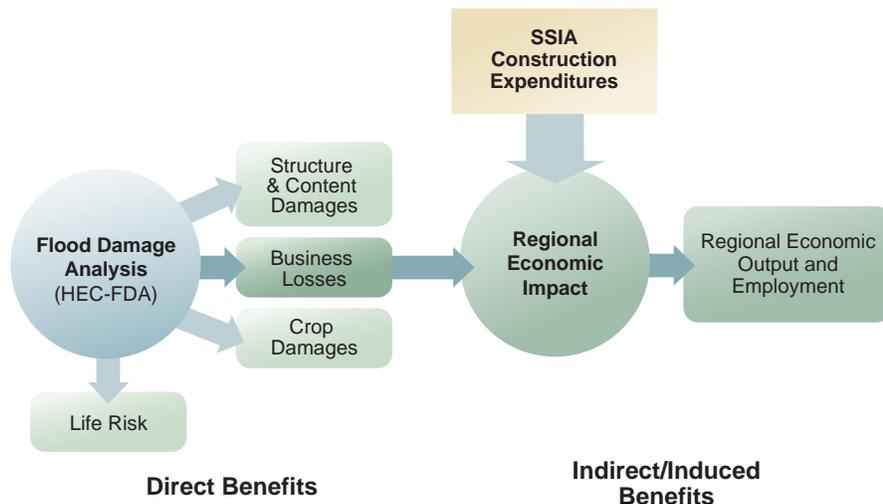
Reduction in flood damages is only one aspect of the potential economic benefits of the SSIA. As illustrated in Figure 3-8, flood risk reduction improvements can also provide both direct and indirect benefits to local, regional, and State economies.

Implementation of the SSIA would contribute to local and regional economic activities, as described below:

- **Increased benefits to regional economies** – Implementing the SSIA would directly and indirectly benefit local and regional economies and support continued economic development in the valley. Implementation of the plan would reduce the potential for lost agricultural, commercial, and industrial production/income, and secondary “ripple” effects, as a result of a flood.

Construction activities related to SSIA implementation could be expected to boost economic output over the coming decades by as much as \$900 million, and avoided business losses due to flooding could increase long-term economic output by over \$100 million. The potential for flood-induced industry relocation or failure to recover to pre-flood levels would also be reduced. In addition, construction projects resulting from implementation of the SSIA would be expected to boost regional short-term employment and employment incomes, and increase regional economic output. Construction activities in support of SSIA implementation could be expected to generate as many as 6,500 jobs annually over the coming decades, while reduced business losses from flooding could be expected to boost long-term employment. These employment economic benefits would also enhance the revenues of local governments through increased income and sales taxes.

- Enhanced agricultural sustainability** – Central Valley agriculture is a critical sector of the State economy that provides and supports reliable, affordable food and fiber production, both domestically and on a global scale. Agricultural and associated processing industries and services also account for a considerable portion of local employment. Flood management improvements would reduce direct crop damages. Improved flood protection would result in an increased ability to obtain favorable crop insurance coverage and rates. Similarly, improved protection would also increase the ability to obtain agricultural loans with favorable terms. As a result, flood management improvement has the potential to contribute to improved agricultural sustainability. Over 90 percent of the citizens in rural-agricultural areas and small communities within the SPFC Planning Area could receive additional flood protection by levee improvement measures, flood proofing, and relocation opportunities presented in the SSIA.



Key: HEC-FDA = U.S. Army Corps of Engineers Hydrologic Engineering Centers Flood Damage Analysis
 SSIA = State Systemwide Investment Approach

Figure 3-8. Components of Economic Analysis

- **Reduced disruption of public services** – In addition to reducing physical damages to structures and infrastructure, flood management improvements would reduce potential disruption of critical public services needed to maintain the health, safety, and welfare of the population. These critical functions include emergency services, transportation, health care, education, and public utilities (water and wastewater, electricity, natural gas, and communications). Interruption of these services and functions would greatly affect socioeconomic conditions in the region and its economic and industrial diversity. The CVFPP has not quantitatively assessed the loss of critical public services, but has estimated the number of critical facilities *exposed* to flood hazards.

3.14.3 Improved Public Health and Safety

A primary objective of the SSIA is to protect the citizens living and working in the floodplains of the Central Valley.

- **Reduced potential for injuries and loss of life** – When fully implemented, the SSIA would significantly reduce the potential for flooding in urban areas and other population centers, thereby reducing the direct threats posed by flooding to public safety, including the potential for injury or loss of life. Implementation of the SSIA would result in an increase in the population receiving at least a 100-year (1% annual chance) level of flood protection from the current 21 percent to over 90 percent. Additional reductions in the potential for loss of life would be achieved as a result of nonstructural flood mitigation, such as improved flood emergency response, operations and maintenance, and floodplain management measures.

HEC-FDA was used to estimate life risk indicators and inform the decision-making process. However, these values are NOT forecasts of deaths expected to occur from flood events, to be used for emergency planning or other purposes. Instead, these values are informative indices of life risk, providing a metric for assessing the reduction in life risk attributable to the SSIA. Based on the analysis, the SSIA was shown to reduce life risk by about 49 percent compared with current conditions.

The economic and life safety benefits for the SSIA described above do not include benefits attributable to projects that were recently completed or are currently under construction. Therefore, the overall benefits of the SSIA described herein are considerably underestimated.

- **Reduced release of hazardous materials during floods** – Floods can cause a release of hazardous materials resulting in increased threats to public health and safety. Hazardous materials and contaminants may exist in floodplains, including feed lots, fuel tanks, septic systems, water and wastewater treatment facilities, landfills, illegal dumping, and other sources. Improved flood management under the SSIA would contribute to reducing public exposure to hazardous materials released during floods and improve water quality.

3.14.4 Ecosystem Restoration Benefits

Environmental restoration is fully integrated with the flood risk reduction components of the SSIA. Major restoration benefits of the SSIA include the following:

- Floodways would be expanded and extended to improve the flow carrying capacity of the channels, and the lands acquired for the expansion would be used for habitat restoration and environmentally-friendly agricultural activities. Over 10,000 acres of new habitats would be created within the flood management system. In addition, over 25,000 acres of land would be leased for growing grains, corn, and other habitat-compatible crops. Flood management system improvements would provide opportunities for improving ecosystem function and increasing habitat extent, quantity, quality, and connectivity from the Delta to the upper Sacramento River. Expanded floodways would create space for river meandering, sediment erosion and deposition, natural ecosystem disturbance processes, and a healthy diversity of riverine habitat.
- The SSIA would improve fish passage at flood diversions, flashboard dams, and flood management structures. This includes connecting fishery habitat from Delta to Yolo and Sutter bypasses and to the Butte Basin. These actions would assist in increasing and improving habitat connectivity and promoting the recovery of anadromous fish populations.
- Changes in flood control facility operations, including directing flows more frequently and for longer durations over weirs and into bypasses, levee setbacks, and other similar measures planned under the SSIA, would enhance riverine processes and improve the overall health of the ecosystem.

Overall, these restoration activities would contribute to improving habitat connectivity along the flood management system, would provide for migration of fish to spawning areas in the watershed, and would enhance riverine processes.

3.14.5 Open Space and Recreational Opportunities

The State's interest in public health and sustainable economic growth are well supported by the quality of life benefits of nature-based recreation and the economic vitality provided by environmental tourism revenues. The potential for recreational use of the flood control system has long been recognized. In 1929, when the flood control system was under construction, noted landscape architect Frederick Law Olmstead Jr. recommended that a system of recreation lands be preserved within the leveed floodplains along the lower Sacramento River and other waterways.

The SSIA includes floodplain reconnection and floodway expansion, which would improve ecosystem functions, fish passage, and the quantity, quality, and diversity of natural habitats, all of which contribute to increasing opportunities for recreation and ecotourism, as well as augmenting the aesthetic values of those areas. Expansion of habitat areas provides fishing, hunting, and wildlife viewing opportunities. Recreation-related spending associated with increased use by visitors can be an important contributor to local and regional economies.

3.14.6 Increasing Flood System Resiliency and Climate Change Adaptability

Climate change is expected to result in more precipitation in the form of rainfall, more frequent flooding, and higher peak flows. Expansion and extension of the bypass system under the SSIA would reduce peak flood stages throughout the system, increasing the flood carrying capacity of channels and, hence, add flexibility to manage extreme flood events and future climate change effects.

3.14.7 Water Management Benefits

The SSIA, as an integrated flood and water management program, would provide opportunities for improved water management in many ways. While estimates of water management benefits will be quantified for the 2017 CVFPP, DWR expects that the average annual water management benefits of the SSIA may approach a few hundred thousand acre-feet compared to No Project. SSIA elements that could contribute to improved water management include reservoir operations and increases in channel groundwater recharge due to expansion and extension of the bypass system.

- **Reservoir operation** – The F-CO program (see Section 3.5.8) is designed to modify operation of reservoirs in a way that will improve flood management and also provide opportunities for more aggressive refilling of reservoirs during dry years. Such operations could increase water supplies within reservoirs, especially in dry years when the water supply system is most stressed. Water supply benefits from F-BO would vary depending on current reservoir operation manual requirements, watershed hydrology, flexibility in reservoir operation (i.e., adequate release capacity), quality of reservoir inflow forecasts, etc. Therefore, a case-by-case study of flood management reservoirs will be needed to adequately define and quantify the potential benefits of reservoir F-BO.
- **Groundwater recharge** – Groundwater aquifers are naturally recharged through various processes, including percolation of precipitation and infiltration of water from lakes, canals, irrigation and in-channel groundwater recharge. Implementation of the SSIA includes expansion and extension of the bypass system and levee setbacks. These actions would expand flood system lands by an additional 35,000 to 40,000 acres, which would be flooded during high water and contribute to in-channel and floodplain groundwater recharge.

3.14.8 Reduced Long-Term Flood System Management Costs

Although not quantified for the 2012 CVFPP, the SSIA was developed to reduce the overall, long-term costs associated with flood management in the Central Valley. This includes the following:

- Reduced long-term emergency response and recovery needs
- Reduced long-term operations and maintenance costs
- Efficiency through regional approaches to permitting and regulatory needs

3.15 Land Use

SPFC improvements under the SSIA provide for higher levels of flood protection for existing land uses without taking actions that may encourage changes to those uses. Elements of the SSIA have been carefully formulated to reduce flood risk in the area protected by SPFC facilities while avoiding land use changes that promote growth in deep floodplains and increase State flood hazard liabilities. Improved flood protection with the SSIA enhances the likelihood that activities associated with each existing land use will continue to thrive.

Following is a summary of land use conditions under the SSIA:

- Urban Land Use** – Urban and urbanizing areas within the SPFC Planning Area would achieve a minimum of 200-year (0.5% annual chance) flood protection, as specified by legislation. Legislation requires each city and county within the Sacramento-San Joaquin Valley to amend its general plan to include data, analysis, goals, and policies for protection of lives and property, and related feasible implementation measures. DWR will make data, analysis, and information gathered for the CVFPP available to local agencies for inclusion in their amended general plans. In addition, these local entities are required to amend their zoning ordinances to be consistent with their general plans. As a result, urban development would continue based on sound planning; however, the SSIA does not promote urban development in floodplains beyond existing urban/urbanizing areas.
- Small Community Land Use** – The SSIA supports the continued viability of small communities within the SPFC Planning Area to preserve cultural and historical continuity and important social, economic, and public services to rural-agricultural populations, agricultural enterprises, and commercial operations. Under the SSIA, several small communities within the SPFC Planning Area would achieve 100-year (1% annual chance) flood protection through structural means such as ring levees, where feasible. This would preserve small community development opportunities within specific boundaries without encouraging broader urban development. For other small communities where structural improvements are not feasible, the SSIA proposes nonstructural means such as flood proofing and elevating structures to support continued small communities land use, providing feasible flood protection in a way that is not growth-inducing.
- Rural-Agricultural Area Land Use** – The SSIA includes improvements for rural-agricultural flood protection, but excludes participation in flood projects to achieve 100-year (1% annual chance) flood protection

EFFECTS OF STATE SYSTEMWIDE INVESTMENT APPROACH IMPLEMENTATION ON LAND USE

Preliminary analyses indicate that with implementation of the SSIA it is expected that:

- 100 percent of urban areas protected by SPFC facilities attain 200-year level of flood protection
- About 20 of the small communities in the SPFC Planning Area (from a total of 27) will attain 100-year level of flood protection. The rest of the small communities are expected to get flood protection through nonstructural means, including raising, flood proofing, and relocation of structures
- About 90 percent of residents in small communities within the SPFC Planning Area will receive at least 100-year flood protection
- In rural areas, the level of flood protection will increase slightly; in the Sacramento River Basin, rural areas receiving a 25-year or higher level of protection would increase by about 6 percent, while the San Joaquin River Basin will increase slightly
- About 10,000 acres of agricultural lands would be converted to environmental habitat restoration within the expansion of the bypass systems

that would be growth-inducing and, thus, increase potential flood risks. The SSIA includes many elements to preserve rural-agricultural viability, such as purchase of conservation easements to preserve agriculture and prevent urban development, when consistent with local land use planning and in cooperation with willing landowners. Because expansion of floodways would be primarily in rural-agricultural areas, some loss of agricultural land would occur. However, based on preliminary planning, 75 percent of additional land needed for bypass expansion would continue to be farmed. The remaining 25 percent that would be subject to more frequent flooding would be converted to ecosystem uses.

The State will work with FEMA’s National Flood Insurance Program to promote the continued sustainable rural-agricultural economy and to examine opportunities to provide affordable flood insurance for low risk agricultural and farming structures in the floodplain.

- **Ecosystem/Open Space Land Use** – Opportunities for ecosystem and open space land use would increase within the footprint of the flood management system facilities, especially through expansion of bypasses and select areas where setback levees for multiple benefits prove feasible. This net increase in habitat area should contribute to flood risk reduction and ecosystem restoration and enhancement, while providing for open space and recreational opportunities in rural areas.

Setback levees along some reaches of the main rivers may increase habitat area. These setbacks are likely to be most feasible in reaches where there are known levee conditions that would be difficult to correct with fix-in-place methods, operations and maintenance problems exist, channel hydraulic performance would be significantly improved, regional flood risk reduction benefits would be realized, and/or there is an opportunity for uniquely valuable ecosystem restoration.

**LIMITING GROWTH IN
CENTRAL VALLEY FLOODPLAINS**

SSIA improvements are designed to discourage growth in rural floodplains with the intention of reducing flood risks. The State does not promote flood management improvements that would induce growth in rural areas.

Urban flood risk reductions under the SSIA will be limited to areas protected by facilities of the State Plan of Flood Control.

Agricultural conservation measures proposed by the SSIA are also designed to limit conversion of agricultural land to urban uses, and to preserve the robust agricultural economy of the Central Valley.



Feather River Setback Levee was Constructed for Multiple Benefits Including Improved Flow Conditions

4.0 IMPLEMENTING AND MANAGING THE STATE SYSTEMWIDE INVESTMENT APPROACH

Section 3 outlined the integrated set of on-the-ground projects that comprise the State Systemwide Investment Approach (SSIA). Section 4 describes how DWR will implement the SSIA, including the development of feasibility studies, funding strategies, and implementation challenges.

The SSIA is a broad plan for flood system improvements and additional work is needed to refine its individual elements. Some elements have already been implemented (since 2007), 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 studies, engineering, feasibility studies, designs, funding, and partnering are required to better define, and incrementally fund and implement, these elements over the next 20 to 25 years.

In general, DWR will continue to prioritize its implementation efforts on the most significant flood risks. However, some critical elements could take longer to implement because of complexity, local and federal interest, and funding that will be made available incrementally over the next few decades. While implementation must occur incrementally, the accumulated outcome will be a sustainable flood management system.

This section describes DWR programs and strategy for implementing and managing the SSIA over time, planning level cost estimates, and funding strategies and partnership among federal, State, and local agencies needed to implement the SSIA. Each of the programs below will have an implementation plan with details of program activities and priorities.

4.1 Flood Management Programs

SSIA implementation requires a wide range of actions for developing, constructing, and managing improvements to the SPFC. This work will be organized into several programs, established and led by DWR and implemented in coordination with local, State, and federal partnering agencies. These programs are governed by DWR's existing FloodSAFE organization. Each program is responsible for specialized implementation of different portions of the SSIA; together, they cover all work required for implementation and management.

DWR's major flood management programs are as follows:

- Flood Emergency Response Program
- Flood System Operations and Maintenance Program

- Floodplain Risk Management Program
- Flood System Assessment, Engineering, Feasibility, and Permitting Program
- Flood Risk Reduction Projects Program

The first three programs are responsible for residual risk management. The fourth program is responsible for conducting the feasibility evaluations and design, engineering, and other activities necessary for implementation. The last program is responsible for working with partnering agencies to implement on-the-ground projects that make up the SSIA.

The following sections describe these programs and related key policies.

ENVIRONMENTAL JUSTICE

California’s low socio-economic status residents are often the most vulnerable to the impacts of natural disasters due to the location and quality of housing, lack of resources to relocate, barriers to transportation, or other factors. Consequently, reducing the risk of flooding, and improving flood emergency response are both very relevant to low socio-economic status populations.

It will be important and necessary for local and regional agencies to incorporate environmental justice principals into regional flood management plans and flood emergency response and recovery activities.

4.1.1 Flood Emergency Response Program

The responsibility of the Flood Emergency Response Program is to prepare for floods, effectively respond to flood events, and quickly recover when flooding occurs. The SSIA supports enhanced emergency response, particularly for rural-agricultural areas where physical improvements are not anticipated to be as extensive as in more populated areas. Program enhancements include providing flood hazard information, real-time flood data, more frequent and timely flood forecasts, and state-of-the-art flood emergency information dissemination. In addition, the SSIA includes a State cost-shared program for improving levee crowns to provide all-weather access roads that allow agencies to quickly respond to flood emergencies. This is a one-time State-local cost-shared program. The program also provides real-time flood information to assist local agencies in deciding whether and how to conduct flood emergency response and evacuation actions for the public.

Reservoir flood operations during major flood events play a role in reducing downstream flood peaks. Coordinated operation of reservoirs to help manage the timing of their individual flood peaks, thereby minimizing cumulative downstream flood peaks, is a major element of the process.

Similarly, coordinated flood operations among local maintaining agencies, cities and counties, the California Emergency Management Agency, the State-Federal Flood Operation Center, and USACE are critically important in managing and fighting floods, and saving lives and properties.

The Flood Emergency Response Program will make flood management system information easily accessible to entities involved in flood management. Through the California Data Exchange Center, the State intends to provide access to collected flood management and related maps, data, and materials (including as-builts, operations and maintenance manuals, levee logs, permits, channel capacities, easements, real-time flood data and forecasts, and flood models). In addition, through the State-Federal Flood Operations Center, DWR will continue to provide floodfight assis-

tance in the field in the form of technical assistance, flood emergency response teams, and materials when the local resources are exhausted.

DWR supports establishing a program to assist local agencies in preparing flood emergency response plans and developing appropriate regional communications tools and processes for emergency response operations. An important consideration in flood emergency preparation is the availability of strategically-located resources for floodfight activities. Local maintaining agencies, as the first responders, have the responsibility for stockpiling floodfight materials for timely response to flood threats before other floodfight assistance becomes available. In addition, without impacting necessary action to protect public safety during an emergency, response planning should consider opportunities to avoid and minimize ecosystem impacts.



To quickly respond to flood emergencies, the State proposes to provide all-weather access roads on levee crowns

4.1.2 Flood System Operations and Maintenance Program

The Flood System Operations and Maintenance Program includes work to keep specific flood management facilities (as defined in the California Water Code) in good, serviceable condition so that facilities continue to function as designed. Program activities include channel maintenance (hydraulic assessments, sediment removal, channel clearing, and vegetation management); erosion and levee repairs; levee inspection, evaluation, and maintenance; and repair and replacement of hydraulic structures.

Currently, operations and maintenance responsibilities within the flood management system are fragmented and often confusing. Funding has been insufficient to keep pace with the rising cost of routine maintenance. Implementation of the SSIA requires efficient and sustainable long-term operations and maintenance practices through the following:

- Reforming roles and responsibilities
- Formalizing criteria by which maintenance practices, procedures, and inspections are performed and reported
- Implementing strategies to adequately and reliably fund routine activities and streamline permitting

Some of the proposed activities will likely involve legislative action, new institutional arrangements involving local maintaining agencies, modifications to existing State programs, and additional revenue generation.

The SSIA includes enhancements to the current operations and maintenance of the flood management system, as described in the following sections.

Consolidation of State's Role and Responsibility

The State supports consolidation of operations and maintenance responsibilities, where appropriate, for the purpose of improving efficiency and maintaining critical flood system functions.

- The State will work with local maintaining agencies to examine opportunities and local agency support for legislative action that would allow DWR to assume full operations and maintenance responsibility for the Sacramento River bypass system (Sutter and Yolo bypasses, in combination with their appurtenant control features – the Moulton, Colusa, Tisdale, Fremont, and Sacramento weirs/bypasses, and proposed new bypasses, when constructed) to support proper function during flooding conditions. DWR will require State funding augmentation before accepting this additional responsibility. The bypass system is a central element of the Sacramento River Flood Control Project, conveying the majority of floodflows. The State currently has responsibility for maintaining a portion of these facilities under the California Water Code.
- The State supports working with local maintaining agencies and, with their support, developing a coordinated partnership program to conduct regular erosion repairs on the waterside of the Sacramento River and the San Joaquin River levee systems to promote efficient and timely repairs. The State already has significant responsibility for maintaining certain channels and a portion of certain levees under the California Water Code. Local agencies would be expected to contribute a cost-share component, fee, or equivalent, in exchange for the State's service recognizing that because of different statutory responsibilities for the Sacramento and San Joaquin systems, the cost-share would likely be different.

Standardization of Operations and Maintenance Practices

The State supports implementing more comprehensive and enhanced operations and maintenance standards for SPFC facilities. This would include formalizing criteria and guidance for operations and maintenance practices and procedures, such as best management practices to facilitate efficient maintenance and environmental compliance. The guidance would provide a common basis for State inspection and reporting activities, which serve as the basis for evaluating State funding and assistance eligibility.

The State will take the lead role in training local agencies to implement enhanced operations and maintenance standards and guidelines. Furthermore, the State has a continued interest in enforcing maintenance area formation per California Water Code Section 12878, where appropriate, in rare cases when local agencies consistently fail to meet routine maintenance expectations.

Consolidation of Roles and Responsibilities of Local Agencies

The State has an interest in encouraging local agencies, especially in rural-agricultural areas, to form regional maintenance authorities to enhance their ability to collectively perform their operations and maintenance responsibilities. The State prefers voluntary formation of joint power authorities, similar to those established in urban areas, with possible State-sponsored incentives.

FLOOD SYSTEM OPERATIONS AND MAINTENANCE AND ENVIRONMENTAL STEWARDSHIP

Over the years, the Flood System Operations and Maintenance Program has made significant steps in incorporating environmental stewardship into its operations. Some of these steps include the following:

- Enhanced interagency collaboration to efficiently integrate public safety and environmental stewardship objectives.
- Routine maintenance agreement with Department of Fish and Game to minimize environmental impacts associated with routine flood control project operations and maintenance.
- Initiated Corridor Management planning on the Feather River to protect public safety in a manner that also enhances the environment.
- Integrated environmental specialists in project design and development.
- Increased environmental training of maintenance staff and cross pollination of information between engineers, geology staff, and environmental scientists.
- Increased coordination with local stream groups in development of channel management actions.
- Developed and implemented a levee vegetation management strategy as an alternative to USACE vegetation removal policy. Managed vegetation research to improve understanding of public safety implications of the vegetation on the levees.
- Increased utilization of native species in restoration activities.
- Implemented selective vegetation management to support habitat enhancement.
- Integrated habitat enhancement into major rehabilitation projects.
- Implemented enhanced invasive species removal and control.
- Worked on fish passage improvements structures along important migration corridors.
- Adopted scheduling of maintenance activities to avoid sensitive time periods for species.
- Worked in partnership with other agencies to create habitat.
- Changed channel vegetation management from dozing and disking to mowing and expanded channel grazing program.
- Implemented equipment retrofits for improved air quality.
- Increased recycling of waste product and initiated chipping of wood debris for co-generation fuel as opposed to burning on site.
- Purchased specialized equipment to minimize environmental disturbance during maintenance activities.
- Expanded use of hand crews in areas containing sensitive environmental resources.
- Utilization of carefully selected herbicides and rodenticides to minimize impacts to nontargeted species.
- Rehabilitated Maintenance Yard buildings for energy efficiencies.
- Implemented landscape water use efficiency improvements at maintenance yards.

4.1.3 Floodplain Risk Management Program

The Floodplain Risk Management Program strives to reduce the consequences of riverine flooding in the Central Valley. A major focus of this work is the delineation and evaluation of floodplains to assist local decision makers with their near-term and long-term land use planning efforts.

The State promotes an enhanced floodplain management program, especially in rural-agricultural areas, through the following:

- The State will actively engage FEMA to help provide grants to local agencies and citizens for applicable risk mitigation actions, including property acquisition, structure demolition, and relocation; and floodproofing and elevating residential and nonresidential structures.
- Senate Bill 5, and related legislation passed in 2007, established various floodplain management requirements for cities and counties related to local land use planning. The State will collaborate with local planning agencies and provide information used to develop the CVFPP to help them integrate these data into their local land use planning. The State will also encourage local planning agencies to actively participate in development of regional flood management plans, which will help to reduce flood risk for local jurisdictions and comply with the provisions of Senate Bill 5.
- The State supports efforts to reform the National Flood Insurance Program that would result in more equitable implementation while reflecting corresponding flood risks. Nationally-supported flood insurance premiums and payouts should be commensurate with demonstrated flood risk for a structure or area to encourage sound floodplain management at the State, local, and personal levels. Structures that sustain flood losses outside FEMA Special Flood Hazard Areas should be evaluated and their flood insurance premiums adjusted based on their full risk of flooding. In addition, to sustain agricultural communities and support the natural and beneficial functions of floodplains, FEMA should consider establishing a flood zone for agriculturally-based communities to allow replacement or reinvestment development in the floodplain for existing structures. The State will work with FEMA to consider a special, lower rate structure that reflects actual flood risks for agricultural buildings in rural-agricultural areas located in Special Flood Hazard Areas.

4.1.4 Flood System Risk Assessment, Engineering, Feasibility, and Permitting Program

Risk Assessment, Engineering, and Feasibility Evaluations

Risk assessments and engineering are performed under this program that support ongoing planning, feasibility evaluations, and refinement of the SSIA. The program looks beyond individual projects to plan the manner in which all flood management facilities, operations, habitat and ecosystem restoration, and other practices work together as a system to protect life and property and enhance the ecosystem.

The program will support development of site-specific improvements. Feasibility studies and updates to the CVFPP will be prepared under this program. This program will also perform flood system engineering and modeling assessments of existing facility conditions for use in identifying areas needing improvements. In addition, the program will develop and maintain hydrologic, hydraulic, geotechnical, economic, and other models and relationships, providing the foundation of information necessary for developing site-specific and systemwide projects. In support of the CVFPP, this program will prepare two basin-wide feasibility studies, in partnership with USACE, , as described in Section 4.4.4.

Role of USACE in Flood Risk Reduction Projects

The majority of Central Valley flood management facilities, and nearly all SPFC facilities, are part of the State-federal flood protection system. Any modifications or additions to, or deletions from, an existing federal flood management project require federal participation and approval through USACE and Congress. Major improvements or modifications to the SPFC will require a federal feasibility study. Feasibility-scope investigations are a critical and integral part of federal involvement in new water resources projects or modification to existing federal projects. Feasibility reports and subsequent documentation are used by federal decision makers and Congress to authorize new projects or project modifications and appropriate funds.

USACE, in partnership with the State and other local interests, is currently conducting a number of feasibility studies in the Central Valley. After feasibility studies are completed and successfully processed, it is anticipated that, in accordance with their findings and recommendations, the studies will lead to Congressional authorization and appropriation. Federal feasibility studies are an element of the State Flood Risk Reduction Projects Program. DWR and the Board are actively coordinating with USACE on these feasibility studies. Additional information concerning federal feasibility investigations is presented in Section 4.4.3.

Integrated Flood System Improvements and Permitting

DWR has initiated integrated flood management programs that could also facilitate permitting processes for implementing flood risk reduction programs and operations and maintenance of the flood management system in the Central Valley. Below are descriptions of major programs to achieve the goal of implementing multiobjective projects while facilitating programmatic permitting for flood management activities. Upon adoption of the CVFPP, these programs could inform DWR and partnering agencies in developing the Conservation Strategy that promotes implementation of integrated multiobjective projects while reducing or eliminating the need for mitigation, facilitating project permitting and reducing the costs and the time needed to acquire required permits.

Conservation Planning

This program coordinates the development and implementation of system and regional approaches for improving ecosystems associated with the flood management system. An initial Conservation Framework, included as Attachment 2, will provide environmental guidance for integrated flood project planning until the more detailed Conservation Strategy is completed in time to guide development of the

2017 CVFPP. The Conservation Strategy described below integrates measures to mitigate potential impacts to environmental resources resulting from improvements to the SPFC, along with other ecosystem restoration activities implemented within the SFPC footprint.

APPROACHES TO ENVIRONMENTAL COMPLIANCE AND ENHANCEMENTS

Through development of the Conservation Framework and future Conservation Strategy, DWR is evaluating systemwide and regional permitting approaches that will bring efficiencies to the approval processes for project construction and operations and maintenance activities. These permitting approaches are being informed through analyses of restoration opportunities to help prioritize restoration as mitigation investments.

DWR, through development of the future Conservation Strategy, is evaluating systemwide and regional permitting approaches that will bring efficiencies to the approval processes for project construction and operations and maintenance activities. The Conservation Framework provides an overview of floodway ecosystem conditions and trends, key conservation goals that further clarify the CVFPP supporting goal of promoting ecosystem functions, and the ways flood management improvements can be accomplished to improve both public safety and environmental conditions. The future Conservation Strategy will be consistent with the Conservation Framework and provide a comprehensive, long-term approach for the State to achieve the objectives of the Central Valley Flood Protection Act, FloodSAFE, and CVFPP Goals.

Corridor Management Strategy

The Corridor Management Strategy involves developing a vision, strategy, and plan (Corridor Management Plan (CMP)) for managing river corridors that integrate flood risk management, improved ecosystem function, and water management over a long-term planning horizon (greater than 30 years). A CMP includes a strategy for managing flood protection facilities, conveyance channels, floodplains, and associated uplands; a maintenance plan; and a restoration plan. A CMP also 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 routine habitat restoration. CMPs rely on coordination, collaboration, and cooperative working relationships with interested parties and stakeholders, including State, federal, and local agencies, nongovernmental organizations, maintenance districts, agricultural interests, and landowners. The State has initiated development of a CMP for a 20-mile-long reach of the lower Feather River (from Yuba City to the Sutter Bypass). CMPs will be a key method for working with agricultural communities, in particular, in a coordinated approach to implementing the Conservation Strategy.

CMP strategies are a 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 development and implementation of the CVFPP – an integrated flood management plan to reduce flood risk, promote ecosystem function, and create a more sustainable flood management system that allows for ongoing operations and maintenance activities.

Flood Corridor Program

The Flood Corridor Program is a unique local assistance program focused on providing nonstructural flood risk reduction integrated with natural resource and agricultural land protection. The Flood Corridor Program is implementing multiobjective projects that create and restore natural floodways, reconnecting streams and rivers to their historic floodplains, where feasible, and using other nonstructural approaches such as constructing levee setbacks, creating detention basins, and removing structures from flood-prone areas. The integrated approach helps DWR and the State achieve public goals of making communities safe from flooding while restoring important wildlife habitat and protecting farmland.

The above programs and CMP approach will collectively help implement the elements of the SSIA. As shown in Figure 4-1, each program contributes to system improvements, urban improvements, small community improvements, and rural-agricultural area improvements. System improvements will also provide additional flow capacity and flood system flexibility to accommodate climate change and large flood events (over 200-year events).

FLOOD MANAGEMENT PROGRAMS	SYSTEM IMPROVEMENTS	URBAN IMPROVEMENTS	SMALL COMMUNITIES	RURAL AREAS
Flood Emergency Response				
Flood System Operations and Maintenance				
Floodplain Risk Management				
Flood System Assessment, Engineering, Feasibility, and Permitting				
Flood Risk Reduction Projects				

Key: Full Contribution Partial Contribution

Figure 4-1. Flood Management Programs and Their Relative Contributions to State Systemwide Investment Approach Implementation

Rural-Agricultural Area Flood Management

The State will help coordinate activities needed to improve flood management in rural-agricultural areas. Over 90 percent of the Central Valley’s levee-protected floodplains are rural-agricultural in character, with levees providing limited flood protection to over 60,000 people.

The approximately 1,200-mile-long State-federal levee system protecting rural-agricultural areas was constructed to a geometry standard using available soil materials with the intent to pass design flows with adequate freeboard. In recent years, it has become clear that a large portion of the rural-agricultural levee system does not meet current levee engineering performance standards because of inade-

quate cross sections, geotechnical weaknesses, erosion, encroachments, penetrations, or other concerns. It is also clear that the combined resources of local agencies, the State, and the federal government will not be sufficient to improve the levees protecting rural-agricultural areas to meet the current 100-year level of flood protection performance standards. The CVFPP recognizes these realities, but also notes that it is important to improve flood protection for rural-agricultural areas, to the extent feasible, on a prioritized basis.

Historically, the highly variable and largely unknown geotechnical characteristics of rural-agricultural levees were addressed through inspections, floodfighting during flood events, and periodic repairs. The accepted practice has been to conduct regular inspections during flood events to identify areas of weakness (such as erosion sites, boils, sloughs, fallen trees, and cracks), followed by vigorous floodfights and post-flood repairs wherever these weaknesses appeared. Therefore, it is fundamentally important to provide access for inspection and floodfighting activities via all-weather roadways on levee crowns and, where possible, on the landside levee toes. The program will invest in rural-agricultural area levees, addressing the greatest risk factors first.

Upon adoption of the CVFPP, the State will work with the local maintaining agencies to develop local and regional flood management plans for repairs and improvements to rural-agricultural levee systems. These plans will identify actions to improve public safety and reduce flood damages in a cost-effective manner, with financial support from the State, when feasible. The local flood management plans will prioritize improvements within rural-agricultural basins, with an emphasis on past performance and life safety.

The State supports developing a levee repair standard for rural-agricultural areas, in coordination with local and regional flood management agencies. While Urban Levee Design Criteria should be applied when the consequences of failure may result in significant loss of life or billions of dollars in damages in an urban area, implementing levee improvements or repairs to meet this standard requires an enormous financial investment that is difficult to justify in rural-agricultural areas.

The State supports cost-sharing of the following rural-agricultural flood management improvements, subject to availability of funds and where feasible to:

- Providing opportunities to improve reaches of levee where a failure would result in rapid, deep flooding of a small community.
- Providing opportunities to improve reaches of levee that protect critical infrastructure of statewide importance.
- Addressing known, localized performance problems or levees that have experienced distress during past flood events, prioritized based on flood risk.
- Improving access for flood emergency response and floodfighting by providing all-weather access roads on levee crowns, with associated ramps and turnouts.
- Improving visibility and accessibility by removing or modifying encroachments, where necessary.

- Preparing and implementing economically feasible local or regional flood management plans. Benefits could include reduced flood damages, improved life safety, protection of critical infrastructure, and ecosystem restoration.
- Repairing rural-agricultural erosion sites identified by the latest inspection, on a priority basis (most critical first).
- Developing rural-agricultural area levee repair standards, in coordination with local and regional flood management agencies.

The State may help local agencies identify feasible projects, prepare financial plans, and develop cost-sharing arrangements to implement feasible flood management improvements in rural-agricultural areas.

The State also proposes reducing small community flood risks by improving levees protecting small communities and/or constructing new levees and flood walls (see Section 3). In many small communities, structural improvements will not be economically feasible and other management actions may be implemented, including working with FEMA to provide assistance for floodproofing homes and structures or relocating structures from deep floodplains. In addition, the State will work with FEMA to evaluate the feasibility of a program to provide post-flood recovery assistance to rural-agricultural areas (See Section 4.1.3).

4.1.5 Flood Risk Reduction Projects Program

The Flood Risk Reduction Projects Program works to develop on-the-ground projects (see Section 3) that are compatible with and support the CVFPP Goals. In addition to improvement of existing facilities and implementation of new projects, some existing flood protection facilities may be removed or modified under this program if the facilities no longer support system performance (see Section 4.3). State investments in system improvements may be through direct investment in new or improved facilities or through grant programs. System improvements will generally be implemented through a partnership program and cost-sharing among DWR, local agencies, the Board, and USACE, as the interests of agencies in the improvements are identified.

Three major implementation programs are required to develop and construct on-the-ground projects: System Improvements, High Risk Area Flood Risk Reductions, and Small Community Flood Risk Reductions programs. In addition, all levels of project funding, planning, design, and development will consider opportunities to integrate ecosystem enhancements with flood damage reduction projects.

The following is a summary of each implementation program for the Flood Risk Reduction Projects Program.



Erosion along the Sacramento River in January 2002

System Improvements

This program will coordinate development of more complicated system projects, such as system reservoir operations, expansion and extension of flood bypasses, new bypasses, flood system structures, and ecosystem enhancements (including fish and wildlife habitat enhancement and fish passage improvements). System improvements will provide operational flexibility during major flood events by lowering peak flood stages throughout the system, redirecting devastating floodflows away from urban areas, creating open space, and providing integration of ecosystem enhancement and flood risk reduction. Specific actions under this program include the following:

- Acquiring land and establishing easements
- Improving existing levees in urban areas and construction of new setback levees, where feasible
- Developing and extending riparian corridors and environmental restoration
- Implementing fish passage improvements and fish and wildlife habitat connectivity
- Upgrading flood control structures and removing sediment from bypass system weirs, gates, and channels
- Coordinating reservoir operations during major floods and establishing dynamic flood control diagrams, where feasible

Participation and partnership in this program by USACE will be critical for implementing large-scale systemwide projects. The State and local project sponsors would be responsible for any lands, easements, rights-of-way, and relocations. An important element of system improvements is the Conservation Strategy, discussed in Section 4.1.4.

High Risk Area Flood Risk Reductions

This program will coordinate development of regional flood damage reduction projects for urban areas to achieve an urban level of flood protection (protection from a 200-year flood). This program replaces the Early Implementation Program

that DWR managed during the first phase of FloodSAFE. Many local agencies, including Reclamation District 784, the City of Marysville, Sutter Butte Flood Control Agency, and those in the Sacramento, West Sacramento, and Stockton areas, have been working diligently toward achieving the goal of providing 200-year protection. This program will be implemented in partnership with local agencies and USACE, with close coordination and cooperation among program participants.

Small Community Flood Risk Reductions

This program will coordinate the development of local flood damage reduction projects for small communities. This program may include State-led improvements to SPFC facilities or provide support for locally sponsored projects. The program activities may include achieving 100-year flood protection by

APPROACH TO URBAN FLOOD RISK REDUCTION
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The SSIA outlines improvements to SPFC facilities to achieve 200-year flood protection for urban and urbanizing areas. Some urban areas receive protection from SPFC levees and local, non-SPFC levees. The State would assist local agencies in improving these pertinent non-SPFC levees to achieve an urban level of flood protection, but without accepting any responsibility for those levees as they may remain non-SPFC facilities.

constructing new ring levees around small communities and improvement of existing levees and floodwalls where feasible. In addition to feasible structural improvements (see Section 3), previously discussed small communities may be considered for non-structural flood risk reduction, such as flood-proofing, raising structures, and relocation of structures. This program will be implemented in partnership with local agencies, FEMA, and USACE, with close coordination and cooperation among program participants.

4.2 Levee Vegetation Management Strategy

Levee vegetation management practices and procedures are an important component of the Flood System Operations and Maintenance Program, and of numerous ongoing and proposed flood risk reduction projects. Through management actions set forth in the CVFPP, and the associated Conservation Framework, the State will implement a flexible and adaptive integrated vegetation management strategy that meets public safety goals and protects and enhances sensitive habitats within the Central Valley. Implementation of the State's approach 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 State recognizes that woody vegetation on levees must be appropriately managed. The State's levee vegetation management strategy is focused on improving public safety by providing for levee integrity, visibility, and accessibility for inspections, maintenance and floodfight operations; at the same time, it protects important and critical environmental resources. While the strategy has a particular focus on protecting and enhancing the remaining shaded riverine aquatic habitat associated with the SPFC, it also addresses long-term quality and connectivity of habitat within the full flood management corridor.

Levee failure mechanisms (or risk factors), such as under-seepage, 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. Given that USACE Engineer Research and Development Center's research report (July, 2011) has shown 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 the *Flood Control System Status Report* (2011) is that levee vegetation is a low threat to levee integrity in comparison with other risk factors; this is consistent with the fact that, with many levee failures in California, none have been attributed to vegetation.

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. Dense riparian brush provides the greatest erosion protection and least levee safety threat. Larger woody vegeta-

tion helps stabilize levees through extensive root systems. In consideration of the relatively low potential threat to public safety and high habitat value for State- and federally-listed species, the State will, in coordination with State and federal resource agencies:

**ADAPTIVE LEVEL
VEGETATION MANAGEMENT**

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. 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 addresses “visibility and accessibility” criteria while progressing gradually (over many decades) towards 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.

- Allow retention of vegetation on the lower waterside levee slope (below the vegetation management zone)
- Protect existing lower waterside levee slope vegetation on State-maintained levees, and encourage a similar practice for projects and maintenance activities by local entities
- Allow development of appropriate vegetation on the lower waterside levee slope and near the waterside levee toe

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, or which create a visibility problem within the vegetation management zone.

This strategy affords levee 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 strategy 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 appropriate management.

A chronology of past and ongoing interaction with USACE regarding implementation of USACE levee vegetation policy and Public Law 84-99 rehabilitation eligibility is provided in Section 3; a summary of the CVFPP levee vegetation management strategy is described below, and the full text of that strategy is included in Attachment 2 – Conservation Framework. Specific vegetation management procedures will be

dependent on whether a levee is (1) a new or legacy levee, and (2) directly adjacent to the river or set back from the channel. Revisions to the following procedures may be considered in future 5-year updates to the CVFPP. The following summarizes the current vegetation management strategy:

- 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.
- Vegetation present on the system, except for the lower waterside slope, will be trimmed to provide for visibility and access, as originally defined in the Framework Agreement, signed February 27, 2009 by participants of the California Levees Roundtable. It is important to note that the 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 USACE to a nonfederal 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).
- Vegetation present on the system will be evaluated, based on accepted engineering practice, and as part of the routine operations and maintenance responsibilities of DWR and other levee maintaining agencies, trees and other woody vegetation will be monitored to identify changed conditions that could pose an unacceptable threat. DWR will develop and incorporate vegetation criteria into its inspection checklist to guide identification of potential threats, as the science becomes available. Any vegetation that has been evaluated and found to present an unacceptable threat will be removed in coordination with the resource agencies.
- DWR will implement, and will advise local maintainers in their implementation of an adaptive vegetation management strategy. This strategy will include a long-term vegetation life-cycle management plan, which will allow existing trees and other woody vegetation of a certain size to live out their normal life cycles, but will result in the gradual elimination of trees and other woody vegetation from the vegetation management zone through the removal of immature (less than 4 inches) trees and immature woody vegetation. Throughout their lives and after their deaths, these trees and other woody vegetation will be periodically evaluated and, if found to pose an unacceptable threat to levee integrity would be removed in coordination with the resource agencies.
- Implementation of the life-cycle management plan will result in the gradual loss of important terrestrial and upper waterside riparian habitat throughout the State-federal project levee system. However, the CVFPP's vegetation management strategy includes the early establishment of riparian forest corridors that will result in a net gain of this habitat. The Conservation Framework includes a tree planting program, which will be more fully defined in the Conservation Strategy, to ensure that the quantity and quality of the riparian corridors of the Central Valley are maintained and enhanced over time. A monitoring plan will also be included in the Conservation Strategy.

- The CVFPP also calls for encouraging and supporting research on the risks and benefits of trees on levee performance, and techniques for concurrently achieving flood risk reduction and environmental quality goals. State and local agency-sponsored research, along with USACE-sponsored research, are 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 address other data gaps. DWR and its partnering agencies will incorporate new information into evolving policies and practices.

4.2.1 Long-Term Compatibility of State Levee Vegetation Management Strategy and U.S. Army Corps of Engineers Vegetation Policy

As described in the foregoing, removing lower waterside levee slope vegetation is a very low priority and would generally not be justified until high levee risk factors (as documented in the *Flood Control System Status Report* (2011)) are addressed. However, compatibility between the State levee vegetation management strategy and USACE vegetation policy is potentially achievable when framed in the following context:

Through long-term implementation of life-cycle vegetation management on the landside slope, crown, and upper waterside slope of SPFC levees, the CVFPP levee vegetation management strategy will gradually (over a period of decades) result in levees clear of woody vegetation, consistent with USACE vegetation policy, except for lower waterside vegetation – which is mostly the same part of the levee where USACE has indicated that variances can be appropriate.

DWR believes that the best path toward State-USACE vegetation policy compatibility is through a sufficiently flexible systemwide variance process consistent with the above levee vegetation management strategy that can supplement, if necessary, the existing vegetation variance for lower waterside slope vegetation (per USACE letter dated August 3, 1949). Removal of woody vegetation on the lower water side that does not pose an unacceptable threat to levee integrity will be deferred indefinitely to allow for development of new information, tools, and techniques that can expand future options for mutually acceptable treatment of lower waterside vegetation.

4.3 Removal and Addition of State Plan of Flood Control Facilities

As the SSIA is implemented, some features of the SPFC may prove to be obsolete and slated for removal, while other features may be added. The following provides guidance for physical and administrative removal and addition of SPFC facilities.

4.3.1 State Plan of Flood Control Facilities Removal

Over the years, some of the facilities included in the SPFC have ceased to exist, have failed to achieve their original design objectives, have deteriorated to the point of becoming nonfunctioning, or otherwise have become a detriment to the existing system. Accordingly, in some cases, it is in the public interest for the State to formally remove these facilities from the SPFC. Removal of a facility from the SPFC may consist of physical and administrative actions, or only administrative actions. Physical removal of any facility is subject to a case-by-case evaluation. To be considered for removal from the SPFC, candidate facilities need to meet one or more of the following criteria:

- Physical removal of the SPFC facility would result in improving the flood management system
- Removal of the SPFC facility is in the mutual interest of the State and the local maintaining agency
- Physical removal of the facility has already been initiated or completed

For facilities to be removed from the SPFC, it must be demonstrated that such action would not cause unacceptable impacts to other flood management features, protected people or property, or to nonflood management purposes. If removal of a specific facility would cause potential undesirable or unacceptable effects to flood management or to other purposes, mitigation measures would be implemented to offset such potential adverse effects before the facility is removed.

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California Water Code Section 9614 (h)
 “The evaluation shall include a list of facilities recommended to be removed from the State Plan of Flood Control. For each facility recommended for removal, the evaluation shall identify both of the following:
 (1) The reasons for proposing the removal of the facility from the State Plan of Flood Control.
 (2) Any additional recommended actions associated with removing the facility from the State Plan of Flood Control.”

4.3.2 State Plan of Flood Control Facilities Addition

Ongoing State-federal projects in the Sacramento and San Joaquin river basins are expected to become part of the SPFC after completion, and turned over to the State and local maintaining agencies. Also, while some projects completed through the Early Implementation Projects Program and Section 221 of the Flood Control Act of 1970 are not currently part of the SPFC, they may become part of the SPFC in the future after undergoing the appropriate processes.

Generally, the traditional way for facilities to become part of the SPFC is by completion of the following processes:

- USACE prepares a Chief of Engineers Report to recommend to Congress that federal participation in a project be authorized and that completed works be incorporated into the federal project. Congress passes and the President signs legislation for the project, usually as part of a periodic Water Resources Development Act.
- The State Legislature passes and the Governor signs legislation authorizing State participation in the project, incorporating specific language referencing federal authorization.

CENTRAL VALLEY FLOOD PROTECTION ACT OF 2008

California Water Code Section 9611.

“The Sacramento-San Joaquin River Flood Management System comprises all of the following:

(a) The facilities of the State Plan of Flood Control as that plan may be amended pursuant to this part.

(b) Any existing dam, levee, or other flood management facility that is not part of the State Plan of Flood Control if the board determines, upon recommendation of the department, that the facility does one or more of the following:

(1) Provides significant systemwide benefits for managing flood risks within the Sacramento-San Joaquin Valley.

(2) Protects urban areas within the Sacramento-San Joaquin Valley.

(c) Upon completion of the Central Valley Flood Protection Plan pursuant to this part, the department may identify the and propose to the board additional structural and non-structural facilities that may become facilities of the State Plan of Flood Control, consistent with the Central Valley Flood Protection Plan. The board may add those facilities to the State Plan of Flood Control based on a determination showing how the facility accomplishes the purposes identified in subdivision (b).

(d) For the purposes of subdivision (c), facilities that may become facilities of the State Plan of Flood Control include bypasses, floodway corridors, flood plain storage, or other projects that expand the capacity of the flood protection system in the Sacramento-San Joaquin Valley to provide flood protection.”

- The project is constructed. After construction is complete, the project finishes the closeout phase. USACE prepares an Operation and Maintenance Manual for the project unit.
- USACE and the Board execute a standard agreement transferring responsibility for operations, maintenance, repair, and rehabilitation to the State.
- The Board and appropriate local maintaining agency or DWR execute a standard agreement, further transferring these responsibilities to the maintaining agency.
- In addition, the Central Valley Flood Protection Act of 2008 authorizes the Board to add facilities to the SPFC directly. Such facilities would need to meet other legal requirements, including, but not limited, to the California Environmental Quality Act, Water Resources Law of 1945, and Flood Control Law of 1946.

4.4 Refining Flood System Investments

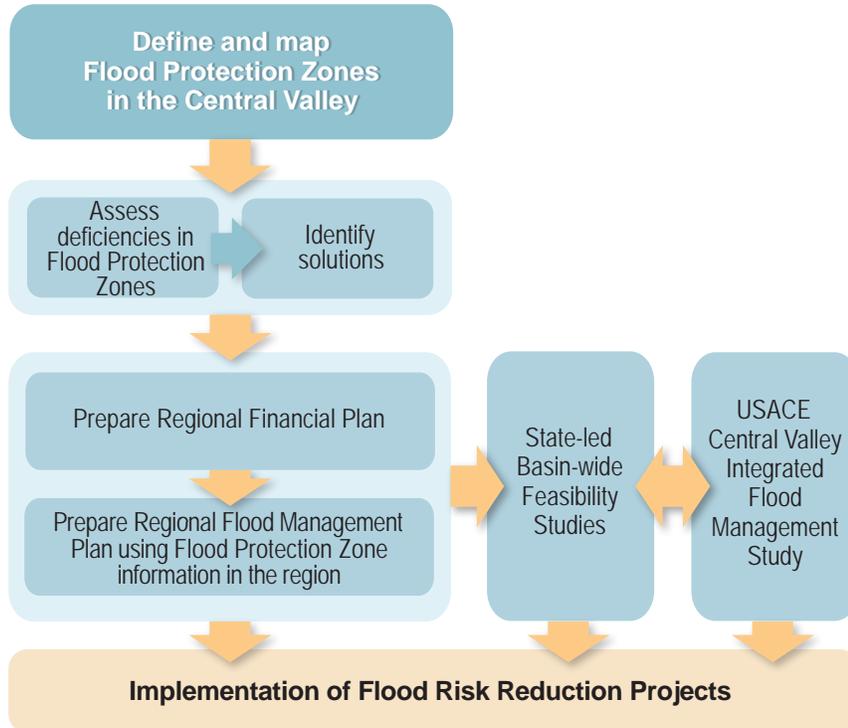
While the CVFPP establishes an overall vision for Central Valley flood risk management, detailed feasibility studies are needed to further refine and define specific improvements that support the CVFPP Goals. Two proposed State

feasibility studies for the Sacramento and San Joaquin river basins will focus on defining a systemwide set of flood management improvements to the SPFC, beginning with the physical elements included in the SSIA. Elements can be expected to be refined and modified based on those two feasibility studies. This is especially true for larger system elements that require more studies and feasibility evaluations to better understand their costs and benefits and to reduce the level of uncertainty. The feasibility studies are also needed for federal project appropriation.

To prepare the State feasibility studies, the State will first work with local agencies to prepare regional flood management plans. These plans (see Section 4.4.1) will include assessment of levees in each levee Flood Protection Zone (FPZ), will identify reasonable and feasible solutions to remedy the areas needing repair, and will include a regional financial framework. The State will use the regional plans as foundational information and will integrate the plans with system improvement

feasibility analyses to prepare the two basin-wide feasibility studies. These feasibility studies will be prepared in coordination with USACE and in conjunction with its CVIFMS.

Figure 4-2 is a schematic presentation of the process outlined above, showing the interconnection of regional flood management plans, State basin-wide feasibility studies, and USACE CVIFMS. The majority of flood risk reduction project implementation will occur as a result of the State basin-wide feasibility studies. However, implementation of some projects will continue while the feasibility studies are prepared.



KEY: USACE = U.S. Army Corps of Engineers

Figure 4-2. Planning and Implementing Flood Risk Reduction Projects

The section below further discusses the regional flood management plans, State basin-wide feasibility studies, and USACE CVIFMS.

4.4.1 Regional Flood Management Plans

To document site-specific flood system improvement needs and to involve local agencies in developing local investment strategies, the State will work with local entities and engage other interested stakeholders to define local flood system improvements that support the SSIA. This work will be site-specific for individual river reaches and likely begin with each FPZ within the potential implementation regions. FPZs are the smallest planning unit for gathering and organizing data and evaluating the costs and benefits of proposed flood management actions as they relate to overall systemwide improvements. Flood protection needs within the FPZs of an implementation region will be aggregated into regional flood management needs that, in turn, will be used to formulate regional projects/programs and associated feasibility analyses.

**CENTRAL VALLEY FLOOD PROTECTION
ACT OF 2008**
.....

California Water Code Section 8201

“(a) A local agency may prepare a local plan of flood protection in accordance with this chapter....

(d) Plans prepared pursuant to this chapter, within the Sacramento-San Joaquin Valley as defined by Section 9602, shall be consistent with the Central Valley Flood Protection Plan pursuant to Section 9612.”

The regional plans will be prepared with participation of local maintaining agencies, regional flood management agencies, counties and cities within the region, and agricultural and environmental interests. The role of counties and cities in the planning process is important because they are required to update their general plans to incorporate information used to prepare the regional plans. DWR will participate in the planning process, will provide any available information, and may provide financial assistance for preparing the regional plans, if funds are available.

Based on analyses conducted for selected projects in a region, a regional financing strategy will also be prepared and will identify potential federal, State, and local cost-sharing. The cost-sharing formula may differ based on the nature of the flood risk

reduction needs of and systemwide benefits achieved in each region. The regional analyses will be combined with the regional financing plan to form a regional flood management plan. To implement SPFC improvements from a systemwide perspective, evaluations will consider monetary and nonmonetary benefits on a regional basis, to be updated as system improvements are defined over time.

The State and its partners will need to develop benefit-cost analyses by focusing on different project purposes in various reaches of the system. For example, in urban areas the focus would likely be on flood risk reduction, while in rural-agricultural areas the focus would be on flood risk reduction supported by floodplain management and improved ecosystem function and sustainability. The State proposes to provide a greater cost-share at the local level for environmentally beneficial projects, such as setback levees. The State will allow local rural entities to cover their cost-shares with in-kind services, agricultural conservation easements, and other compatible elements.

Development of regional flood management plans and formulation of specific capital improvement projects will continue after completion of the 2012 CVFPP. This plan development process will coordinate with other overlapping planning efforts by identifying common goals and pursuing opportunities to collaborate and reduce potential conflicts with these other efforts. The information gathered for the regional flood management plans will be used to help develop of the State basin-wide feasibility studies scheduled for completion by 2017.

A review of areas protected by facilities of the SPFC initially identifies regions with varying characteristics (see Figure 4-3). Ultimately, more or fewer regions may be used, depending on organization and preferences of local entities.

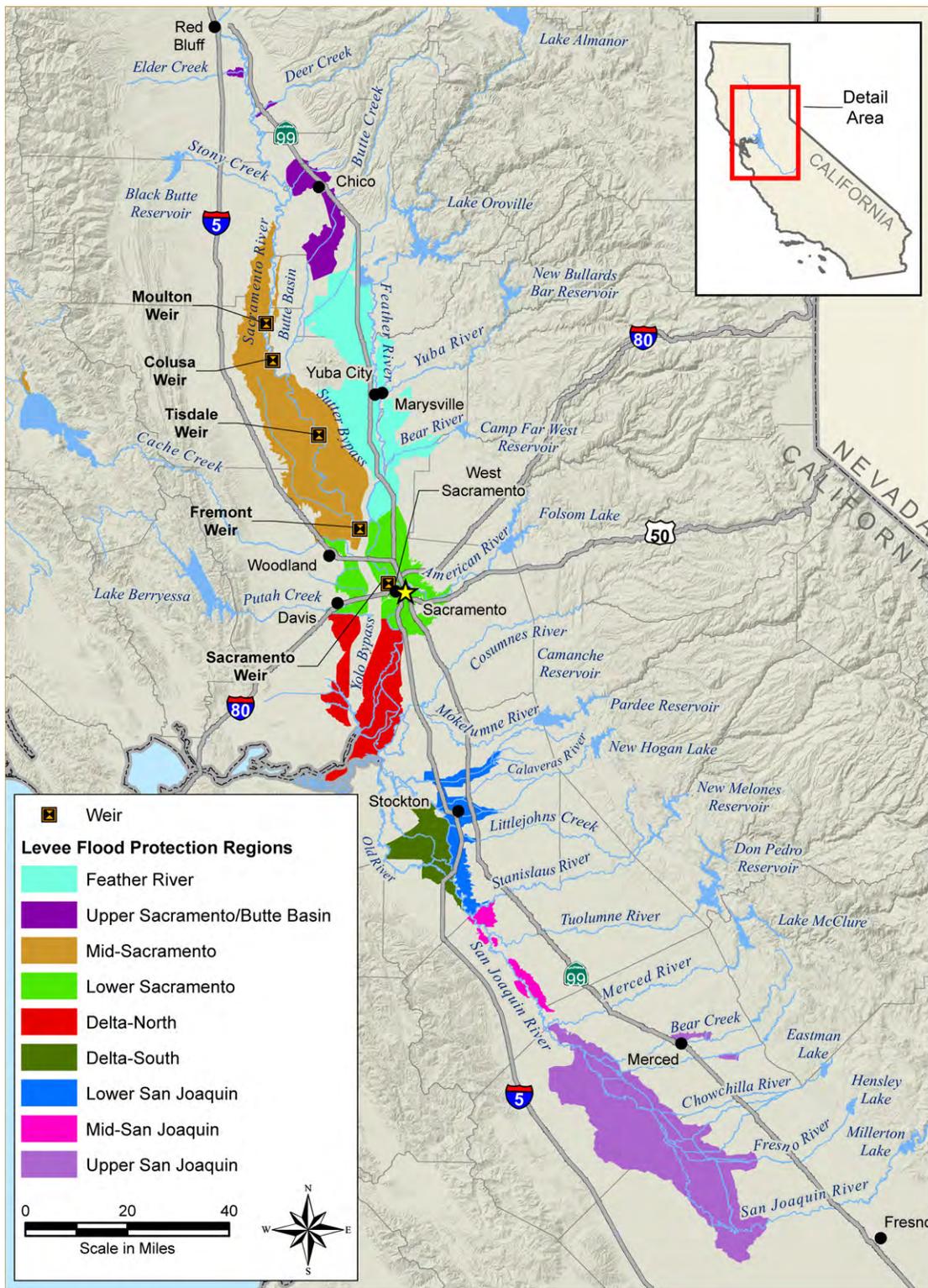


Figure 4-3. Central Valley Flood Protection Plan Implementation Regions and Flood Protection Zones

4.4.2 Assisting Local Agencies in Land Use Planning

The Central Valley Flood Protection Act requires each city and county within the Sacramento- San Joaquin Valley to amend its general plan to include flood-related information gathered for and presented in the CVFPP, within 24 months of the Board adopting the CVFPP. To assist local agencies in complying with the law, DWR will prepare the following information and make it available to local agencies:

- Information gathered and used in the CVFPP.
- Maps and geographic information system (GIS) data used to generate maps in the CVFPP and related documents.
- Levee inspection data and completed geotechnical assessment results of SPFC facilities and related non-SPFC facilities, where data are available.
- Water surface elevations for 100-year and 200-year flood events.
- 100-year and 200-year inundation maps of the areas protected by the facilities of the SPFC.
- Criteria for demonstrating an urban level of flood protection, including urban levee design criteria.

The information listed above will be made available, subject to availability of funds, to local agencies upon request. DWR has prioritized its work so that information needed for urban areas is developed first and shared with local agencies. The State proposes a planning process in which local agencies, with assistance from DWR, will work together to prepare regional flood management plans (see Section 4.4.1). The local land use

agencies are encouraged to actively participate in development of the regional flood management plans. Participation of the agencies in regional planning combined with specific information listed in this section will help local land use agencies to update their general plans and any zoning considerations, as required by the law.

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 California Government Code 65302.9
 “(a) Within 24 months of the adoption of the Central Valley Flood Protection Plan by the Central Valley Flood Protection Board pursuant to Section 9612 of the Water Code, each city and county within the Sacramento-San Joaquin Valley, shall amend its General Plan...
 (b) To assist each city or county in complying with this section, the Central Valley Flood Protection Board, the Department of Water Resources, and local flood agencies shall collaborate with cities or counties by providing them with information and other technical assistance.”

4.4.3 Central Valley Integrated Flood Management Study

The USACE CVIFMS is a feasibility study to evaluate flood management improvements in the Central Valley from a federal perspective, and to provide a framework for authorizing and implementing flood risk reduction projects in the Central Valley. When completed, this feasibility study will ultimately be used to determine the federal interest in implementing elements of the CVFPP and identifying nonfederal responsibilities regarding changes to the SPFC. Through the CVIFMS, USACE is reviewing documents and providing technical and policy level input, joint data, information, and analytical tools for the CVFPP. The CVIFMS would integrate information and findings from the two State basin-wide feasibility studies; USACE

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 California Water Code Section 9615.
 “For the purpose of preparing the plan, the department shall collaborate with the United States Army Corps of Engineers...”

is conducting the CVIFMS, in partnership with DWR and the Board, under existing federal authorization for the *Sacramento-San Joaquin River Basins Comprehensive Study* (USACE, 2002).

From a federal perspective, potential changes to existing facilities of the SPFC should show a positive impact on the facilities, the people the facilities protect, and the purposes of the facilities. Therefore, it is important to the State to work closely with USACE to further analytically define and refine elements of the SSIA, and to evaluate potential flood management, ecosystem restoration, and other related project benefits to justify a strong federal interest in the SSIA. The State will continue to work closely with USACE to examine opportunities to fully integrate processes and analyses needed for preparing the State basin-wide feasibility studies with the CVIFMS.

4.4.4 State Basin-Wide Feasibility Studies

As mentioned above, and as part of SSIA implementation, the State will initiate two basin-wide feasibility studies. The primary purposes of these State-led feasibility studies are to (1) develop a Locally Preferred Plan for consideration by USACE in formulating and selecting a recommended plan and pursuing federal authorization, (2) prepare environmental compliance evaluations, and (3) establish the State's role in project implementation. A benefit of these State-led feasibility studies is that the State can effectively contribute to, and help accelerate, the federal feasibility study; if USACE is not able to move forward with implementation, the State would be poised to do so.

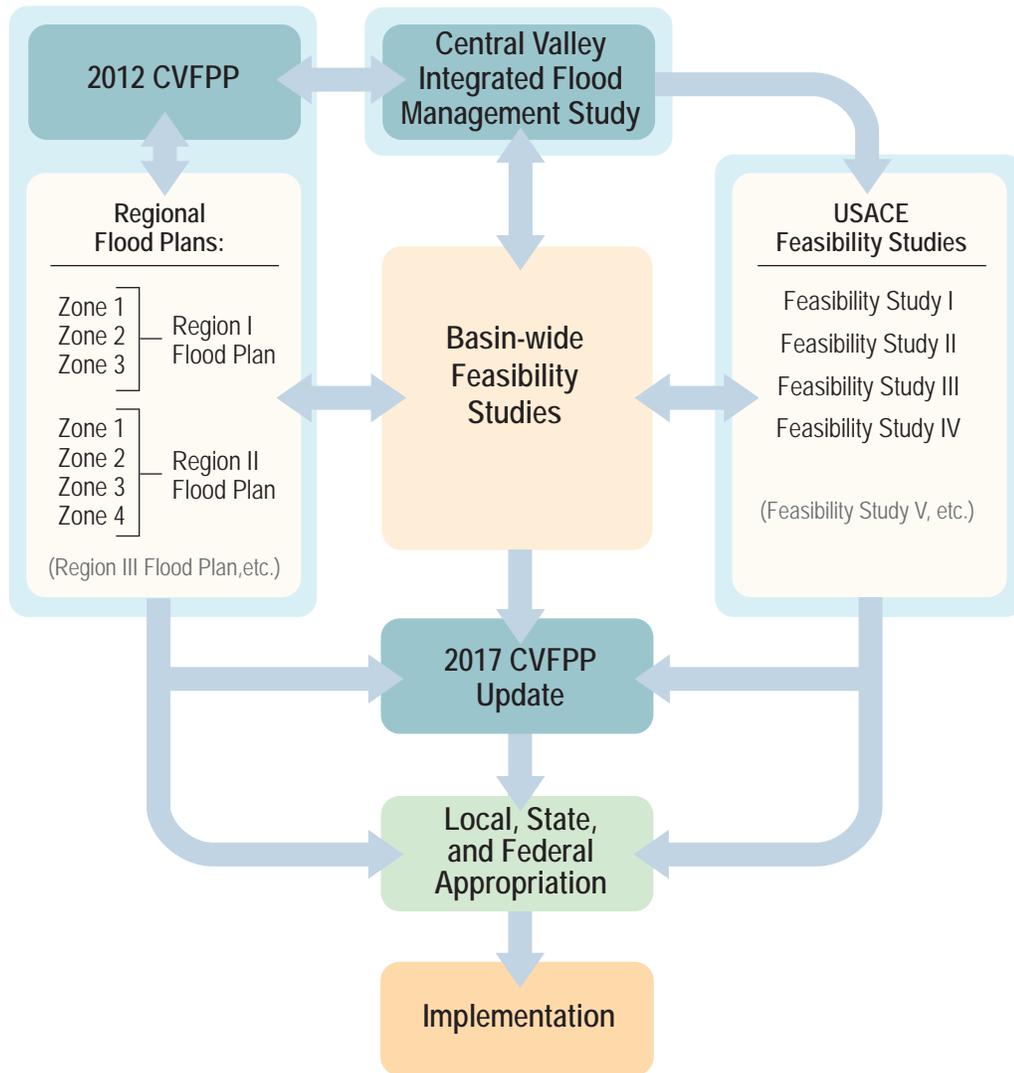
History suggests that federal studies can be accomplished in a more efficient manner when there is (1) strong nonfederal sponsor understanding of the federal project implementation process, (2) active nonfederal leadership and direction, and (3) a well-developed Locally Preferred Plan for use in the process.

FEASIBILITY STUDY COORDINATION

As part of CVFPP implementation and development of the 2017 update, the State will continue to coordinate and engage with federal partners on the State basin-wide feasibility studies, the CVIFMS, and other related efforts.

The State feasibility studies will examine the options and elements included in the 2012 CVFPP to determine study feasibility and refine study features/characteristics. The State feasibility studies will be accomplished in close coordination and partnership with USACE; the CVIFMS, in particular, will follow the federal milestone system, and will comply with the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* (Water Resources Council, 1983). It is anticipated that the State feasibility studies will establish a complete, well-developed Locally Preferred Plan in the context of a federal feasibility study, and provide a solid foundation for initiation of federal studies, as appropriate. Engagement with federal partners would occur throughout the State feasibility studies period. State planning and technical analyses will employ approaches consistent with federal practices, such that information can be efficiently used in corresponding federal feasibility studies. Under this condition, it is fully anticipated that the corresponding federal studies would incorporate information developed by the State basin-wide feasibility studies, including the Locally Preferred Plan.

The State-led feasibility studies will integrate information presented in regional flood management plans prepared by local agencies, and information, analyses, and evaluations conducted as part of federal feasibility studies and the CVIFMS, as shown in Figure 4-4. Upon adoption of the CVFPP, DWR intends to work closely with the USACE Sacramento District to further examine opportunities for fully integrating the basin-wide feasibility studies with CVIFMS.



KEY:
 CVFPP = Central Valley Flood Protection Plan USACE = U.S. Army Corps of Engineers

Figure 4-4. Preparing Basin-Wide Feasibility Studies Leading to Implementation

4.4.5 Program Coordination, Communication, and Integration

Development and implementation of the CVFPP requires continued coordination, communication, and integration with other flood and water management and ecosystem enhancement programs in the planning area. These programs include, but are not limited to, other State and federal efforts such as the San Joaquin River Restora-

tion Program, Bay-Delta Conservation Plan, Delta Stewardship Council Delta Plan, Delta Protection Commission Economic Sustainability Plan, Statewide Flood Management Planning Program, USACE CVIFMS, and other programs. The State has a strong interest in coordinating and, when feasible, achieving integration of flood risk management with water supply reliability enhancement, environmental restoration, and other multiresource benefits.

Effective integration across resource categories and planning efforts means that all of the programs and projects, when implemented, work together to achieve the key goals of the various programs in a cost-effective and appropriately prioritized sequence, and do not cancel intended benefits. It is recognized, however, that effective integration of planning among many programs for multiple benefits is a significant challenge. Carrying that integration across multiple major planning efforts is difficult and complex. The sheer complexity of the various planning processes, as well as gaps in understanding of how they may work together; make it difficult to define effective and integrated fixes at a systemwide level. Contributing to the integration challenge are competition for available funding and the competing priorities of involved agencies and interest groups with different views and measures of what constitutes success.

With these challenges in mind, it is also recognized that coordination, communication, and integration across a number of programs and projects also present opportunities for collaboration, minimizing duplication, reducing costs, and identifying other opportunities. The State recommends taking the following steps (as well as other similar steps) to achieve, to a large extent, integration and implement projects and programs in a coordinated fashion:

- The integration of flood management with other resource management activities is best achieved during project planning and on-the-ground activities. In executing the CVFPP, the State proposes to work with local agencies to prepare regional flood management plans. Preparation of the regional plans will include examining opportunities for integrating of flood management with water management and ecosystem restoration and to coordinate with other agencies' relevant activities in the region.
- At the high level planning, the flood management activities are incorporated and tied with the broad environmental enhancement activities in the CVFPP. In addition, through reservoir operation activities (F-CO and F-BO) flood and water management activities are also integrated.
- During preparation of systemwide feasibility studies and project implementation, standardized, well-documented analytical tools will be employed to evaluate performance with regard to key resource categories. For example, DWR is working with the State Water Project, Yuba County Water Agency, USACE, and National Weather Service-River Forecast Center to develop F-CO for Lake Oroville and New Bullards Bar. The reservoir operation model developed for the F-CO can be enhanced and also used for water operations, hence integrating flood and water operations of the reservoirs.

- The State supports investing in “no-regrets” programs and actions that clearly enhance system resiliency, integrate programs and resources, and preserve flexibility for future generations. Actions that fall into this category may include the following:
 - » *Acquisition of agricultural conservation easements where compatible with local land use plans (especially in deep floodplains adjacent to existing flood conveyance channels).*
 - » *Expansion of existing river and bypass channels through levee setbacks, creation of new flood bypass channels, and development of wildlife and fisheries habitats in the bypass system, creating open space and integrating with recreation activities.*
 - » *Isolation, stabilization, or removal of mercury and other heavy metals, polychlorinated biphenyls, and other long-lasting ecosystem contaminants within the State flood management system to improve channel conveyance and water quality and fishery habitat.*
 - » *Development of new maintenance practices and institutional frameworks, such as corridor management planning and the Conservation Strategy, to facilitate long-term integrated management of the system that effectively serves public safety, water management, and ecosystem needs.*
- At the feasibility study level for specific projects, reasonable opportunities will be carefully evaluated for integrating of multiple objectives into project design. During feasibility studies, DWR and its implementation partnering agencies will conduct system impact analyses for all significant resources categories, and will consult with all interested agencies and stakeholders before finalizing projects for execution.
- At the systemwide level, major implementation activities will continue to be coordinated with other ongoing programs in the planning area.

4.4.6 Process for Updating the Central Valley Flood Protection Plan

Updates to the CVFPP will be prepared by DWR and its partner agencies (including USACE, the Board, and local agencies) every five years. Following adoption of this initial CVFPP by the Board in mid-2012, work will continue toward the first update of the CVFPP, due in 2017. Work required for the first, and each subsequent, update will generally follow the five-year cycle shown in Figure 4-5.

Each update will build on the previous CVFPP and will describe accomplishments since the prior version; will identify results of subsequent technical analyses; will highlight changes in approaches, projects, and programs; and will describe near-term implementation of projects (or components of longer-term projects) that can be expected to be completed before the next update. Therefore, level of detail is expected to increase from version to version as feasibility studies and implementation progress. Because of the five-year update cycle, the CVFPP will be a living document that adapts to progress, changing conditions, new information, and available funding.

Development of the Financing Plan for the CVFPP will be the major deliverable in the first year (portions of 2012 and 2013) following adoption of the 2012 CVFPP.

The 2017 update of the CVFPP will be reviewed by the Board for overall consistency with the adopted 2012 CVFPP, and the cycle will be repeated for the 2022 update. The 2017 CVFPP update will be prepared in close coordination with USACE.

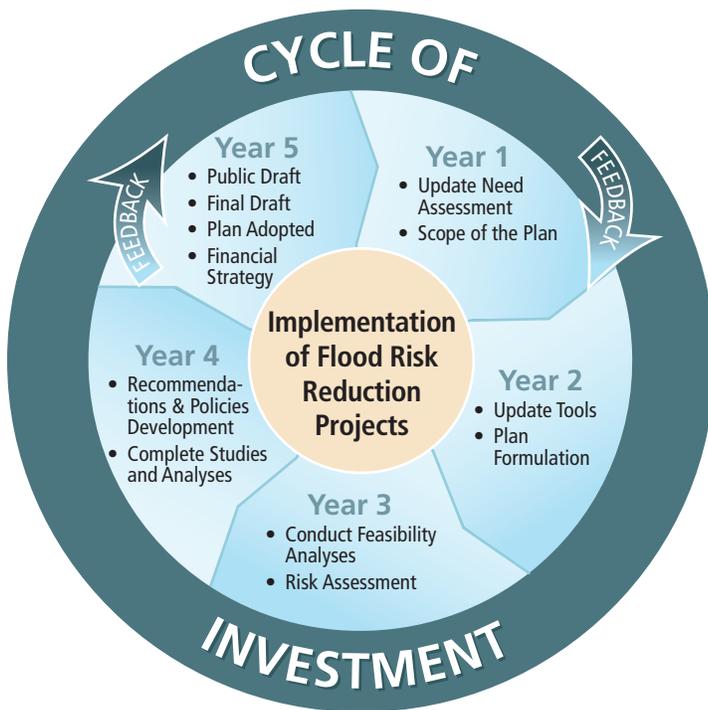


Figure 4-5. Five-Year Cycle for Investment and Central Valley Flood Protection Plan

4.5 2007 – 2011 Accomplishments and Near-Term Priority Actions (2012 through 2017)

4.5.1 Accomplishments

Since the passage of Propositions 1E and 84 in November 2006, DWR has been working with USACE and local agencies to improve flood management within areas protected by facilities of the SPFC. These accomplishments are considered part of the SSIA. Major accomplishments to date are summarized below.

Flood Emergency Response

- Conducted 15 flood emergency exercises, including the Golden Guardian Statewide Flood Exercise
- Added about 50 flood forecasting and water supply gaging sites
- Developed a Flood Emergency Response Information System
- Developed F-CO program for Yuba-Feather River

The Golden Guardian Statewide Flood Exercise Series was first implemented in 2004 and has become a statewide exercise series conducted to coordinate flood emergency preparation, response, and recovery by local, State, and federal governmental entities and private sector and volunteer organizations. The goal of the Golden Guardian Exercise Series is to build on the lessons learned from this and subsequent exercises, as well as real-world events. Golden Guardian is currently the largest statewide flood emergency exercise program of its kind in the country.

The Golden Guardian 2011 Full-Scale Exercise was conducted in May 2011 and was based on a major past California flood. The exercise focused on California's strategy in preparing for and responding to a catastrophic flood in the inland region of the State. Over 5,000 local, regional, State, and federal responders participated in various events throughout the three-day exercise.

The Golden Guardian 2013 exercise will be based on a major Bay Area earthquake, providing an opportunity to assess emergency operations plans as they relate to potential effects on the flood management system in the Sacramento-San Joaquin Delta.

- Updated hydrology for Central Valley streams
- Stockpiled 240,000 tons of rocks in the Delta for emergency response
- Enhanced environmental integration in emergency response activities, including an emergency response exercise with environmental resource and regulatory agencies

Flood System Operations and Maintenance

- Repaired over 120 critical levee erosion sites
- Proactively repaired over 220 levee sites
- Removed three million cubic yards of sediment from the bypasses
- Rehabilitated seven flood system structures
- Developed and began implementing, in partnership with resource and regulatory agencies, environmental initiatives, including the Corridor Management Strategy and Small Erosion Repair Program
- Initiated and coordinated the interagency Flood Management Collaborative Program

Floodplain Management

- Prepared voluntary flood-related Building Standards Code (California Code of Regulations, Title 24, Parts 2 and 2.5) for single-family residential occupancy groups R-3 and R-3.1 for adoption by cities and counties
- Sent flood risk notification letters to 300,000 effected property owners in the Central Valley in 2010 and 2011
- Mapped Central Valley Levee Flood Protection Zones

Flood Risk Assessment, Engineering and Feasibility, and Permitting

- Collected topographic data and light detection and ranging (or LiDAR) data for 9,000 square miles along the flood system
- Conducted engineering and geotechnical evaluations for urban and nonurban levees
- Developed a comprehensive medium-scale GIS data set of riparian vegetation for the Central Valley
- Assessed major fish passage barriers within the Systemwide Planning Area

- Evaluated potential floodplain restoration opportunity areas throughout the Systemwide Planning Area
- Developed a statewide policy framework and approach for Regional Advance Mitigation Planning (RAMP)
- Catalogued and summarized conservation objectives from 30 conservation planning efforts that overlap the Systemwide Planning Area
- Prepared the public draft Conservation Framework
- Implemented 12 Flood Corridor Program projects in the Central Valley, providing over 4,000 acres of habitat conservation and over 500 acres of agricultural land conservation
- Prepared the *State Plan of Flood Control Descriptive Document*, 2009
- Prepared the *Flood Control System Status Report*, 2011
- Prepared the Public Draft 2012 CVFPP



Geotechnical improvements to levees in the Pocket Area of Sacramento

Capital Improvement Projects

DWR, USACE, and local agencies have been working on capital improvement projects to upgrade the State-federal flood management system in the Central Valley, including the following:

- American River Common Features Project, to provide 200-year protection to areas protected by levees along the following reaches:
 - » *American River downstream from Folsom Dam*
 - » *Sacramento River downstream from the American River*
 - » *Natomas Basin*
- Folsom Dam Modifications (as part of the Folsom Dam Joint Federal Project)
- Marysville Ring Levee Improvement Project
- Mid-Valley Area Levee Reconstruction Project
- South Sacramento Streams Project
- Three Rivers Levee Improvement Authority, Feather River Levee Improvement Project, Yuba County
- Three Rivers Levee Improvement Authority, Upper Yuba River Levee Improvement Project, Yuba County
- Levee District 1, Star Bend levee setback on the Feather River, Sutter County

- Reclamation District 2103, Bear River North Levee Rehabilitation Project, Sutter, Yuba and Placer counties
- Reclamation District 17, 100-Year Seepage Area Project, San Joaquin River, San Joaquin County
- West Sacramento Area Flood Control Agency, Capital Outlay, City of West Sacramento
- Repair of two Yolo Bypass east bank levee slips in West Sacramento (underway)

DWR has also been working with USACE, the Board, and local agencies to evaluate the potential feasibility of the following projects and efforts in the Central Valley. These activities will continue through the next phase of implementation (2012 to 2017) to the extent feasible. The State will work with USACE and local agencies to incorporate ecosystem restoration in these feasibility studies:

- American River Common Features General Re-Evaluation Report
- Lower San Joaquin River Feasibility Study, investigating actions to achieve a 200-year level flood protection and opportunities for floodplain restoration, recreational enhancements, and ecosystem restoration for the City of Stockton and surrounding areas
- Merced County Streams Group investigation, evaluating options to increase the level of flood protection from a 50-year event to 200-year event within the Merced urban area
- Sutter Basin Feasibility Study, improving flood protection for communities in Sutter- Butte Basin
- West Sacramento General Reevaluation Report, providing a minimum 200-year level of protection for the City of West Sacramento
- West Stanislaus County-Orestimba Creek Feasibility Study, evaluating feasible flood protection alternatives for the City of Newman and surrounding area
- Woodland/Lower Cache Creek Feasibility Study
- Yuba Basin Project General Re-evaluation Report, increasing the level of flood protection for the Yuba River Basin communities of Marysville, Linda, Olivehurst, and Arboga

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California Water Code Section 9616 (b)
 "The plan shall include a prioritized list of recommended actions to reduce flood risks and meet the objectives described in subdivision (a)."

- Mid-Valley Area Levee Reconstruction Project
- South Sacramento County Streams Project study, increasing flood protection for the urbanized area of South Sacramento County

4.5.2 Near-Term Priority Actions

Between adoption of the 2012 CVFPP and its first update in 2017, priority actions include the following (organized by flood management programs):

Flood Emergency Response Program

- Develop improved flood forecasting and notifications for rural-agricultural areas of the Central Valley, and provide assistance to local agencies in preparing for and responding to flood emergencies
- Invest in additional monitoring gages and forecasting points to facilitate timely and accurate dissemination of flood information, particularly for rural-agricultural areas subject to more frequent flooding
- To the extent funding is available, propose a State grant program to assist rural local agencies throughout the Central Valley preparing flood emergency responses plans for their jurisdictions, and to develop appropriate regional communication tools and processes for flood emergency response operations
- Continue implementation of F-CO of reservoirs and initiate F-BO programs, where feasible
- Provide flood system information to local flood emergency responders
- Formalize procedures for enhanced inspection and maintenance

Flood System Operations and Maintenance Program/ Rural Agricultural Areas

- Work with rural-agricultural communities to develop levee repair standards
- Repair erosion sites throughout the flood system that were identified by the 2011 inspection program, before these sites further degrade the integrity of the flood control system and require costly repair
- Repair known and documented critical problems, prioritized based on flood risks
- Provide all-weather access roads on levee crowns for quick response to flood emergencies
- Implement rural levee projects that are consistent with the SSIA, are ready to proceed, and are shown to be feasible

Floodplain Risk Management Program

- Prepare new flood hazard identification and notification information for rural-agricultural community planners and local officials using updated hydrology and hydraulic studies
- Work with FEMA to actively engage the agency in floodplain management in the Central Valley, including funding for floodproofing homes and structures in floodplains, relocating structures and homes from deep floodplains, and developing a special insurance program for structures located in floodplains that play a major role in promoting the vibrant agricultural economy in rural areas of the Central Valley

Flood System Risk Assessment, Engineering, Feasibility, and Permitting

- Launch a major effort to coordinate FloodSAFE activities with all levels of USACE, and with Congress to refine USACE feasibility study processes under the two State basin-wide feasibility studies, for the purpose of facilitating timely federal cost-sharing of flood management projects in the Central Valley
- Perform two basin-wide feasibility studies: one for the Sacramento River Basin and one for the San Joaquin River Basin
- Initiate feasibility studies and designs for ecosystem projects that are consistent with the SSIA, are ready to proceed, and are shown to be feasible, such as the Fremont Weir fish passage project
- Complete the Conservation Strategy
- Develop a comprehensive fine-scale GIS dataset of riparian vegetation for the Central Valley
- On completion of the State basin-wide feasibility studies and refinement of the projects, prepare a long-term implementation plan for presentation in the 2017 CVFPP
- Complete the Financing Plan for the CVFPP in 2013
- Prepare the 2017 update of the CVFPP, identifying flood management improvements to be made in the subsequent five-year cycle
- Continue engagement with partners and stakeholders
- Evaluate the feasibility of initiating a program to provide post-flood recovery assistance to rural-agricultural areas
- Develop a regional assessment for RAMP
- Provide programmatic permitting for operations and maintenance of the flood management system



DWR will continue working with local agencies to implement flood management activities

Flood Risk Reductions Projects Program

- Continue to design and construct projects that are consistent with the SSIA, are ready to proceed, and are shown to be feasible, such as levee improvements for high-risk urban and urbanizing areas
- Implement small community projects that are consistent with the SSIA, are ready to proceed, and are shown to be feasible
- Acquire lands, rights-of-way, and easements to implement systemwide projects, including extending and expanding the bypass system and ecosystem restoration components, as soon as studies to further refine the locations of the lands to be acquired are completed
- Work with local agencies to implement rural-agricultural area flood management activities that are consistent with the SSIA, ready to proceed, and are shown to be feasible
- Work with local agencies and USACE in completing regional flood management plans with USACE to prepare basin-wide feasibility studies
- New Bullards Bar Outlet Modifications Project

PLANNING LEVEL COST ESTIMATES

Cost estimates presented in the plan are only conceptual and not intended for use for a specific project. Actual implementation costs will likely be higher than estimates in the 2012 CVFPP because of future price increases and the incremental nature of plan implementation.

4.6 Estimated Costs and Time to Implement

Section 3 presented cost information for the SSIA. Discussion in this section focuses on the investment and implementation schedule for the SSIA.

4.6.1 State Systemwide Investment Approach Cost Estimates

Table 4-1 summarizes costs to implement various elements of the SSIA.

Table 4-1. State Systemwide Investment Approach Cost Estimates by Element

ELEMENT	LOW ESTIMATE (\$ Millions)		HIGH ESTIMATE (\$ Millions)
System Improvements	\$5,140	to	\$6,500
Urban Improvements	\$5,500	to	\$6,700
Rural-Agricultural Improvements	\$1,080	to	\$1,180
Small Community Improvements	\$690	to	\$690
Residual Risk Management	\$1,510	to	\$1,860
Total	\$13,920	to	\$16,910

Table 4-2. State Systemwide Investment Approach Cost Estimates by Region

REGION	LOW ESTIMATE (\$ Millions)	HIGH ESTIMATE (\$ Millions)
1 - Upper Sacramento Region	\$480	\$610
2 - Mid-Sacramento Region	\$860	\$1,050
3 - Feather River Region	\$3,040	\$3,690
4 - Lower Sacramento Region	\$5,390	\$6,500
5 - Delta North Region	\$1,770	\$2,060
6 - Delta South Region	\$580	\$740
7 - Lower San Joaquin Region	\$730	\$930
8 - Mid - San Joaquin Region	\$190	\$250
9 - Upper San Joaquin Region	\$890	\$1,080
Total	\$13,920	\$16,910

These costs are planning level estimates; they are based on 2011 price levels and will differ in the future. The estimated distribution of costs among implementation regions is shown in Table 4-2.

The total cost of the SSIA is estimated to be between \$14 billion and \$17 billion. As shown in Figure 4-6, the SSIA invests approximately equally in urban flood protection and system improvements; this will promote opportunities for flood system operational flexibility, ecosystem enhancement, open space, and expansion of the flood-carrying capacity of the Central Valley flood management system.

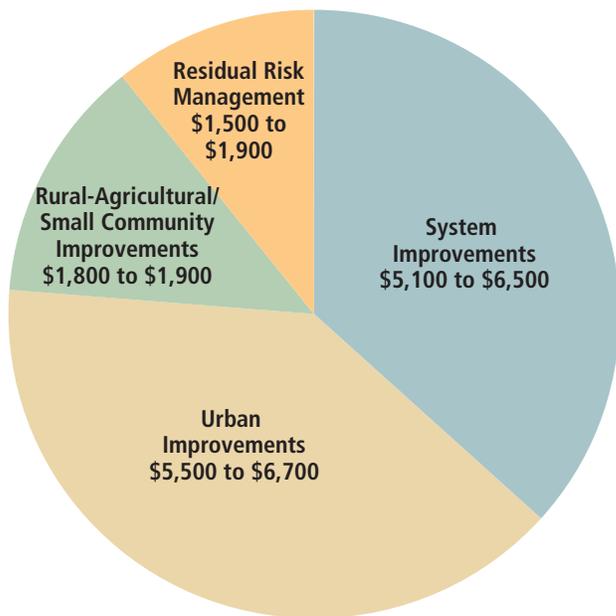


Figure 4-6. State Systemwide Investment Approach Investments by Element (\$ millions)

Over 23 percent of the total investment will be for the combination of rural-agricultural areas, small communities, and residual risk management, primarily designed to improve flood risk reduction in rural-agricultural areas. More than one third (38 percent) of estimated costs are for the Lower Sacramento Region, where flood risks and potential threats to lives and economic losses are of the greatest concern.

Full implementation of the SSIA will take 20 to 25 years. As shown in Section 4.5, implementation has already begun for some features of the SSIA through programs such as the Early Implementation Projects Program, which began in 2007. Additional physical improvements will begin in the next cycle of investment (2012 through 2017) and some will be completed beyond 2017. A consideration in formulating the SSIA has been the time that would be required to implement the approach. It is estimated that most features of the SSIA could be implemented in the next 15 to 20 years, assuming State and federal funding will be available in a timely manner.

4.6.2 Implementation Phasing

Some elements of the SSIA are more complicated and will take longer to develop and implement than others. Phasing of system improvements will help accommodate the timing of project planning, design, land acquisition, partnering, etc., as well as funding availability. Implementation phasing is not, however, intended to expedite implementation of some SSIA elements at the expense of other elements. Progress will be made with implementation of all elements during each phase of program implementation. Each five-year CVFPP update will refine implementation for subsequent phases.

- **Phase I** will generally occur within five years (2012 to 2017) of CVFPP adoption. DWR will begin working on priority improvements, such as improved flood forecasting and emergency response, land use planning initiatives, enhanced operations and maintenance practices, and flood risk reduction projects. Physical on-the-ground improvements will focus on continued efforts to improve flood risk reduction in urban areas, develop small community and rural flood risk reduction projects, repair erosion sites, and implement ecosystem improvements, where feasible. The Conservation Strategy will be developed, and feasibility evaluations and land acquisitions for expansion of the bypasses will be initiated. A more detailed list of activities for Phase I is presented in Section 4.5.
- **Phase II** will include broad flood system improvements with an emphasis on improving the operational flexibility of the flood management system. Work will include F-BO of reservoirs and construction of levee setbacks. Work on modifying flood control structures, such as weirs, gates, and pumping plants, will be undertaken to further add flexibility to flood system operations. Work to reduce flood risks in urban areas, rural-agricultural areas, and small communities will continue. Design and construction of levee setbacks and bypasses will be initiated. Improvements for rural-agricultural areas will also be initiated, where feasible.
- **Phase III** will include completing system improvements with an emphasis on reducing peak flood stages throughout large areas of the system. Many Phase III activities require a much longer period of planning and design preparation. Although these activities will be initiated in early phases, during Phase III, implementation of major system improvement elements, such as expansion of bypasses, construction of new bypasses, and implementation of the Conservation Strategy, will be completed.

Each phase of implementation will generally require the reevaluation of components of the SSIA, including prioritizing policies, programs, and project elements that provide the greatest benefit to public safety, environmental quality, and California's economy. Work on all phases will occur at the same time, but the emphasis changes. For example, emphasis during the first five years will be on foundation improvements. During the following five years, the emphasis will be on implementing improvements in Phase II, with emphasis on increasing flood system flexibility. Prioritizing investments in facilities will also be based on population and assets at risk.

Phased implementation recognizes that some projects are more complicated and require more time to complete, and that the need for some projects is more immediate than for others. Phased implementation also allows time for incremental funding and for CVFPP updates to incorporate improved understanding of the flood system over time. Each five-year update of the CVFPP will track ongoing and completed projects and programs and refine subsequent implementation actions.

As implementation phasing continues and elements of the SSIA are completed, the benefit-cost ratio of remaining elements may decrease; this is because project elements with higher benefit-cost ratios will likely be implemented earlier. It is important to recognize that the SSIA is an integrated approach to flood management, and that each element contributes to the overall goals of the CVFPP and should be holistically implemented. Accordingly, federal and State representatives will need to work together to quickly develop and gain approval for a “program” implementation process that accommodates incremental implementation of project elements toward the overall flood risk reduction and ecosystem restoration goals of the SSIA.

CENTRAL VALLEY FLOOD PROTECTION ACT OF 2008

California Water Code Section 9616 (a)
 “The plan shall...
 (13) Provide a feasible, comprehensive, and long-term financing plan for implementing the plan.”

The CVFPP includes a flood risk reduction financing strategy founded on the following:

- Flood management is a shared responsibility among federal, State, and local agencies, with the cost of improvement shared by all partners
- Interest and ability of the partnering agencies to participate and fund the projects
- Broad evaluation of system benefits
- Strong interest in achieving greater flood system reliability and sustainability
- Commitment to improve system operations and maintenance
- Need to continue to manage residual risk
- Commitment to conservation and enhancement of environmental quality, especially remnant riparian vegetation that grows in channels and on levees of Central Valley rivers and streams

4.7 Financing Strategy for Implementing State Systemwide Investment Approach

Implementation of the CVFPP began in January 2007 when bond funding became available. Since that time, DWR has invested in prudent Central Valley flood risk reduction projects and programs in advance of the CVFPP. For example, improvements in maintenance, emergency response, and repair of critically eroding levees, floodplain delineation, levee investigations, and upgraded levees for urban areas were important investments, integral to the SSIA, that could be made while the CVFPP was being prepared. The strategy for investing in projects that are ready to move forward, are feasible, and are considered to be consistent with the CVFPP Goals will continue during the next five years while detailed, basin-wide feasibility studies are completed. Implementation is based on phasing – prioritizing funding for the most critical actions, while setting the foundation for flood system improvement and developing more detailed feasibility studies to support the SSIA.

The Central Valley Flood Protection Act of 2008 requires DWR to prepare a Financing Plan for the CVFPP. Following adoption of the CVFPP in 2012, DWR will prepare a framework for financing projects at a regional level. DWR will use the information gathered from preparation of the framework to prepare the Financing Plan for the CVFPP that will guide investment in flood risk management in the Central Valley during the next 20 years. The Financing Plan will be available in 2013, after adop-

tion of 2012 CVFPP. The Financing Plan is critical to implementation, given the uncertainty in State, federal, and local agency budgets and cost-sharing capabilities.

The following sections describe preparation of near-term and long-term financing plans for the CVFPP.

4.7.1 Funding for State Systemwide Investment Approach Implementation

A mix of federal, State, and local funds will be needed to implement the SSIA. Funding sources will vary according to the type of project or program, beneficiaries, availability of funds, urgency, and other factors. Cost-sharing among State, federal, and local agencies may also change depending on project objectives and agency interests. A legislative requirement for Proposition 1E funds is to maximize, to the extent feasible, federal and local cost-sharing in flood management projects. Cost-sharing rules are governed by federal and State laws, regulations, and policies, which continue to evolve over time. The geographic extent and magnitude of project benefits must be evaluated to identify potential beneficiaries on a regional or systemwide scale. The intent of the CVFPP is to support equitable distribution of project costs among beneficiaries, encourage projects that provide benefits outside their immediate locales, and help achieve added flexibility in the SPFC. The State proposes to place a priority on funding and providing a greater cost-share for flood management improvement projects that provide multiple benefits.

Table 4-1 shows the funding required to implement various elements of the SSIA, and the specific flood management programs established to successfully implement the SSIA elements. Table 4-3 presents planning estimates for an equitable distribution of expenditures among State, federal, and local agencies over time. This distribution is based on a traditional cost-sharing formula, assuming local and federal interest in some of the SSIA elements, and recognizing that State, federal, and local agency interests may vary depending on the type of investment and results of feasibility studies. For example, Table 4-3 is based on local agencies having an interest in investing in their respective urban areas and small communities to reduce flood risks, while they may not be fully interested in investing in system improvement components of the SSIA. Similarly, USACE may have an interest in investing in urban flood risk reduction while its interest in system improvement components may be limited to specific actions such as ecosystem restoration. The State has an interest in implementing a robust flood emergency response program and expects to fund most of the flood emergency response activities proposed for implementation (some local cost-sharing may be required). Cost-sharing for implementation of the SSIA will be refined during feasibility studies and project implementation as additional project-level information is gathered and the interests of the partnering agencies in elements of the

California Water Code Section 12585.7 identifies the State cost-share of nonfederal capital costs for flood management projects. The State normally pays 50 percent of the nonfederal cost-share, but will pay up to 20 percent more (for a maximum of 70 percent of the nonfederal cost-share) if the project makes significant contributions to other objectives, including the following:

- Enhancement, protection, and restoration of endangered species and riparian, aquatic, or other important habitats
- Open space
- Recreational opportunities
- Flood control for communities with median household income less than 120 percent of the poverty level
- Flood control for State transportation infrastructure or water supply facilities

SSIA are identified. In general, a cost-sharing arrangement among State, federal, and local agencies will be needed to implement the projects.

It is expected that FEMA will play an active role in, and provide funding assistance for, floodplain management activities formulated in the SSIA, including floodproofing of rural-agricultural homes and structures, and relocating rural homes from deep floodplains.

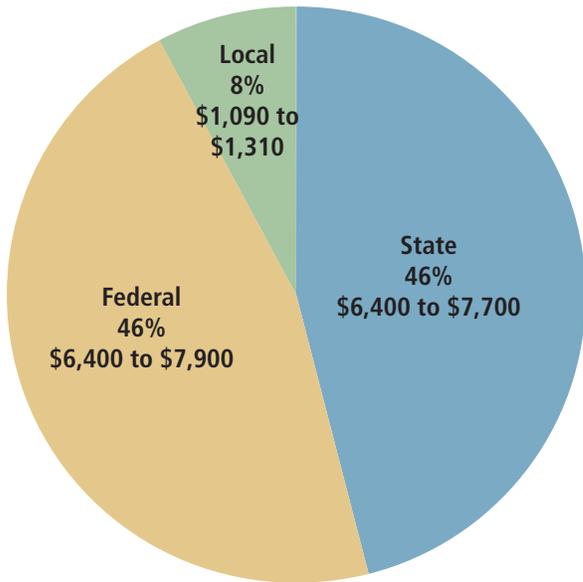


Figure 4-7. State Systemwide Investment Approach Potential Cost-Sharing by Agency (% and \$ millions)

Figure 4-7 illustrates the potential allocation of SSIA costs to State, federal, and local interests. Federal cost-sharing for capital improvements will be based on results of feasibility studies, and cost-sharing amounts will vary depending on the mix of purposes included in a project. For example, the federal cost-share for ecosystem restoration projects can be as much as 50 to 65 percent for urban flood risk reduction projects. Costs that do not qualify for federal cost-sharing include lands, easements, relocations, operations and maintenance, and other costs that must be paid by nonfederal sponsors. Water supply, recreation, or other benefits included in flood risk reduction projects can further modify federal cost-sharing. State cost-sharing of the nonfederal costs also depends on the mix of project purposes. Adequate funding from local agencies may require creation of assessment districts to implement capital improvements or to support effective, efficient, and improved system operations and maintenance.

4.7.2 Financing of Central Valley Flood Protection Plan (through 2017 and beyond)

STATE SYSTEMWIDE INVESTMENT APPROACH IMPLEMENTATION

The State will need to present a General Obligation Bond Law to voters to provide an additional \$4 to \$5 billion to cover the remaining State’s share of investment in the flood reduction projects outlined in SSIA.

The State may have to rely more heavily on State bond funding to finance flood risk reduction projects until more federal funding becomes available. Propositions 84 and 1E provided \$4.9 billion for flood risk reduction in California, of which \$3.0 to \$3.3 billion could be used for flood risk reduction in areas protected by facilities of the SPFC. The remaining bond funding was allocated to statewide flood risk reduction (including the Statewide Subventions Program, Stormwater Management Program, and flood risk reduction in the Delta). The State has already invested \$1.6 billion over the last five years. Additionally,

\$1.5 billion to \$1.7 billion of bond funding are already authorized and available for implementing flood risk reduction projects associated with the SPFC. It is estimated that local agencies, through assessments, will provide their share of the cost of about \$0.5 billion from 2012 through 2017. DWR needs to work closely with USACE and Congress to obtain at least \$1 billion in appropriations through 2017. The combination of State, federal, and local funding sources could provide about \$3 billion for the next phase of implementation, until more robust federal financing is available.

Table 4-3. State Systemwide Investment Approach Range of Investments over Time (\$ millions)

FLOOD MANAGEMENT PROGRAMS	FLOOD EMERGENCY RESPONSE		FLOOD SYSTEM OPERATIONS AND MAINTENANCE		FLOODPLAIN RISK MANAGEMENT		FLOOD SYSTEM ASSESSMENT, ENGINEERING, FEASIBILITY, AND PERMITTING		FLOOD RISK REDUCTION PROJECTS		TOTAL	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
2007-2011	State	\$64	\$180	\$99	\$257	\$1,032	\$1,632					
	Federal ¹	-	-	-	\$160	\$620	\$780					
	Local	-	-	-	\$40	\$450	\$490					
	Subtotal	\$64	\$180	\$99	\$457	\$2,102	\$2,902					
2012-2017	State	\$130 to \$140	\$30 to \$60	\$30 to \$40	\$170 to \$200	\$1,140 to \$1,300	\$1,500 to \$1,730					
	Federal	-	\$20 to \$40	\$70 to \$90	\$230 to \$270	\$1,190 to \$1,340	\$1,500 to \$1,740					
	Local	-	\$10 to \$10	-	\$50 to \$60	\$140 to \$220	\$190 to \$290					
	Subtotal	\$130 to \$140	\$60 to \$110	\$100 to \$130	\$450 to \$530	\$2,470 to \$2,860	\$3,210 to \$3,770					
2018 and Beyond	State	\$290 to \$310	\$20 to \$50	\$60 to \$120	\$270 to \$420	\$2,630 to \$3,440	\$3,270 to \$4,340					
	Federal	-	\$130 to \$160	\$340 to \$450	\$590 to \$740	\$3,090 to \$4,020	\$4,150 to \$5,370					
	Local	-	\$50 to \$60	-	\$120 to \$150	\$230 to \$320	\$410 to \$530					
	Subtotal	\$290 to \$310	\$200 to \$270	\$400 to \$570	\$980 to \$1,310	\$5,950 to \$7,780	\$7,830 to \$10,240					
Total	State	\$480 to \$510	\$230 to \$290	\$190 to \$260	\$700 to \$880	\$4,800 to \$5,770	\$6,400 to \$7,700					
	Federal	-	\$150 to \$200	\$410 to \$540	\$980 to \$1,170	\$4,900 to \$5,980	\$6,430 to \$7,890					
	Local	-	\$60 to \$70	-	\$210 to \$250	\$820 to \$990	\$1,090 to \$1,310					
	Subtotal	\$480 to \$510	\$440 to \$560	\$600 to \$800	\$1,890 to \$2,300	\$10,520 to \$12,740	\$13,920 to \$16,910					

¹ Federal and local project cost-shares for 2007 – to 2011 were estimated.

Key:
State = State of California

Table 4-4. State Investments over Time (\$ millions)

FLOOD MANAGEMENT PROGRAMS	2007 – 11	2012 – 2017	2018 AND BEYOND	TOTAL
Flood Emergency Response	\$64	\$130 to \$140	\$290 to \$310	\$480 to \$510
Flood System Operations and Maintenance	\$180	\$30 to \$60	\$20 to \$50	\$230 to \$290
Floodplain Risk Management	\$99	\$30 to \$40	\$60 to \$120	\$190 to \$260
Flood System Assessment, Engineering, Feasibility, and Permitting	\$257	\$170 to \$200	\$270 to \$420	\$700 to \$880
Flood Risk Reduction Projects	\$1,032	\$1,140 to \$1,300	\$2,630 to \$3,440	\$4,800 to \$5,770
<i>System Improvement Costs</i>	\$350	\$495 to \$565	\$1,155 to \$1,610	\$1,995 to \$2,525
<i>Urban Improvement Costs</i>	\$550	\$545 to \$620	\$445 to \$730	\$1,535 to \$1,900
<i>Rural-Agricultural Area and Small Community Improvement Costs</i>	\$132	\$105 to \$120	\$1,040 to \$1,095	\$1,275 to \$1,345
Total	\$1,632	\$1,500 to \$1,730	\$3,270 to \$4,340	\$6,400 to \$7,700

Beyond 2017, an additional \$8 billion to \$10 billion will be needed for implementing the SSIA (See Table 4-3). Table 4-4 summarizes the State's share of investments to implement the SSIA, ranging from \$6.4 to \$7.7 billion. Considering that the State already has authorized bond funding of over \$3.0 to \$3.3 billion to implement the SSIA, an additional bond measure will be needed to cover the remaining \$4 to \$5 billion of the State's share.

During the next five years (2013 through 2017), the State must work diligently with its federal and local partners and the Legislature to overcome several challenges that influence investment in flood risk reduction projects:

- Limited State, federal, and local funding for cost-sharing
- Changing regulations
- Resource intensive and time consuming federal feasibility study processes
- Need to fund ongoing implementation programs in addition to new capital projects

These challenges are further discussed in the next sections.

4.8 Central Valley Flood Protection Plan Approvals and Partner Roles and Responsibilities

DWR and the Board are the State lead agencies for implementing the SSIA and preparing the five-year CVFPP updates. It is the intent of the State that all major flood management programs and projects in the Central Valley be planned and implemented consistent with the vision, overall goals, and provisions of the evolving CVFPP. Ensuring consistency between the CVFPP and its program elements and projects over time will be the responsibility of the State through the continued partnership of DWR and the Board.

DWR will also work closely with USACE and the Board in developing the federal CVIFMS and the two State basin-wide feasibility studies. In addition, the State is partnering with USACE on a number of regional feasibility and post-authorization scope-change investigations aimed at further modifying the flood management system. Findings and recommendations from these regional investigations will be included in the two State feasibility studies. Future modifications to the SPFC originating from the CVFPP will primarily be identified through the two State feasibility studies.

Flood system improvement requires a coordinated partnership of federal, State, and local agencies. DWR will continue its tradition of working closely with federal and local partners to improve flood protection in the Central Valley.

4.9 Implementation Challenges and Uncertainties

Many challenges and uncertainties arise during the implementation of any large-scale program. These can include funding availability; federal and state government budgetary issues; future economic activities and inflation; and changes to federal programs, policies, and permitting.

Potential challenges and uncertainties are briefly described below:

- **Funding availability** – Implementation of SSIA will require an investment of \$14 billion to \$17 billion, shared by federal, State, and local agencies. Through Propositions 84 and 1E, the State has provided approximately \$5 billion for flood management activities, of which \$3.0 billion are allocated for implementing the SSIA. An additional \$11 to \$14 billion will be needed during the next 20 years from federal, State, and local sources. It is anticipated that another State bond measure will be required to augment federal and local agency funding. The amount of funding available from these sources and timing of the funding are unknown at this time.
- **Federal, State, and local agencies budgetary issues** – Flood management in California is a shared responsibility among federal, State, and local agencies. These agencies face daunting challenges in balancing their budgets. Shortfalls in State and local agency budgets and the federal deficit are issues of great concern in planning for implementation of a program that solely relies on cost-sharing from various level of government funding.
- **Economic activities** – Cost estimates presented in the CVFPP are based on 2011 level costs and, therefore, do not reflect future costs of implementation. Future costs and corresponding funding needs are, among other factors, dependent on future inflation rates and the time needed to implement the SSIA. Economic activities also influence competition and bidding conditions among the contractors who would build the future improvements to the SPFC.

- **Federal programs, policies, and permitting** – Many federal programs, policies, and permitting processes administered by USACE affect implementation of flood risk reduction programs. The following summarizes the potential impacts of USACE policies and programs on implementation of the SSIA:
 - » **Section 408** – *Under Section 408 of the Rivers and Harbors Act of 1899, the Secretary of the Army has the authority to regulate all significant modifications to a USACE civil works project. To issue a Section 408 permit, the Secretary must determine that a modification will not impair the usefulness of a federal project and will not be injurious to the public interest. Thus, such modifications, when approved, will be subject to requirements established by USACE related to acceptable design criteria and all associated environmental constraints. Since 2006, USACE has developed new, stringent guidance for Section 408 permitting authority, which has resulted in significant cost and schedule impacts on recent projects.*
 - » **Section 104 Credit** – *In May 2011, the Assistant Secretary of the Army for Civil Works (ASA-CW) declared that USACE will no longer accept Section 104 credit applications. The ASA-CW indicated that more recent crediting language included in the Water Resources Development Act of 2007 was a more modern tool. Furthermore, the change would address a USACE concern that Section 104 credit letters, because they can be issued early in the federal project implementation process, can encourage nonfederal sponsors to distort the federal project formulation process and pursue a credit that may be unlikely to materialize. Specifically, USACE intends to use Section 221 of the Flood Control Act of 1970, as amended by Section 2003 of Water Resources Development Act of 2007, which under current guidance requires completion of a federal decision document (USACE Chief of Engineers Report) for a proposed project before to approval for credit. This USACE guidance policy is likely to have a chilling effect on local efforts to expedite urgently needed flood risk reduction projects, which will ultimately affect schedules for project execution in the Central Valley.*
 - » **Levee Vegetation Policy** – *The current USACE levee vegetation policy has impacted progress in implementing flood risk reduction projects during the last three years, as sponsors have attempted to comply with those requirements. The State believes that strict compliance with the policy would be cost-prohibitive, disastrous for the ecosystem, and detrimental to public safety because it redirects funding from more critical problems unless a workable systemwide variance process is established by USACE.*

- » ***Feasibility Studies** – The current USACE feasibility study process is a time-consuming and expensive way of implementing fragmented projects, and is inconsistent with the reality that many system-wide projects have multiple sponsors, each with its own requirements. In the case of the SSIA, there is an opportunity for USACE to work with the State to demonstrate federal interest in improving flood protection through a systemwide approach. This approach has the potential to benefit State, federal, and local interests.*
- » ***Reservoir Operations** – Revisions to reservoir Water Control Manuals will require USACE participation and/or review, as well as appropriate environmental documentation. Changes to federal projects will require action by Congress.*
- » ***Technical challenges** – Many technical challenges also lie ahead. Better understanding of climate change and development of the appropriate adaptive strategy to address it, adequate technical information for project decision making, and other similar issues should be resolved over time as regional and basin-wide feasibility evaluations move forward.*

These issues can add considerably to costs, uncertainty, and time needed for project implementation. FloodSAFE and other State officials plan to actively engage USACE and Congress to resolve these issues to support future implementation of the SSIA.

Many flood management challenges lie ahead and require diligent collaboration and effective partnerships to be overcome. The CVFPP reflects the State's effort to take a balanced approach to achieving the objectives established in the Central Valley Flood Protection Act of 2008 as well as the primary and supporting goals defined in the initial phase of CVFPP formulation.

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5.0 ACRONYMS AND ABBREVIATIONS

ASA-CW.....	Assistant Secretary of the Army for Civil Works
Board.....	Central Valley Flood Protection Board
cfs.....	cubic feet per second
CMP.....	Corridor Management Plan
Conservation Strategy.....	Central Valley Flood System Conservation Strategy
CVFPP.....	Central Valley Flood Protection Plan
CVIFMS.....	Central Valley Integrated Flood Management Study
CWC.....	California Water Code
Delta.....	Sacramento-San Joaquin Delta
DWR.....	California Department of Water Resources
EAD.....	expected annual damages
ETL.....	Engineering Technical Letter
F-BO.....	Forecast-Based Operations
F-CO.....	Forecast-Coordinated Operations
FEMA.....	Federal Emergency Management Agency
FloodSAFE.....	FloodSAFE California
FPZ.....	Flood Protection Zone
Framework Agreement.....	California’s Central Valley Flood System Improvement Framework Agreement
ft.....	feet
GIS.....	geographic information system
HEC-FDA.....	USACE Hydrologic Engineering Centers Flood Damage Analysis
LCM.....	Life Cycle Management
O&M.....	operations and maintenance
PGL.....	Policy Guidance Letter
Proposition 1E.....	Disaster Preparedness and Flood Prevention Bond Act of 2006
Proposition 84.....	Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006
RAMP.....	Regional Advance Mitigation Planning
Reclamation.....	U.S. Department of the Interior, Bureau of Reclamation
SPA.....	Systemwide Planning Area
SPFC.....	State Plan of Flood Control
SSIA.....	State Systemwide Investment Approach
State.....	State of California
USACE.....	U.S. Army Corps of Engineers

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