

Lower San Joaquin River and Delta South Regional Flood Management Plan 2014

November 2014



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Executive Summary

The California Department of Water Resources (DWR) and the Central Valley Flood Protection Board (CVFPB) prepared the Central Valley Flood Protection Plan in 2012. As a result, DWR funded local flood management groups to prepare six Regional Flood Management Plans (RFMP) throughout California's Central Valley (see Figure on following page). The intent was for these plans to be locally developed to provide DWR information on the local visions for flood management for use in future DWR studies, such as its San Joaquin River Basin-Wide Feasibility Study (BWFS), and the 2017 Central Valley Flood Protection Plan (CVFPP).

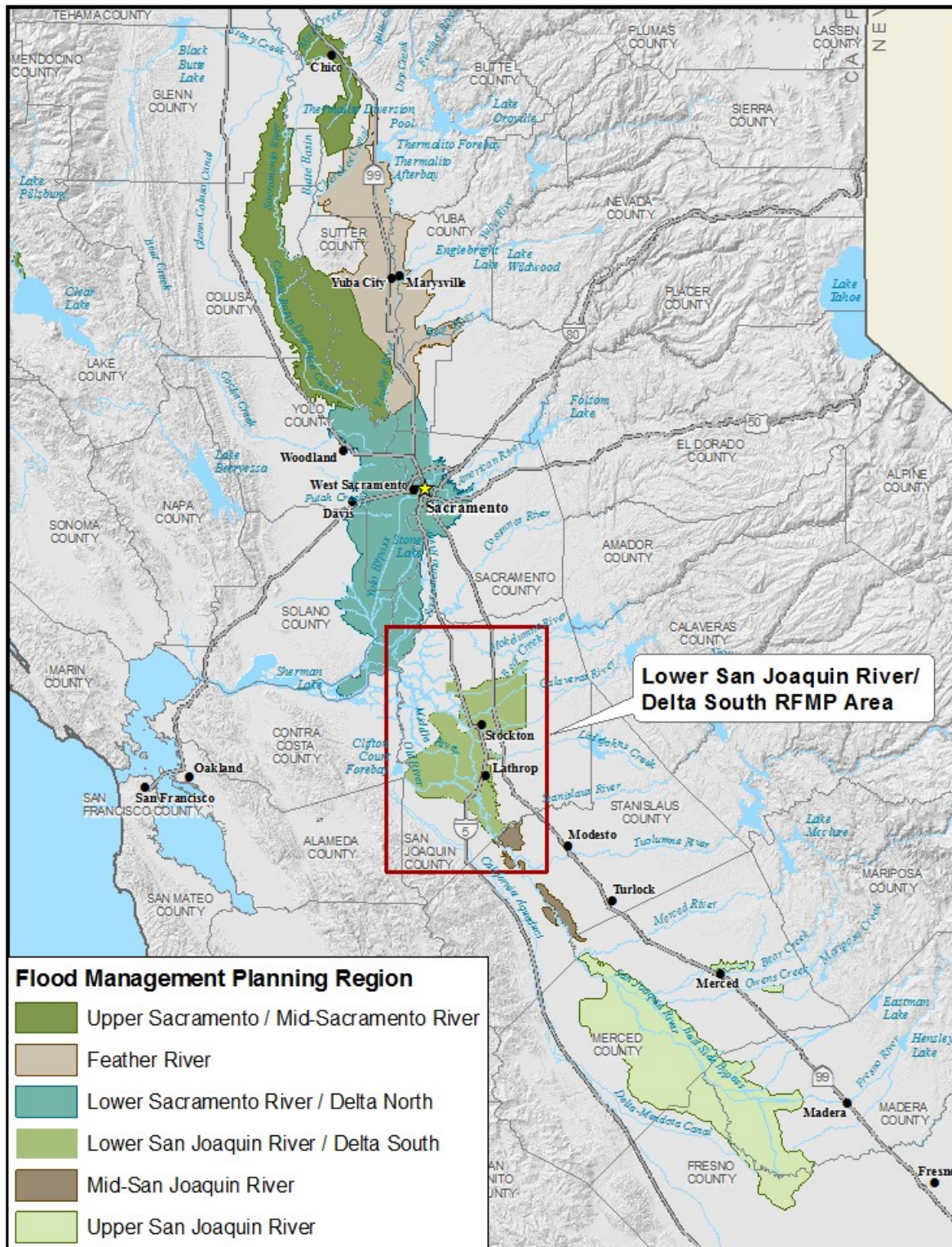
This RFMP is one of the six prepared during 2013 and 2014, and covers the Lower San Joaquin River Region and Delta South Region (collectively called "Regions"). The RFMP provides a reconnaissance-level assessment of flood risks, and presents a prioritized list of near-term and long-term flood risk reduction projects for the Regions. One key aspect of DWR funding was that each RFMP be prepared based on available existing information, with no new technical analyses.

The San Joaquin Area Flood Control Agency (SJAFCA) was authorized by the local maintaining agencies in the Regions to serve as the lead agency responsible for the completion of the RFMP. The Regions consist of a portion of San Joaquin County; the cities of Stockton and Lathrop; a portion of the cities of Manteca and Tracy; and 27 Reclamation Districts (RDs). Three additional areas of local interest (RD 2115, RD 2119, and RD 403) participated in the RFMP process.

Vision for RFMP

The vision adopted for the RFMP consists of the following elements:

1. A multi-faceted plan to improve public safety through integrated flood management in order to reduce the chance and consequences of flooding while promoting coincident integrated water management benefits, other multi-benefit components, and sustainable economic growth.
2. Achieve this vision by improving flood management systems, emergency response, O&M, the ecosystem, and both public and institutional awareness.



Approach

The approach for preparing the RFMP included the following efforts:

1. Inform stakeholders about recent State Legislation and the importance of flood risk management
2. Engage stakeholders in identifying flood management needs
3. Identify multi-benefit project components as applicable/practicable to leverage as many funding sources as possible for project implementation
4. Engage stakeholders on developing a prioritized list of projects
5. Identify funding needs and evaluate funding sources to implement flood management projects over the next 25 years

The long-term vision and approach for this RFMP were developed with input from flood risk management officials in the Regions, while recognizing that reducing exposure to flood risk and implementing significant system improvements throughout the Regions will take decades.

While many sources of data were accessed, the primary source of information that fed the RFMP was the experience of engineers and other representatives from local maintaining agencies (LMAs). These are the individuals who best know the condition, past performance, and needed improvements for the flood management facilities (mainly levees).

Regional Setting

The Regions are in the central portion of the Central Valley of California, near the downstream end of the 14,700 square mile San Joaquin River Basin. In general, the Regions are defined as areas that are protected by State Plan of Flood Control (SPFC) and related non-SPFC levees and consist of a mixture of urban and agricultural land uses.

Land uses generally relate to the Central Valley's agricultural heritage and proximity to effective distribution facilities, namely the Stockton Ship Channel, interstate freeways, transcontinental railroads and warehousing facilities. The Regions consist of actively farmed agricultural land (75%), urban and built-up land (23%) and native vegetation and grazing land (2%). Urban development is generally centered near the cities of Stockton, Lathrop, Manteca, and Tracy.

The Regions are populated by approximately 385,000 residents, which is just less than half of San Joaquin County's total population. Stockton is the largest city in the Regions with a total population of 295,000, followed by Tracy (84,000), Manteca (70,000), and Lathrop (19,000).

Hazards and Challenges

The most common flood system challenges noted by stakeholders include: structural deficiencies; changing hydrology; compliance with recent State legislation (Senate Bill 5); regulatory permitting associated with operations and maintenance; and inadequate funding and staffing.

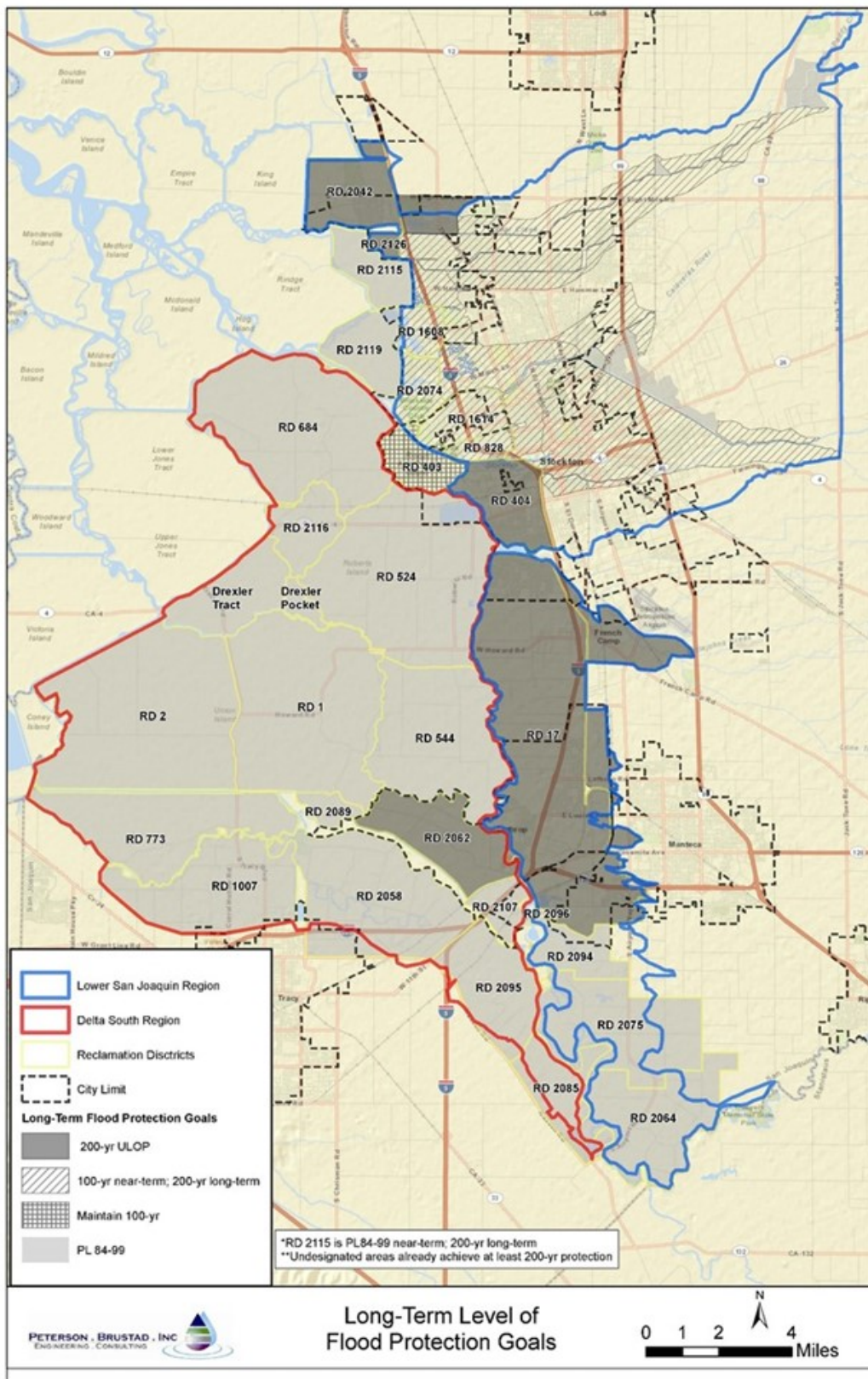
The structural deficiencies are typical for levees throughout the Central Valley. Erosion, seepage, slope instability, levee geometry problems (steep slopes, non-compliance with cross-sectional standards) and other problems are common throughout the Regions. Also, needed improvements include emergency response, floodplain risk management, and operation and maintenance (O&M).

Flooding in the Regions can come from three main sources:

- **San Joaquin River** – can be of long duration (months)
 - Prolonged snow melt
 - Rain-on-snow events
 - Prolonged duration atmospheric river rainfall events
- **Local Creek Flooding** – generally shorter duration (days to week)
 - Very intense, short duration “cloudburst” rainfall events
 - Prolonged duration atmospheric river rainfall events
- **High Tides** – generally short duration (hours) and cyclical over a few days (complicated by winds)

Levels of Flood Protection

During the RFMP effort, it became clear that different areas within the Regions had different goals for the level of flood protection. For example, agricultural areas generally wanted to pursue and/or maintain PL 84-99 levee standards. Developing areas were generally interested in pursuing an Urban Level of Protection (ULOP), but were also concerned about the financial costs associated with achieving this increased level of protection. Highly developed areas like the City of Stockton chose 100-year flood protection for the near-term and 200-year-flood protection for the long-term if it proves to be feasible. As more information is developed identifying 200-year inundation areas, the level of improvements, and costs necessary to provide flood protection for these areas, the City will be in a better position to identify specific areas where providing 200-year level of protection makes sense. It is anticipated that these goals and policies would be developed in conjunction with the General Plan amendment planning process. Finally, some areas opted to pursue and/or maintain protection from the 100-year flood in accordance with FEMA regulations. See the figure on the following page for the target levels of flood protection for the Regions.



Proposed Improvements

With these preliminary long-term flood protection targets as a framework, potential projects and programs to achieve these goals were solicited from stakeholders, and identified from previous studies. As part of the RFMP, the Regions developed implementation timing for each project:

- Tier 1 includes the actions likely to be implemented in the next five years. Tier 1 includes the most critical projects for the Regions.
- Tier 2 includes actions that are likely to be implemented in the period 6 to 12 years in the future.
- Tier 3 includes actions that will take the longest to implement (generally beyond 12 years in the future).

These tiers help demonstrate what funding may be necessary over time. The proposed improvements fit into three categories; 1) LMA-specific projects, 2) projects of regional significance, and 3) programs for residual risk management.

LMA-Specific Projects

The first category of improvements is for structural projects for each of the LMAs. These are primarily projects that improve existing facilities (levees) in place. Each project benefits a single LMA.

The following table shows the schedule and estimated costs (2014 dollars) for a compilation of these site-specific projects for the Delta South Region.

Projects by LMA/City					\$ million			
Summary of Improvement Type over Time					Tier 1	Tier 2	Tier 3	Total
	HMP Geometry				0	0	0	0.0
	PL 84-99 Geometry				22.8	0.0	2.8	25.6
	Penetrations & Enroachments				0.3	11.0	0.0	11.3
	Seepage/Slope Stability				63.1	183.3	84.5	330.9
	Erosion				33.2	0.0	0.0	33.2
	Other Geometry				2.6	0.0	102.6	105.2
	Improve Dryland Levee				0.4	0.0	59.3	59.7
	Channel Improvements				0.0	0.0	11.0	11.0
	Interior Drainage				0.0	0.0	0.0	0.0
	Improve to 200-year ULOP (RD 2062 developer costs)				60.0	110.0	0.0	170.0
	Other Structures				0.0	2.4	0.0	2.4
	Analysis				1.7	0.1	0.0	1.8
				Total	184.1	306.8	260.2	751.1

The following table shows the schedule and estimated costs for site-specific projects for the Lower San Joaquin River Region.

Projects by LMA/City					\$ million			
Summary of Improvement Type over Time					Tier 1	Tier 2	Tier 3	Total
	HMP Geometry				0	0	0	0.0
	PL 84-99 Geometry				17.8	26	0	43.8
	Penetrations & Enroachments				0	2	0	2.0
	Seepage/Slope Stability				2.6	12.2	77.8	92.6
	Erosion				5.6	0	11.2	16.8
	Other Geometry				0.0	0.0	42.7	42.7
	Improve Dryland Levee				19	18	13.8	50.8
	Channel Improvements				12.5	14.4	50	76.9
	Interior Drainage				5.1	1.2	0	6.3
	Improve to 200-year ULOP				20	130	1027	1177.0
	Other Structures				36.46	14.1	0	50.6
	Analysis				4.8	8.5	0	13.3
				Total	123.9	226.4	1222.5	1572.8

Projects of Regional Significance

Several projects have regional significance as they affect several or all of the LMAs, in both Regions. These are generally larger, more complex projects than the site-specific projects shown above.

- Paradise Cut Expansion
- San Joaquin National Wildlife Refuge Expansion
- Floodplain at Dos Rios (transitory storage)
- Study Reservoir Storage Improvements
- Coordinated Reservoir Operations
- Dredging the San Joaquin River from Paradise Cut to the Stanislaus River
- Master Plan for the San Joaquin River Corridor

Due to the complexity of these projects and the uncertainty concerning potential partners, funding for these projects needs to be addressed as these projects move from the conceptual stage to the feasibility analysis stage. However, the RFMP includes place-holder numbers of \$93 million for the Lower San Joaquin River Region and \$335 for the Delta South Region.

Programs for Residual Risk Management

Regardless of improvements to the physical flood management facilities, some risk of flooding is always present. Programs to address residual risk include improved O&M, enhanced emergency response, and improved floodplain risk management:

- Improved Flood O&M
 - Develop Enhanced O&M
 - Identify after-event erosion
 - Increase San Joaquin County Flood Control and Water Conservation Districts O&M for unmet needs
- Enhanced Emergency Response
 - Additional information collection and sharing
 - Local ER planning
 - Additional forecasting and notification
 - Improve San Joaquin County Alert System
 - Provide all-weather roads
- Floodplain Risk Management
 - Land use and floodplain management
 - Flood Contingency Maps
 - Raise structures and protect utilities

Estimates over the next 25 years for these residual risk management actions totaled \$112 million for the Delta South Region and \$165 million for the Lower San Joaquin River Region.

Financial Plan

The Regions have previously made efforts to implement their own unique combination of federal, State and local funding sources to manage flood risk overtime. The Financial Plan developed for the RFMP estimates the cost shares for potential projects and programs based on a wide range of existing and expected future funding sources.

The following table shows these cost shares for the near term (Tiers 1 & 2) and for the long-term (all Tiers). Due to the complexity and typical long lead times for implementing federal projects, costs from federal sources have only been categorized as being funded in the long term. The table shows near term (next 12 years) State cost shares to be 70 percent and local cost share to be 30 percent for both Regions combined. In the long-term with federal funding, the State cost share is projected to be about 53 percent and the local cost-share to be about 21 percent.

RFMP Projects and Programs	Estimated Cost Share (Federal, State, Local)						
	Near Term (Tiers 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Federal	State	Local	Total
Delta South Region	469	173	642	-	911	288	1,199
Lower San Joaquin River Region	333	170	503	802	684	344	1,830
Total	802	343	1,145	802	1,595	632	3,029
Near Term Cost Share Percent	70.0%	30.0%	100.0%				
Long Term /Cost Share Percent				26.5%	52.7%	20.9%	100.0%

Given the existing constraints, namely Propositions 13 and 218, of local jurisdictions to generate additional local funding for improvements and services (O&M for example), the two most feasible ways for local jurisdictions to generate funding are from voter approved taxes and assessments and self-imposed development impact fees. A rough assessment of local capacity of the Regions to fund additional flood control improvements and services shows different results for the two Regions:

- The **Lower San Joaquin River Region** has additional funding capacity based upon current state of development in the Region. The applied methodology estimates financing capacity up to \$182 million over the 25-year study period. This can be compared with the estimated near-term local cost of \$169 million and long-term local cost of \$344 million.
- The **Delta South Region** has a limited amount of additional funding capacity due to its relatively undeveloped nature. The applied methodology estimated financing capacity up to only \$21 million over the 25-year study period. This can be compared with the estimated near-term local cost of \$173 million and long-term local cost of \$288 million. The local financing capacity is insufficient to fund the potential projects costs in this RFMP.

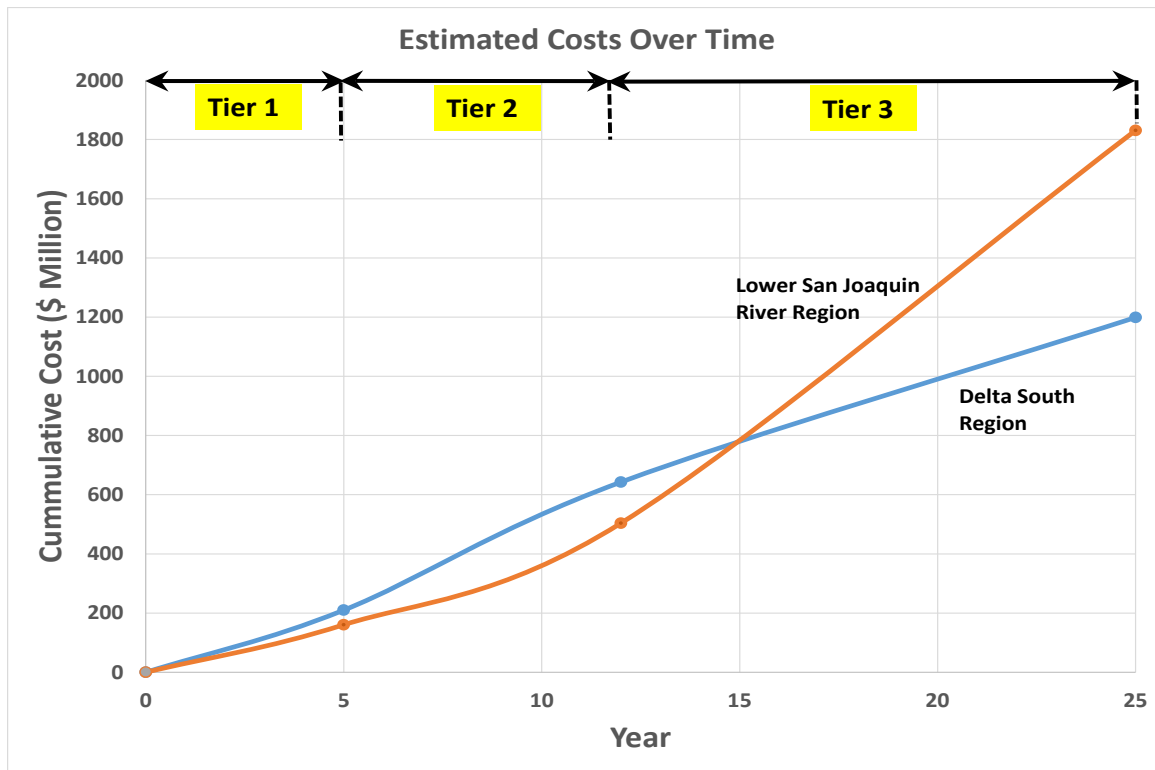
The Financial Plan provides an initial indication of potential funding cost shares and local financing capacity. More detailed project specific financial plans will be needed in the future.

Summary

Combining the LMA-specific projects (urban & rural), the projects of regional significance, and the residual risk management actions provides a good overall view of the anticipated level of investments over the next 25 years. The following figure shows the cumulative estimated implementation costs for each region over time.

The following table compares the estimated implementation costs for the RFMP with those estimated for the State Systemwide Investment Approach (SSIA), the State's preferred approach from the 2012 CVFPP. The RFMP describes how the RFMP is consistent with the SSIA and why the RFMP estimated cost is approximately twice that of the SSIA.

The Regions plan to continue collecting data on projects and other changes to assist any future updates of the RFMP that might be deemed worthwhile. In addition, the Regions plan on participating in continuing RFMP efforts to be funded by DWR through mid-2017. These Phase 2 RFMP efforts are expected to focus on coordination with DWR during preparation of the BWFS and the 2017 CVFPP. An ongoing study is evaluating a strategy to address future funding needs of SJAFCFA and San Joaquin County Flood Control and Water Conservation District. This and other tasks may be competed for Phase 2 RFMP.



	Estimated Costs in \$ Millions	
	SSIA	RFMP ¹
Delta South Region		
Urban Improvements	\$0 to \$0	\$172 ²
Rural Improvements	\$47 to \$52	\$580
Projects of Regional Significance ³	\$427 to \$549	\$335
Residual Risk Management	\$110 to \$135	\$112
Total Costs	\$584 to \$736	\$1,199
Lower San Joaquin River Region		
Urban Improvements	\$626 to \$809	\$1,416 ⁴
Rural Improvements	\$17 to \$19	\$157
Projects of Regional Significance ³	\$7 to \$8	\$94
Residual Risk Management	\$82 to \$97	\$163
Total Costs	\$732 to \$933	\$1,830
Total Estimated Costs for Both Regions	\$1,316 to \$1,669	\$3,029

¹ Estimated cost for RFMP are plus or minus 30 percent

² All local developer costs (River Islands, RD 2062)

³ SSIA uses the term, "System Projects" instead of "Projects of Regional Significance"

⁴ Expect to lower cost based on ULDC analyses

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Acronyms and Abbreviations

\$B	\$ Billion
BWFS	Basin-Wide Feasibility Study
cfs	cubic feet per second
Conservation Strategy /	Central Valley Flood System Conservation Strategy
CEQA	California Environmental Quality Act
CWC	California Water Code
CVFPB	Central Valley Flood Protection Board
CVFPP	Central Valley Flood Protection Plan
CVHS	Central Valley Hydrology Study
DAC	Disadvantaged Community
Delta	Sacramento-San Joaquin Delta
DRMS	Delta Risk Management Strategy
DWR	California Department of Water Resources
ETL	Engineering Technical Letter, USACE
FCM	Flood Contingency Map
FEMA	Federal Emergency Management Agency
FESSRO	FloodSAFE Environmental Stewardship and Statewide Resources Office
FloodSAFE	FloodSAFE California
FSRP	Flood System Repair Project
FPRP	Flood Protection Restoration Project
GIS	Geographic Information System
\$M	\$Million
NEPA	National Environmental Policy Act
HMP	Hazard Mitigation Plan
IRWMP	Integrated Regional Water Management Plan
JPA	Joint Powers Authority
LCM	Life Cycle Management
LMA	Local Maintaining Agency
LOMR	Letter of Map Revision
LSJRFS	Lower San Joaquin River Feasibility Study
NFIP	National Flood Insurance Program
NGO	Non-Governmental Organization
NIMS	National Incident Management System
NRCS	National Resources Conservation Service
NULE	Non-Urban Levee Evaluation
NWR	National Wildlife Refuge
O&M	Operation and Maintenance
PAL	Provisionally Accredited Levee
PL 84-99	Public Law 84-99 Rehabilitation and Inspection Program
Proposition 1E	Disaster Preparedness and Flood Protection Bond Act of 2006

Proposition 84	Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006
RD	Reclamation District
Regions	Lower San Joaquin River Region and Delta South Region
RFMP	Regional Flood Management Plan
RP	Recommended Plan
SEMS	Standardized Emergency Management System
SJR	San Joaquin River
SJMSCP	San Joaquin Multi-Species Habitat Conservation and Open Space Plan
SB5	Senate Bill 5
SEMS	Standardized Emergency Management System
SJAFCA	San Joaquin Area Flood Control Agency
SPFC	State Plan of Flood Control (aka Project)
SSIA	State Systemwide Investment Approach
State	State of California
SWIF	System-Wide Improvement Framework
TBD	To Be Determined
TAC	Technical Advisory Committee
ULDC	Urban Levee Design Criteria
ULE	Urban Levee Evaluation
ULOP	Urban Level of Protection
USACE	U.S. Army Corps of Engineers
USBR	U.S. Bureau of Reclamation
USFWS	U.S. Fish and Wildlife Service

1. Introduction

1.1. Purpose of Report

The San Joaquin Area Flood Control Agency (SJAFC) has partnered with local agencies to develop this Regional Flood Management Plan (RFMP) for the Lower San Joaquin River Region and Delta South Region (collectively referred to as the “Regions”). The RFMP was funded by the State of California Department of Water Resources (DWR) and included in-kind contributions from local agencies within the Regions. See Figure 1 for a depiction of the Regions.

Although DWR funded the RFMP process, the plan was prepared by the Regions, guided by their own concerns, priorities, and expertise. The plan was shaped by local maintaining agency (LMA) representatives, elected officials, property owners, businesses, interested individuals, community representatives, and non-governmental organizations. Also, State and federal agencies participated in many meetings.

This RFMP is intended to provide the long-term vision for managing flood risk within these two Regions. This RFMP will also be used to inform the San Joaquin River Basin-Wide Feasibility Study and the 2017 Central Valley Flood Protection Plan (CVFPP) being prepared by DWR.

This RFMP provides a reconnaissance-level assessment of flood risks, and presents a prioritized list of flood risk reduction projects for the Regions. A planning-level financial plan identifies funding needs and potential sources at the local, State, and federal level for the ultimate implementation of these projects. Although these two Regions are included in this single RFMP, the prioritized project lists are presented separately due to the unique characteristics and needs of each region.

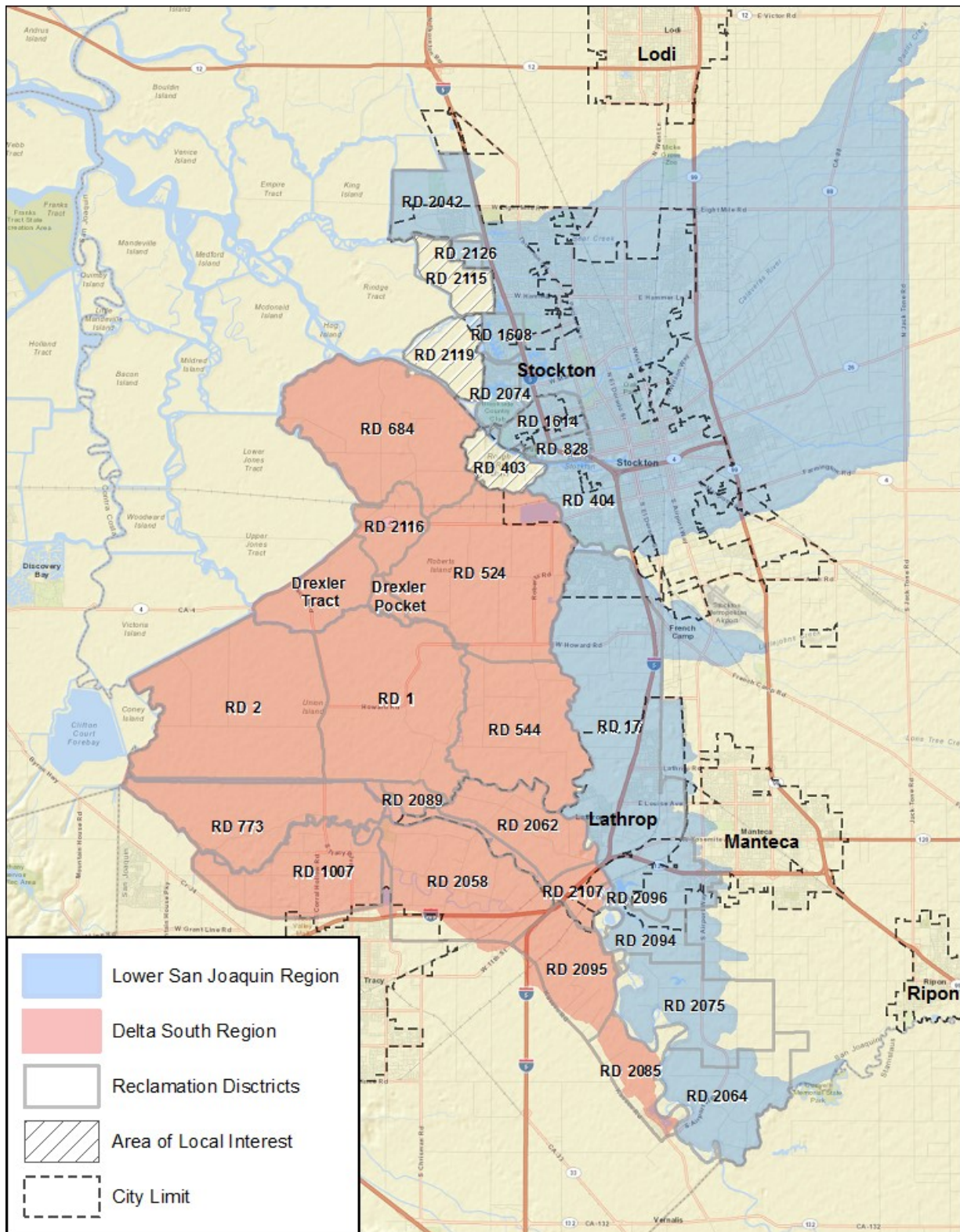


Figure 1 – RFMP Regions

1.2. The Planning Process

The planning process consisted primarily of reviewing existing information and coordinating with LMAs and other stakeholders. The plan formulation tasks focused on developing a description of the current state of flood management, identifying opportunities for improving flood management while achieving multiple objectives, setting priorities, and developing a financing plan. Together, these plan elements define the long-term vision for flood risk reduction.

SJAFCA was authorized by stakeholders to lead the combined RFMP effort for the two regions. SJAFCA relied heavily on coordination with the LMAs. The Regions elected to combine the Lower San Joaquin Region and Delta South Region into a single RFMP effort for many reasons. Both share a common boundary – the San Joaquin River – and both are within San Joaquin County. Furthermore, projects in one Region may have an impact on the other Region, and both Regions have members that participate in the San Joaquin County Flood Protection Technical Advisory Committee (TAC) monthly meetings. The TAC is the Regional Work Group for the RFMP. While the TAC officially consists of the local LMA stakeholders and flood managers, other agencies, NGOs, and interested parties participated in most meetings.

The Regions consist of a portion of San Joaquin County; the cities of Stockton and Lathrop; a portion of the cities of Manteca and Tracy; 27 Reclamation Districts (RDs). Drexler Tract, Drexler Pocket and RD 2116 are within the Delta South Region, but did not participate in the planning process. The cities of Lodi and Ripon were invited to participate in the RFMP, but did not participate beyond an initial meeting. RD 2115, RD 2119, and RD 403, areas of local interest that are closely associated with the Lower San Joaquin River Region, did participate in the RFMP. A total of approximately 260 stakeholders and interested parties were initially identified and included in the RFMP process. The list of stakeholders and interested parties expanded as the study progressed.

An RFMP webpage was created on SJAFCA’s website (<http://sjafca.com/ljsjrdsrfrm.php>), and a telephone hotline (209-475-7688) was established in May 2013 to provide a single point of contact for interested parties. In October 2013, a Project Solicitation Form was put on the RFMP webpage, and distributed to stakeholders. Interested parties that contacted SJAFCA or RFMP team members were also included in the stakeholder distribution list.

Due to the large number of stakeholders, two series of “Small Group Meetings” were held to reach interested parties on a more focused level. The initial Small Group Meetings presented the background, purpose, and objectives of the RFMP. Input was solicited from attendees on what vulnerabilities existed with their flood control facilities, and to identify and gather previous studies on these systems. Information gathered from these initial meetings was used to develop the Regional Setting and Regional Flood Hazard Assessment portions of the RFMP. The study team used a second round of small group meetings in mid-2014 to further refine potential

projects along with their likely implementation timing. Monthly TAC meetings were used to inform the broader group of stakeholders on recently completed and upcoming tasks.

1.3. Relationship with the Central Valley Flood Protection Plan

DWR's and the Central Valley Flood Protection Board's 2012 Central Valley Flood Protection Plan (CVFPP) establishes an overall vision for Central Valley flood risk management. Due to its broad scope, the CVFPP could not investigate site specific objectives, projects, or priorities that can be better defined by the regional entities. The CVFPP provides a broad vision to help guide regional- and State-level financing plans and investments which may be in the range of \$14 billion to \$17 billion over the next 20 to 25 years. The CVFPP proposes a State Systemwide Investment Approach (SSIA) for sustainable, integrated flood management in areas currently protected by facilities of the State Plan of Flood Control (SPFC). The consistency of the RFMP with the SSIA is discussed in Chapter 7.

Improvements to non-SPFC levees that 1) abut SPFC levees, 2) whose performance may affect the performance of SPFC levees, or 3) provide flood risk reduction benefits to areas also being protected by SPFC facilities are included in the SSIA. Figure 2 provides an overview of SPFC and non-SPFC levees in the Lower San Joaquin River Region and Delta South Region included in the 2012 CVFPP.

To further refine the vision presented in the 2012 CVFPP, DWR is conducting two Basin-Wide Feasibility Studies (BWFS). The two BWFS will cover the Sacramento Valley and the San Joaquin Valley. The studies will primarily focus on the long-term needs of the SPFC to provide trans-regional benefits and improvements to the capacity, flexibility, and resiliency of the Central Valley flood management system.

Additionally, DWR's FloodSAFE Environmental Stewardship and Statewide Resources Office (FESSRO) provided support on environmental issues for the development of the 2012 CVFPP, by developing the Central Valley Flood System Conservation Framework, which appears as Attachment 2 to Volume 1 of the 2012 CVFPP. This framework is an integral part of the SSIA identified in the draft CVFPP and describes how environmental stewardship is integrated to make progress towards meeting the environmental objectives of the Central Valley Flood Protection Act of 2008 and related legislation throughout the flood management system. FESSRO is now focusing on further development of the Conservation Strategy, a long-term effort to create a systemwide conservation plan supporting CVFPP implementation.

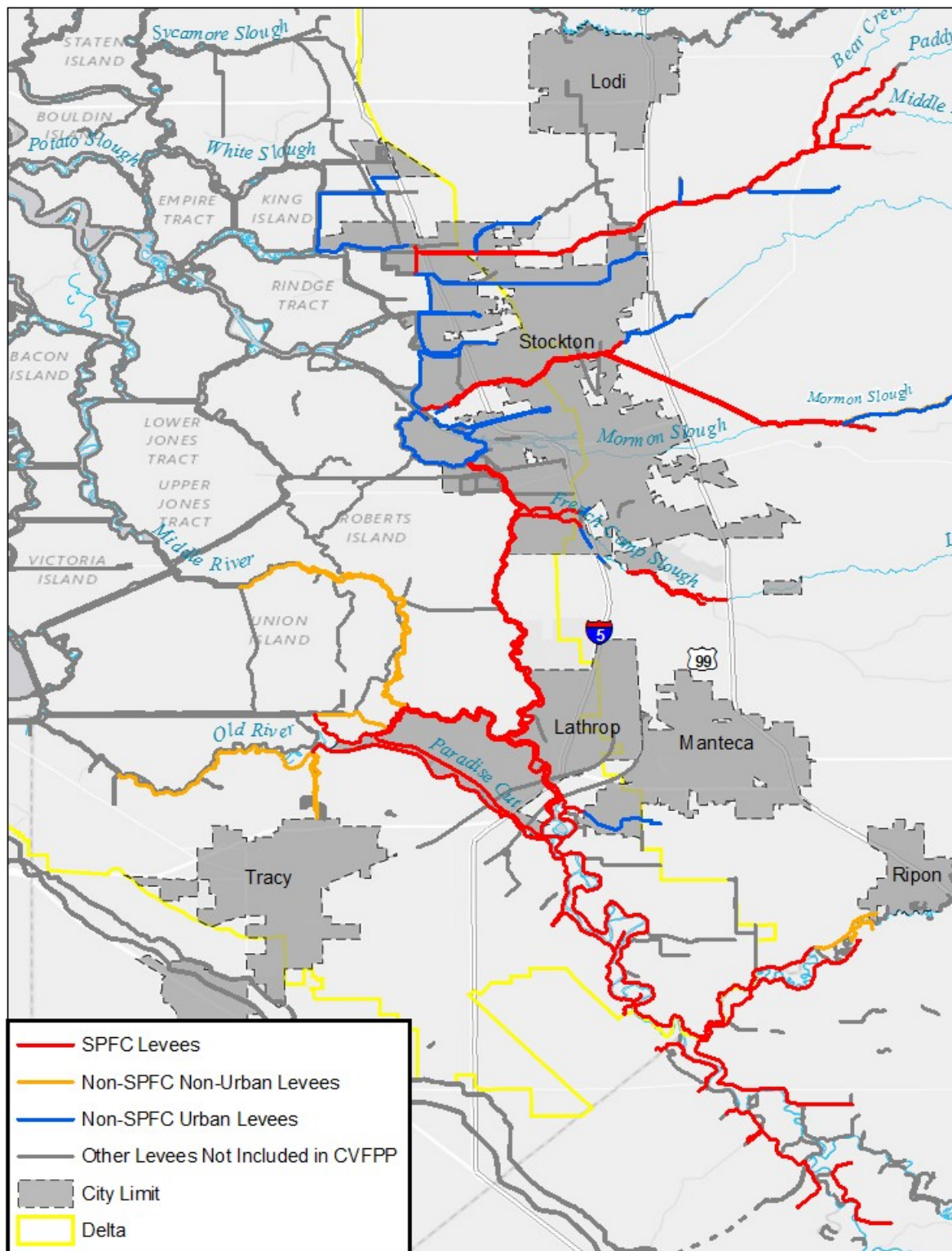


Figure 2 – SPFC and non-SPFC Levees Included in the 2012 CVFPP

1.4. Relationship to Relevant State Legislation

Senate Bill 5 (SB5) (Machado, 2007) requires a 200-year level of flood protection for urban and urbanizing areas within California's Central Valley. SB5 requires all cities and counties in the Central Valley to incorporate the data and analysis of the CVFPP into their general plans within 24 months and into their zoning ordinances within 36 months (July 2014 and 2015, respectively) (Cal. Gov't Code §§ 65302.9, 65860.1.).

SB5 was amended in September 2012 by SB 1278 (Wolk, 2012) and AB 1965 (Pan, Wolk, 2012). SB1278 and AB 1965 extended the requirement for communities to incorporate the CVFPP information into their general plans and zoning ordinances by 12 months (July 2015 and 2016, respectively). SB1278 also removed local drainage and shallow flooding from Urban Level of Flood Protection (ULOP) requirements. The final version of the ULOP exempted areas subject to less than 3-feet of flooding from ULOP requirements.

Under SB5, development in moderate or special flood hazard areas (i.e. 500-year and 100-year floodplains, respectively) would only be allowed within the Central Valley if the city or county can find, based on substantial evidence in the record, that the development will be subject to less than 3 feet of flooding during a 200-year flood event. This is more restrictive than Federal Emergency Management (FEMA) standards, which only require 100-year flood protection.

SB5 describes an urban area as: "a developed area in which there are 10,000 residents or more" and an urbanizing area as "a developed area or an area outside a developed area that is planned or anticipated to have 10,000 residents or more within the next 10 years".

1.5. CVFPP and Regional Goals

The goals of the Lower San Joaquin River and Delta South RFMP process are founded on, and consistent with, the goals of the CVFPP as described in the 2012 Plan:

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 nonstructural 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.

With this as a guide, the vision adopted for the RFMP consists of the following elements:

1. A multi-faceted plan to improve public safety through integrated flood management in order to reduce the chance and consequences of flooding while promoting coincident integrated water management benefits, other multi-benefit components, and sustainable economic growth.
2. Achieve this vision by improving flood management systems, emergency response, O&M, the ecosystem, and both public and institutional awareness.

The approach for developing the RFMP to work towards this vision included:

- Inform stakeholders about recent State legislation and the importance of flood risk management
- Engage stakeholders in identifying flood management needs
- Identify multi-benefit project components as applicable/practicable to leverage as many funding sources as possible for project implementation
- Engage stakeholders on developing a prioritized list of projects
- Identify funding needs and sources to implement flood management projects over the next 25 years

The Small Group Meetings held as part of the RFMP were the primary method to implement this approach.

1.6. Sources of Existing Information

The RFMP relies primarily on existing sources of information provided by local agencies, property owners, interested individuals, non-governmental organizations, as well as State and federal agencies. A partial list of documents used to inform the RFMP includes:

- 2012 Central Valley Flood Protection Plan
- Flood Control System Status Report
- State Plan of Flood Control Descriptive Document
- CVFPP Regional Conditions Report
- Lower San Joaquin River/Delta South Region, Regional Flood Atlas
- 2014 Eastern San Joaquin IRWMP
- 2010 San Joaquin County Urban Flood Protection Governance Study Report
- California's Flood Future: Recommendations for Managing the State's Flood Risk
- Lower San Joaquin River Feasibility Study
- Delta Risk Management Strategy (DRMS) Report
- Geotechnical (ULE/NULE) Evaluations
- 5-year plans from various Reclamation Districts
- Other studies/plans prepared by local agencies and Reclamation Districts
- Documents from ongoing State programs and evaluations
- Institutional knowledge from flood control officials and stakeholders

It is noted that some of these sources of information are not yet finalized. As new information became available throughout the RFMP process, facts, figures, and data included in this document were updated. New information will be considered in future updates of the RFMP.

The RFMP used the best available information and did not generate new technical data or perform new modeling. Therefore, data sets from existing sources may not fall entirely within the boundaries of the Regions. The information in this RFMP was compiled from a number of documents, each with differing levels of detail, completeness, and study area. This RFMP represents a first attempt at compiling and synthesizing available information in the Regions.

1.7. Organization of the Planning Team

SJAFCA was the lead agency responsible for preparing the RFMP, with cooperation from the cities of Stockton, Manteca, Lathrop, San Joaquin County, and the Reclamation Districts (RDs) within the Regions. SJAFCA retained Peterson Brustad Inc. as the lead consultant to assist in the research, planning, and preparation of the RFMP. The following sub-consultants assisted in preparation of the RFMP:

- American Rivers – Environmental support

- ENGEO – Geotechnical support
- HDR Engineering – Local levee expertise and support
- Kim Floyd – Communications and public outreach
- KSN, Inc. – Local levee expertise and support
- Larson Wurzel & Associates, Inc. – Financial plan
- MBK – Local levee expertise and support
- Siegfried – Local levee expertise and support

1.8. Organization of this Report

This RFMP is organized to reflect the natural sequence of the planning process:

1. **Introduction** – The Introduction presents the purpose of the RFMP, the planning process and other organizational descriptions.
2. **Regional Setting** – The Regional Setting provides an overview of the region (population, flooding history, existing flood system, and others) to provide context for the remainder of the report. This Chapter is supported by more detail in Appendix A.
3. **Assessment of Flood Hazards, Challenges, and Risks** – This chapter shows the major hazards, challenges, and risks that the Regions face while improving flood management and reducing risk. This Chapter is supported by freeboard profiles in Appendix B. Appendix C contains additional hazard descriptions for each LMA/City.
4. **Regional Solution Strategy** – Given the unique characteristics of the regions, this chapter guides local decisions on level of flood protection, land use, ecosystem opportunities, and other factors that help formulate improvement projects and programs.
5. **Structural Actions** – This chapter outlines the structural improvements needed to reduce flood risk. Given the many individual damage areas (separate islands and tracts that would flood only when their own levees fail), many of these structural actions are site-specific improvements to existing levees. In addition, the Chapter describes the larger regional structural actions that would have an effect on at least several damage areas. Appendix C contains additional site-specific project information for each LMA/City.
6. **Residual Risk Management Actions** – The residual risk management actions supplement the structural actions to better manage the risk that continues regardless of the structural improvements. Appendix D contains the findings of the Rural LMA Work Group.
7. **Implementation Schedule and Consistency with the SSIA** – This chapter prioritizes the structural and residual risk management actions into three implementation tiers over the next 25 years. The chapter also shows how the RFMP is consistent with the SSIA.

8. **Financial Plan** – This chapter summarizes the means and opportunities for financing proposed projects, programs, and policies given the cost and time priority for implementation. Appendix E contains the complete Financial Plan.
9. **Next Steps** – This chapter describes how the RFMP is considered a living document that will be periodically updated in the future.
10. **References** – This chapter includes a list of references used during preparation of the RFMP.

The RFMP includes the following appendices:

Appendix A - Regional Setting and Context

Appendix B - Freeboard Profiles

Appendix C - LMA-Specific Hazards and Projects

Appendix D - Rural LMA Work Group Topic Papers

Appendix E - Financial Plan

Appendix F - Comment and Response Log

2. Regional Setting

This chapter provides a high-level overview of the regional setting. More detailed regional settling information can be found in Appendix A.

2.1. Area and Boundaries

The Regions are in the central portion of the Central Valley of California, a broad, gently sloping valley that drains into the Sacramento-San Joaquin Delta. Located near the mouth of the San Joaquin River, the Regions are subject to runoff from nearly the entire 14,700 square mile San Joaquin River Basin.

The Regions are characterized by the Lower San Joaquin River, the Delta, and the numerous tributaries which flow through urban areas from the foothills east of the Regions. Some of the primary tributaries to the Lower San Joaquin River include: Bear Creek, Calaveras River, Mormon Slough, Mosher Slough, Stockton Diverting Canal, and the French Camp Slough.

There are numerous sloughs and canals traversing the Delta South Region. Some of the prominent waterways include: Paradise Cut, Old River, Middle River, Burns Cutoff, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal, and Grant Line Canal. Urban development in the Delta South is focused near Tracy and Lathrop.

Figure 1 shows the areas for the two regions.

2.2. Land Use and Population

2.2.1. Land Uses

Land uses generally relate to the Central Valley's agricultural heritage and proximity to effective distribution facilities, namely the Stockton Ship Channel, interstate freeways, and transcontinental railroads.

The Regions consist of actively farmed agricultural land (75%), urban and built-up land (23%) and native vegetation and grazing land (2%). Urban development is generally centered near the cities of Stockton, Lathrop, Manteca, and Tracy. Lands outside the spheres of influence of these cities are generally agricultural. Figure 3 shows the general land uses in the Regions.

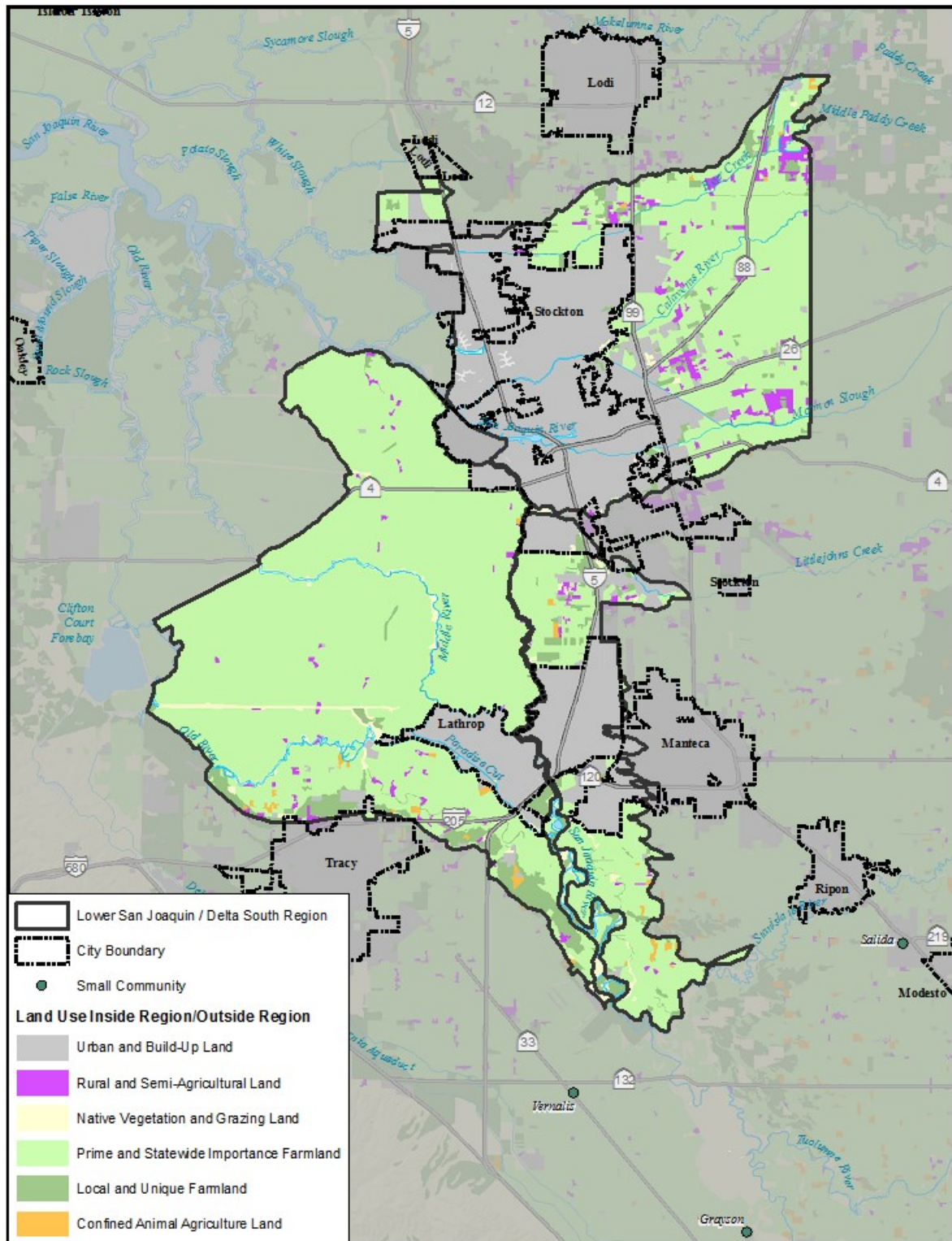


Figure 3 – General Land Uses

2.2.2. Population & Demographics

Based on the 2013 California Department of Finance data, San Joaquin County has a population of 698,414 with most residents concentrated in the urban areas of the cities of Stockton, Tracy, Lathrop, Manteca, Lodi, and Ripon. Table 1 shows the populations of the communities in and near the Regions. It should be noted that this data is identified by jurisdiction, some of which extend beyond the regional boundaries.

Table 1 – Population by Jurisdiction in San Joaquin County

Jurisdiction	Total Population January 1st, 2013
San Joaquin County	698,414
Lathrop	19,209
Lodi	62,930
Manteca	71,164
Ripon	14,606
Stockton	296,344
Tracy	84,060
Other Areas	150,101

Source: 2013 Population Estimates, CA Dept. of Finance, Demographics

The Regions are populated by approximately 385,000 residents, which is just less than half of San Joaquin County's total population. Table 2 shows a comparison of demographics for San Joaquin County and the State of California.

Table 2 – Demographics

	San Joaquin County	State of California
General Data		
Percentage of population under 5 years old	7.7%	6.7%
Percentage of population between the ages of 5 and 18	20.9%	17.6%
Percentage of population between the ages of 18 and 65	60.4%	63.6%
Percentage of population over 65 years old	11.0%	12.1%
Ethnicity		
White	68.4%	73.7%
Black or African American	8.2%	6.6%
American Indian and Alaska Native	2.0%	1.7%
Asian	15.7%	13.9%
Native Hawaiian and Other Pacific Islander	0.7%	0.5%
Two or More Races	5.0%	3.6%
Hispanic or Latino*	39.7%*	38.2%*
* According to the US Census Bureau, people who identify their origin as Spanish, Hispanic, or Latino may be of any race. Thus, the percent Hispanic should not be added to percentages for racial categories.		

2.3. Economy and Industry

The Regions have a long and rich history of farming. Proximity to transcontinental railroads and the Port of Stockton continue to make San Joaquin County one of the most important areas west of the Rocky Mountains for commerce. Accordingly, agriculture and related industries account for 30%-35% of the total economy of San Joaquin County. In 2011, the farming and agriculture industry accounted for more than \$2.2 billion of the economy in San Joaquin County.



Table 3 presents data from the US Census Bureau on the different types of industries in San Joaquin County. This data is not current, but does represent the latest available information on the US Census Bureau website as of the date of the RFMP.

Table 3 – San Joaquin County Business Data

Private nonfarm establishments, 2011	10,697
Private nonfarm employment, 2011	159,882
Private nonfarm employment, percent change, 2010-2011	-0.5%
Non-employer establishments, 2011	34,053
Manufacturers' shipments, 2007 (\$1000)	\$8,272,476
Merchant wholesaler sales, 2007 (\$1000)	\$9,001,313
Retail sales, 2007 (\$1000)	\$7,109,680
Accommodation and food services sales, 2007 (\$1000)	\$745,809
Building permits issued in 2012	1,006

According to the US Census Bureau, the median household income in San Joaquin County from 2007 – 2011 was approximately \$53,764, and approximate 17% of the County's population was below the poverty level. Additionally, the Regions have areas that meet the definition of a Disadvantaged Community (DAC). According to DWR's guidelines, a DAC is defined as an area with a median household income less than \$48,706. This is significant to the Regions because these areas are less able to locally fund large-scale projects, and are therefore eligible for increased State funding to implement these projects.

2.4. Natural Resource Assets

The rich, productive soils in San Joaquin County represent one of the most important natural resource assets in the Regions. The numerous rivers, streams, creeks, sloughs, and channels are also a vital resource. The Stockton Ship Channel is used as a navigational channel by large commercial ships traveling to and from the Port of Stockton. These waterways support the vast agricultural industry, provide drinking water, and recreational opportunities for residents.

Statewide, the Sacramento–San Joaquin Delta provides water for approximately 7 million acres of farmland and drinking water for approximately 25 million people, making it the single largest drinking water source in California. Therefore, the protection and preservation of water quality within the Delta and for the State and federal water projects is critical. The levees in the Regions help protect drinking water in the Delta by maintaining an appropriate balance between freshwater and saltwater. Flooding of Delta islands has the potential to negatively affect water quality due to increases in salinity, both locally and statewide.

If the levees along any of the Reclamation Districts were breached, particularly during a storm or high water event, adjacent islands could be threatened by seepage under the levees and higher wind fetch, which could cause levee failures.

The Regions provide habitat and riparian areas for wildlife. While limited in many areas, riparian systems provide several important functions to both the aquatic and terrestrial ecosystems associated with them. Riparian habitats support a great diversity of wildlife, including sensitive invertebrates, amphibians, reptiles, birds, and mammals. Riparian vegetation occurs intermittently and concentrated around waterways including: Littlejohns Creek, the right bank of the Stanislaus River, French Camp Slough, Lower Calaveras River, and San Joaquin River.

Finally, the Regions have “Designated critical habitat” areas. Designated critical habitat is a term defined in the Endangered Species Act and used by US Fish and Wildlife Service and the National Marine Fisheries Service as an area that is essential for the conservation and recovery of a federally threatened or endangered species that requires special management and protection. It may include an area that is not currently occupied by the species but that will be needed for its recovery. Critical habitats are designated to ensure that actions authorized by federal agencies will not destroy or adversely modify critical habitat, thereby protecting areas necessary for the conservation of the species. Not all federally listed species have designated critical habitat. Appendix A includes a map of designated critical habitat in the Regions.

Species with land designated as critical habitat in the Lower San Joaquin River Region and Delta South Region include: the delta smelt, Central Valley steelhead, Green sturgeon and the Valley Elderberry Longhorn Beetle.

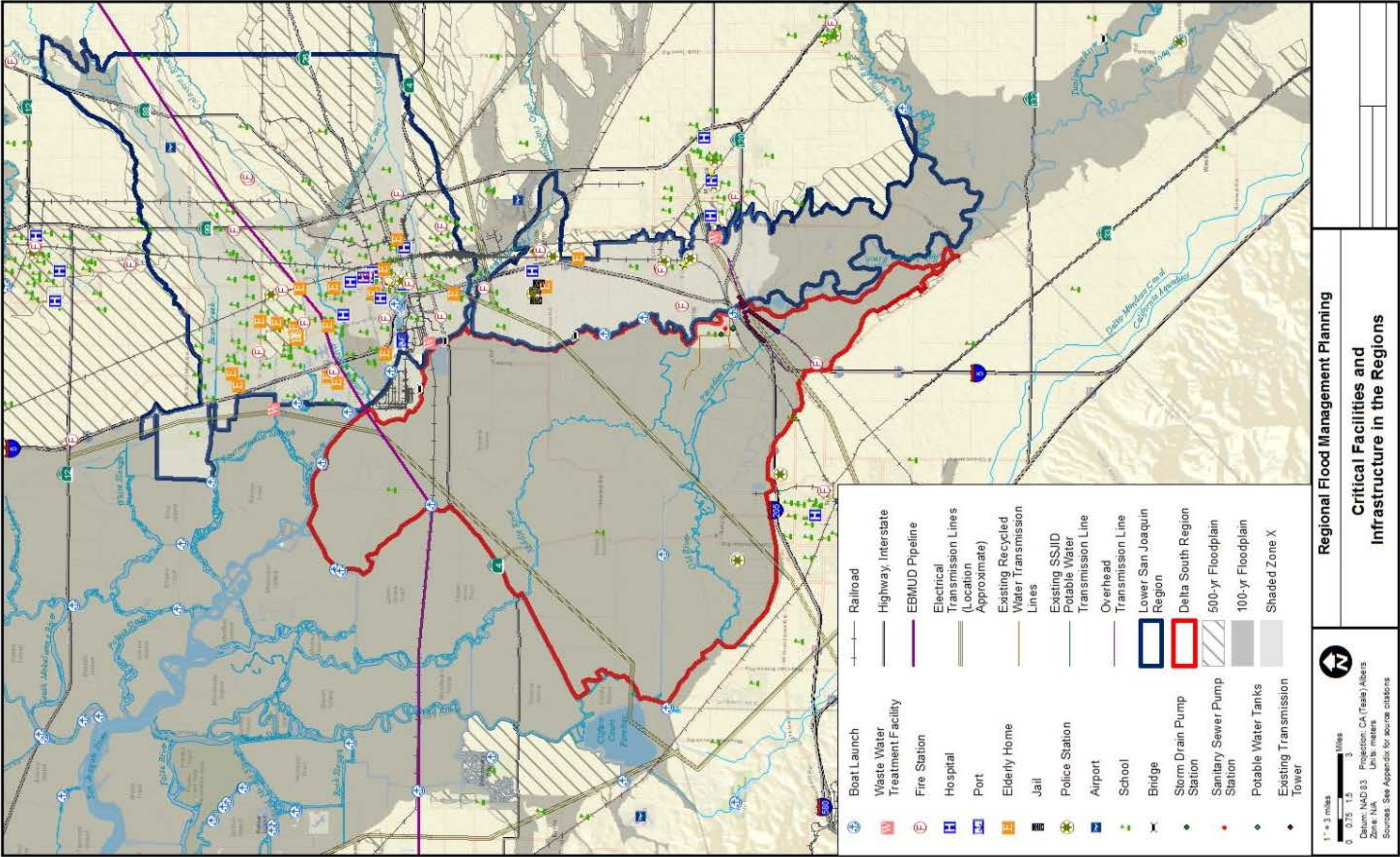
2.5. Critical Infrastructure

The hundreds of thousands of people who live, work, and play in the Regions depend on a significant amount of infrastructure. Specifically, potable water distribution facilities, treatment facilities, interstate freeways, highways, airports, railroads, and the Port of Stockton are all vital to interstate commerce and the economy in the Regions. Figure 4 and Regional Atlas Map 8 provide a graphical overview of the key infrastructure facilities described below.

Major north-south highways include: Interstate 5 and State Highway 99. Major east-west highways include: Interstates 205 and 580 (just west of the Regions); State Highways 4, 26, 88, and 120.

Other critical infrastructure (not exhaustive list) includes:

- The Port of Stockton
- 2 airports including the Stockton Municipal Airport and Wallom Field Airport
- Union Pacific Railroad
- Burlington Northern Santa Fe Railroad
- Central California Traction Railroad
- Lathrop and Stockton City Halls
- 2 San Joaquin County Administration Buildings
- 15 boat launching facilities
- 6 hospitals
- 14 fire stations
- 4 police stations
- Stockton Waste Water Treatment Plant and wastewater ponds
- Lathrop/Manteca Sewer Treatment Plant
- Mokelumne Aqueducts
- City of Manteca Water Quality Plant
- City of Lathrop Water Recycling Plant
- Westside Sewer pump station at the northeast corner of RD 2119
- Tracy wastewater ponds



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Figure 4 – Critical Facilities and Infrastructure

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2.6. Climate

The Regions are characterized by a well-defined cool, wet season lasting generally from November through April, followed by a hot, dry summer. With the Sierra Nevada Mountains to the east, and the exposure to the influence of storms sweeping in from the Pacific Ocean, the Regions can be subjected to rapid, extreme, and persistent rainfall and subsequent flooding.

Flooding in the Region is typically characterized by infrequent severe winter storms, combined with snowmelt runoff from the Sierra Nevada Mountains east of Stockton. Runoff from these storm events traverses the Regions via numerous creeks and rivers, ultimately draining to the San Joaquin River. This type of rainfall event was formerly referred to as a Pineapple Express since the warm, moist air mass originates near Hawaii in the Pacific Ocean. This phenomena is now referred to as an “atmospheric river”.

Like all areas within the Central Valley, the Regions face an uncertain future with the effects of climate change.

2.7. Historical Context of Flood Management

2.7.1. *Historic Flood Events*

The most recent major flood events occurred in the Regions along the Lower San Joaquin River in 1955, 1983, 1986, 1995, 1997, and 2006. The distribution of flood damages in the region has varied considerably with each storm event. However, the highest magnitude of damages occurred to agricultural crops and developments. The 1997 flood event did, however, damage 1,842 residences, mobile homes, and businesses in San Joaquin and Stanislaus counties. Estimated average annual equivalent damages from floods in the Lower San Joaquin River basin amount to about \$25 million based on preliminary HEC-FDA model for the CVFPP. Crop damages (\$15.2 million) account for 60% of the estimated damages. While it is noted the data included herein represents an area larger than the RFMP Regions, it highlights the history and magnitude of severe flood events basin-wide, and in the Regions in particular. See Appendix A for additional information on historic flood events.

State oversight of flood control efforts in the San Joaquin Valley began in 1911, with the creation of the State Reclamation Board, which eventually evolved into the Central Valley Flood Protection Board (CVFPB) in 2007. In recent years, the CVFPB has cooperated with the US Army Corps of Engineers (USACE) to design, construct, and operate & maintain the completed works of the Sacramento and San Joaquin Flood Control Projects. Finally, the CVFPB has given assurances to USACE that the federally authorized Project levees will be operated and maintained in accordance with specified criteria.

Table 4 summarizes the significant flood control projects which impact the Region.

Table 4 - Summary of Significant Historical Flood Control Projects on the San Joaquin River

Time Period	Description
Early Development (19 th Century)	• Early settlers converted many of the secondary channels to canals that conveyed surface water flows from the San Joaquin River for water supply • Private diversions from the San Joaquin River for irrigation purposes were constructed • Private levees were established along many segments of the San Joaquin River to protect private property from high flows
Early 1900's (1900 – 1950)	• 1911: State Reclamation Board established • 1930: Hogan Dam Completed by the City of Stockton for flood control. • 1944: Pick-Sloan Flood Control Act
Late 1900's (1950 – 2000)	• 1951: The Delta-Mendota Canal was completed and the Exchange Contractors began diverting small quantities of imported Delta water • 1951: The Duck Creek Project was completed that provided improvements to Duck Creek and the Littlejohn Creek from French Camp Road to Escalon-Bellota Road • 1952: Farmington Dam and Flood Control Basin were completed • 1964: The Bear Creek Project was completed providing protection to agricultural lands adjacent to the channel and to industry adjacent to the channel • 1968: New Hogan Dam and Lake was completed providing flood control and water supply to the region • 1968: The Mormon Slough Project was completed providing protection to farmland and orchards, and to the urban area of Stockton • 1989: RD17 levees improved to provide 100-yr flood protection for the Weston Ranch • 1995: SJAFCA created • 1997: SJAFCA improved levees along Bear Creek, Pixley Slough, Mosher Slough, Mosher Creek, Mosher Creek Diversion, South Paddy Creek, Mormon Channel, Potter Creek, Calaveras River, and the Stockton Diverting Canal as part of the FPRP • 1997: Seepage repairs made to RD17 levees following the 1997 flood event • 1998: NRCS certified Mosher Slough and Little Bear Creek levees as part of FPRP • 2000: USACE certified levees improved as part of the FPRP
2000 - Present	• 2006: Proposition 1E and 84 approved \$5B in flood control improvements in the State of California • 2006: FEMA accreditation of Stewart Tract levees • 2007: RD 17 began the seepage repair project • 2009: Lower San Joaquin River Feasibility Study initiated to study system deficiencies • 2009 – 2010: RDs and SJAFCA Submitted PAL Compliance Documents to FEMA for: ◦ Shima Tract (P375, P378, P379) ◦ Levees east and southeast of Shima Tract (FEMA segments P375, P378 and P379) ◦ RD 2126/Atlas Tract Dryland Levee (P459) ◦ Fourteen Mile Slough Levee, north bank, east of I-5 (P124) ◦ Lower Calaveras River Levees (P454, P356, P357, P140, P1401) ◦ RD 403/Rough and Ready Island Levees (P222, P223, P259) ◦ Walker Slough Levee (P268) ◦ RD17 and Mossdale Tract (P450, P449, P153, P29, P342, P338, and P339) • 2011: FEMA Approved CLOMR for Smith Canal Gate • 2012: Letter from USACE rescinding certification • 2012: RD 404 slurry wall project • 2013: Levee Certification started for Bear Creek and Calaveras systems • 2013: Smith Canal Gate Design started

2.7.2. Modern Flood Management Efforts

Creation of SJAFCA

In 1995, the San Joaquin Area Flood Control Agency (SJAFCA) was created as a Joint Powers Authority between the City of Stockton, San Joaquin County and the San Joaquin County Flood Control and Water Conservation District for the purpose of addressing flood protection for the City of Stockton and surrounding County area.

SJAFCA's first endeavor was to prevent the possible de-accreditation of levees and to improve project levees to meet FEMA standards. As a result, SJAFCA constructed the Flood Protection Restoration Project (FPRP) which consisted of flood wall and levee improvements along 40 miles of existing channel levees, 12 miles of new levees, modifications to 24 bridges and the addition of two major detention basins and pumps.

Construction of the FPRP was completed in 1998. SJAFCA formed an assessment district to finance the \$70 million project. In addition, SJAFCA established an annual Operations and Maintenance assessment for the upkeep of FPRP improvements. Maintenance of these FPRP levees and improvements are carried out by the San Joaquin County Flood Control and Water Conservation District.

In 1998, SJAFCA received a reimbursement of \$12.6 million from the State of California for a portion of the non-federal cost of the project. Subsequently, USACE determined per Section 211 of the Water Resources Development Act of 1996 that \$33.5 million federal reimbursement was due to SJAFCA. An Agreement for Reimbursement between the two agencies was signed in 2002 to allow USACE to initiate reimbursements, subject to the availability of annual appropriations and other limitations set forth in the agreement. To date, SJAFCA has received \$22.9 million in federal reimbursements. These State and federal reimbursements resulted in cash refunds and assessment reductions to property owners within the assessment district, and the remaining was placed in reserve.

Due to federal budget constraints, SJAFCA is now looking into the implementation of Section 1022 Credit In Lieu of Reimbursement for the remaining \$10.6 million federal reimbursement. These credits may be applied to other flood damage reduction projects or studies in which SJAFCA is currently engaged.

Delta Levee Maintenance Subventions Program

The Delta Levee Maintenance Subvention Program is a State cost sharing program meant to provide technical and financial assistance to LMAs in the Sacramento – San Joaquin Delta. Authorized by the California Water Code Sections 12980 et seq., and managed by DWR, this program is designed to reimburse local agencies for eligible costs. Eligible costs include

maintenance and rehabilitation costs, as well as costs associated with disaster. In order to do this, the Central Valley Flood Protection Board reviews and approves DWR's recommendations and enters into reimbursement agreements with the local agencies. Nearly all LMAs in the Delta South Region participate in the State's Delta Subventions Program.

To qualify for assistance under the program local agencies within the Delta must submit an application to the CVFPB each fiscal year. Agencies are then eligible to receive up to 75% reimbursement of eligible costs incurred in excess of \$1,000 per mile for all of its levees. A levee maintenance and inspection report for these levees is required before reimbursement may take place.

Delta Levees Special Flood Control Projects Program

The Delta Levee Special Flood Control Projects Program, managed by DWR's FESSRO, was initiated in 1988 to address flood problems on islands of special State interest. It is detailed in CWC §12310 through §12318. Until FY 2007-08, the funding for Special Projects was focused on the legislated scope of levee work on eight western Delta islands (all outside the Regions) and the towns of Thornton and Walnut Grove though authorization has been available since 1996 to extend Special Projects funding to other Delta islands and to 12 miles of Suisun Marsh levees bordering northern Suisun Bay from Van Sickle Island west to Montezuma Slough. With the availability of bond funding from Propositions 84 and 1E of 2006, that broader scope is being implemented. Any local public agency that manages eligible project or non-project levees in the Primary Zone or non-project levees in the Secondary Zone is eligible to apply for Special Project funding. Special Project grant applications are received in response to Project Solicitation Packages (PSP), released in accordance with the "*Delta Levees Special Flood Control Projects Final Near-Term Guidelines for Providing Funding to Local Public Agencies*," periodically offered by DWR to accomplish specific objectives of the department as discussed in the "Framework for DWR investments in Delta Integrated Flood Management."

Ongoing Flood System Improvements

The Regions have a reputation of working on flood system improvements on an almost continuous basis. Rather than waiting years or decades to implement the large and complex projects, LMAs are constructing improvement projects almost every year. Most of the improvements involve routine work such as placing erosion protection, constructing seepage cutoff projects, and making incremental improvements to levee geometry.

2.8. The Regional Flood Management System

The flood management system consists of structural elements like levees and pump stations and non-structural elements like emergency response and operation and maintenance.

2.8.1. *Structural Elements*

The flood management system which currently provides protection to the Lower San Joaquin River Region and Delta South Region includes reservoirs with active flood control space (upstream of the RFMP boundary), levees along the major flood control channels, and drainage facilities which pump interior runoff and seepage from levee protected areas back into the flood control channels.

SPFC levees exist along portions of: Bear Creek, the Calaveras River, Mosher Slough, Mormon Slough, and the Stockton Diverting Canal, Littlejohn Creek, French Camp Slough, Paradise Cut, and the lower San Joaquin River downstream of Vernalis. The Regions also have a bypass facility known as Paradise Cut. Paradise Cut consists of a weir and leveed channel that spills water out of the San Joaquin River and into the Grant Line Canal.

2.8.2. *Non-Structural Elements*

Non-structural flood risk management elements include a wide range of measures which limit the risk of flood damage primarily by avoiding or reducing the exposure to damaging flood waters. These elements include raising and waterproofing structures so that they will be above anticipated flood levels, limiting development in floodplains through the acquisition of agricultural conservation easements, obtaining open space easements, and providing incentive programs. Restoration of floodplains to provide additional flood channel storage and conveyance capacity is often regarded as a non-structural element because it reduces, rather than increases, the confinement of floodwaters in existing channels.

San Joaquin County's flood preparedness strategy is recognized by DWR as a preferred model for meeting the "local tactical flood plans" step identified in their grant guidance. O&M activities for specified segments of levee systems are typically performed by the LMAs, the Reclamation Districts and the San Joaquin County Flood Control and Water Conservation District.

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3. Assessment of Flood Hazards, Challenges, and Risks

The flood management facilities in the Lower San Joaquin River and Delta South regions consist of many inter-related elements which collectively work together to reduce the risk of flooding. Some elements – such as the levees – have been constructed and improved over the past 150 years. Other features such as reservoirs outside the Regions, floodplain regulations, flood insurance, and environmental regulations have been added over time. Although the regional flood management system was initially constructed in piecemeal fashion with local resources, the system is now highly regulated, funded from multiple sources, and involves the participation of many agencies.

This chapter presents a brief background on the sources and types of flooding in the Regions, and then summarizes known system deficiencies identified in previous and on-going studies. Non-structural challenges associated with regulatory permitting, funding, operations and maintenance, encroachments, etc. are also presented. Site-specific problems can be found in Appendix C, generally organized for each LMA and city (including the unincorporated areas of San Joaquin County) within the Regions.

With deficiencies established, improvement projects and programs can be selected and prioritized later in the planning process.

3.1. Floods in the Regions

While it is acknowledged that small, controlled flood events on natural landscapes may be beneficial to ecosystems in the Regions, flooding in urban and agricultural areas poses a significant threat to life-safety and the regional economy. Significant flood events can also have a national impact resulting from crop damages, and the need for federal aid.

Flood impacts vary greatly with the intensity and duration of a rainfall event, environmental conditions (i.e. rainfall only, rain-on-snow, etc.), distance of the storm from the Regions, tides, and performance of flood management systems. These conditions result in floods that differ in available warning time, duration, depth, and losses.

3.1.1. *Flood Types and Sources*

The numerous waterways in the Regions that provide recreational opportunities, convey water in the Delta, facilitate transportation of goods, and provide habitat are also the primary sources of flooding. Additionally, tides have a significant influence on flooding for areas generally west of the San Joaquin River.

The primary tributaries to the lower San Joaquin River include: Bear Creek, Calaveras River, Mormon Slough, Mosher Slough, Stockton Diverting Canal, and French Camp Slough. Nearly all of these tributaries have at least one State Plan of Flood Control (SPFC) levee system protecting existing development. Some of the prominent waterways in the Delta South include: Paradise Cut, Old River, Middle River, Burns Cutoff, Turner Cut, Whiskey Slough, Trapper Slough, Victoria Canal, and Grant Line Canal. These waterways are predominantly bordered by locally maintained, non-SPFC facilities.

Flooding in the Regions can come from three main sources as generalized in Figure 5:

- San Joaquin River – can be of long duration (months)
 - Prolonged snow melt
 - Rain-on-snow events
 - Prolonged duration atmospheric river rainfall events
- Local Creek Flooding – generally shorter duration (days to week)
 - Very intense, short duration “cloudburst” rainfall events
 - Prolonged duration atmospheric river rainfall events
- High Tides – generally short duration (hours)
 - High tides – generally cyclical over a few days and complicated by winds

These sources of flooding do not affect all areas of the Regions to the same degree. Each of these floods have different frequencies, risks, impacts, and require different risk mitigation strategies. Any of these events can result in flooding from the failure of flood management facilities.

In addition, most LMAs also have to deal with flooding due to local interior drainage problems (under sized conveyance facilities, inadequate pumping capacity, sedimentation of channels, etc.). Storm drainage generally needs to be pumped out of the areas protected by levees.

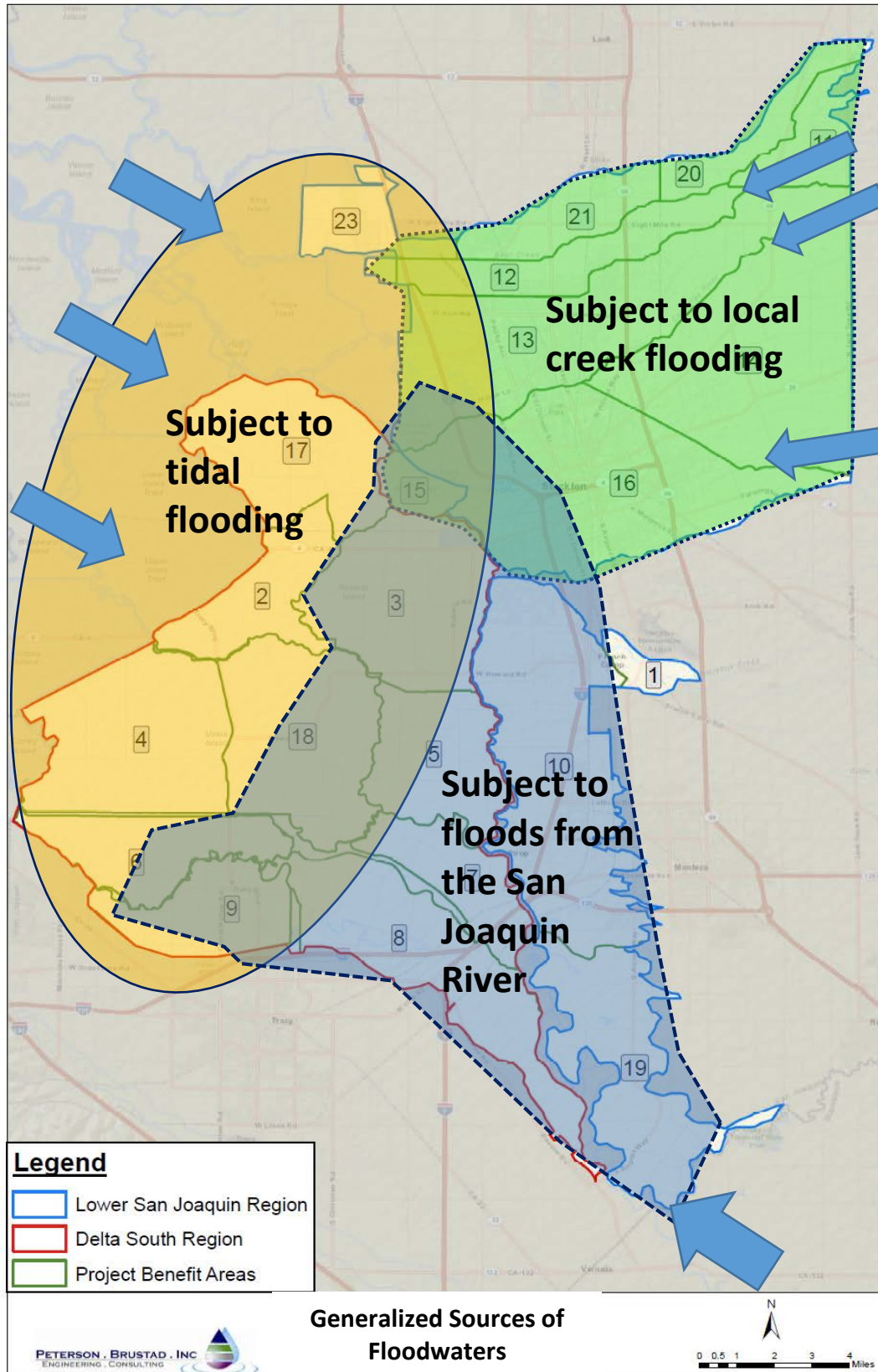


Figure 5 – Generalized Sources of Floodwaters

The design capacities of the channels can be found in the Table 3-2 of the *State Plan of Flood Control Descriptive Document* (DWR, 2010). The references for the design capacities are the Unit-Specific Operation and Maintenance Manuals prepared by the USACE when the unit was completed. However, these design capacities are unreliable for current conditions due to levee improvements and other system changes over the last many decades. Also, the design capacities were originally determined for flows significantly smaller than the 200-year flows in Figure 6.

Table B-2 of the *Flood Control System Status Report* (DWR, 2011) shows estimates of current capacities of channels. DWR compiled this information from many available sources, including judgments of DWR hydrologists. The estimated capacities do not differentiate between left and right banks. Since the original construction, some levees have been raised and otherwise improved. In some cases, there is a levee superiority condition where levees on one side of the channel are higher than the levees on the other side. For example, the levees are higher along RD 17 on the right bank (looking downstream) of the San Joaquin River compared to those on the left bank. Another example is where the left levee on the Stockton Diverting Canal is higher than the right levee.

While a large variety of studies have estimated flood flows, the best available hydrologic and hydraulic information comes from recent studies for levee accreditations and for design of the RD 17 levees. This information is included in the following figures and tables:

- Figure 6 shows the locations of estimated 200-year peak storm flows for Bear Creek, Calaveras River, Paradise Cut, and San Joaquin River.
- Table 5 shows the estimated 100-year and 200-year flows at several key points.
- Table 6 shows the Delta stage-frequency relationship for the 50-, 100-, and 200-year events.

Appendix B includes plots of flow profiles with respect to the tops of levees for urban areas. These are for flow capacity only, without consideration of other levee problems. In addition, the plots show profiles for three feet above the water profile as the minimum freeboard requirement. These “freeboard profiles” allow a quick visual check of where the levees provide adequate freeboard. Figure 7 shows one of these plots for the right levee of the San Joaquin River along RD 17. Appendix B also includes plots of freeboard for the Bear Creek, the Lower Calaveras, and the Upper Calaveras systems.

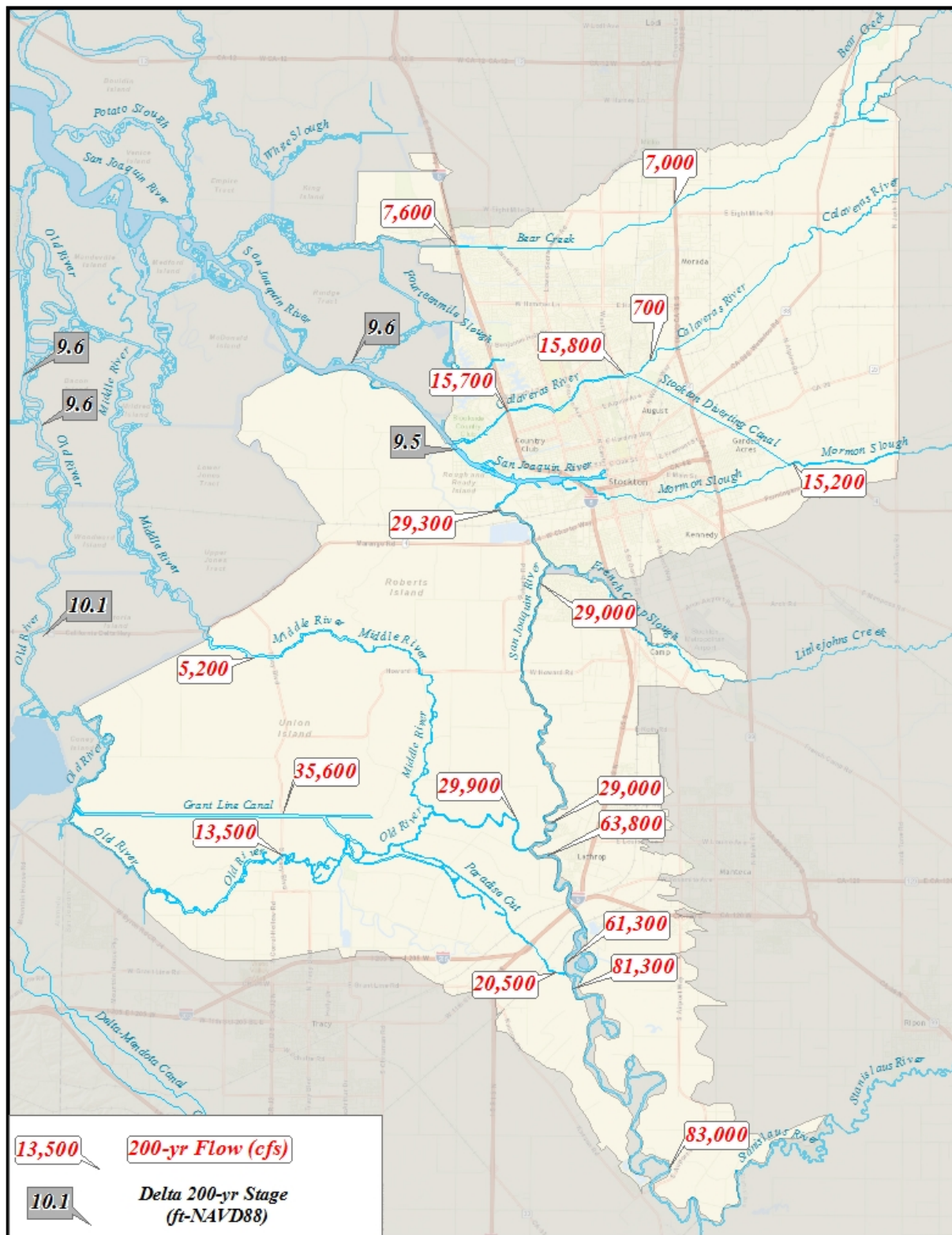


Figure 6 –Estimated 200-yr Flows at Key Locations

Table 5 – Estimated 100-year and 200-year Flows at Key Locations

SAN JOAQUIN RIVER FLOWS [cfs]		
Location	100-year	200-year
at Vernalis (in-channel flow only)	78,209	83,016 ¹
just u/s of Paradise Cut	68,106	81,305
just d/s of Paradise Cut	43,049	61,330
at Mossdale RR Crossing	42,796	63,772
just u/s of Old River	42,792	63,757
just d/s of Old River	13,879	29,024
at Westin Ranch (just u/s of French Camp Slough)	13,870	29,006
just u/s of Burns Cutoff	15,912	29,302
just u/s of Stockton Ship Channel	14,214	27,462

¹ Note: This is the in-channel flow at Vernalis. For the 200yr event, there is also a CVHS hydrograph for right overbank flow at Vernalis with a 35,850 cfs peak flow. This overbank water ponds up behind the RD17 dryland levee and eventually re-enters the San Joaquin River system at Walthall Slough.

CALAVERAS RIVER SYSTEM FLOWS [cfs]		
Location	100-year	200-year
Mormon Slough at Bellota	12,500	12,500
Mormon Slough at Diverting Canal Entrance	14,813	15,187
Upper Calaveras River just u/s of Diverting Canal	630	692
Calaveras River just d/s of Diverting Canal	15,359	15,750
Calaveras River at Interstate-5	15,346	15,736
Calaveras River just u/s of SJR	15,370	15,721

BEAR CREEK FLOWS [cfs]		
Location	100-year	200-year
at Highway 99	6,700	6,987
just u/s of Pixley Slough	6,880	7,189
just d/s of Pixley Slough	7,240	7,600
at Interstate-5	7,400	7,637

Table 6 – Delta Stage-Frequency

Delta Stage-Frequency [ft-NAVD88]			
Location	50yr	100yr	200yr
Rindge Pump Gage Station	9.3	9.4	9.6
Burns Cutoff Gage Station	9.3	9.4	9.5
Rock Slough Gage Station	9.4	9.5	9.6
Bacon Island Gage Station	9.4	9.5	9.6
Byron Gage Station	9.7	9.9	10.1

The Delta stage-frequency relationship in Table 6 is the most recent estimate from studies by Peterson Brustad Inc. If Delta stage-frequency relationships are needed at other locations, refer to the USACE Sacramento District report, Sacramento-San Joaquin Delta Special Study (USACE, 1992).

3.2. Overview of Exposure to Flood Risk

In order to illustrate the level of risk of flooding in the Regions, the FEMA Floodzones are presented in Figure 8. It shows the urban areas of Stockton, Lathrop and Manteca are within levee-protected areas (Shaded Zone X), and a portion of Lathrop is within the 100-year flood plain. Furthermore, nearly the entire Delta South Region is within the 100-year floodplain and nearly the entire Lower San Joaquin River Region is within the 500-year flood plain. This highlights the critical importance of the flood management facilities in the Region.

Additionally, 200-year flood depth information prepared by DWR in August 2013 for the local agencies is shown on Figure 9. Urban and urbanizing areas shown in the figure with depths of flooding greater than 3 feet may be subject to Senate Bill 5 and may need to make adequate progress toward completing flood control projects in order to permit new development after July 2016. These areas may not only be at risk for flooding; their economies may be at risk if new development is halted in 2016, further impacting their ability to pay for flood system improvements. Although not shown on the figure, most of the Delta South Region would experience flooding greater than 3 feet.

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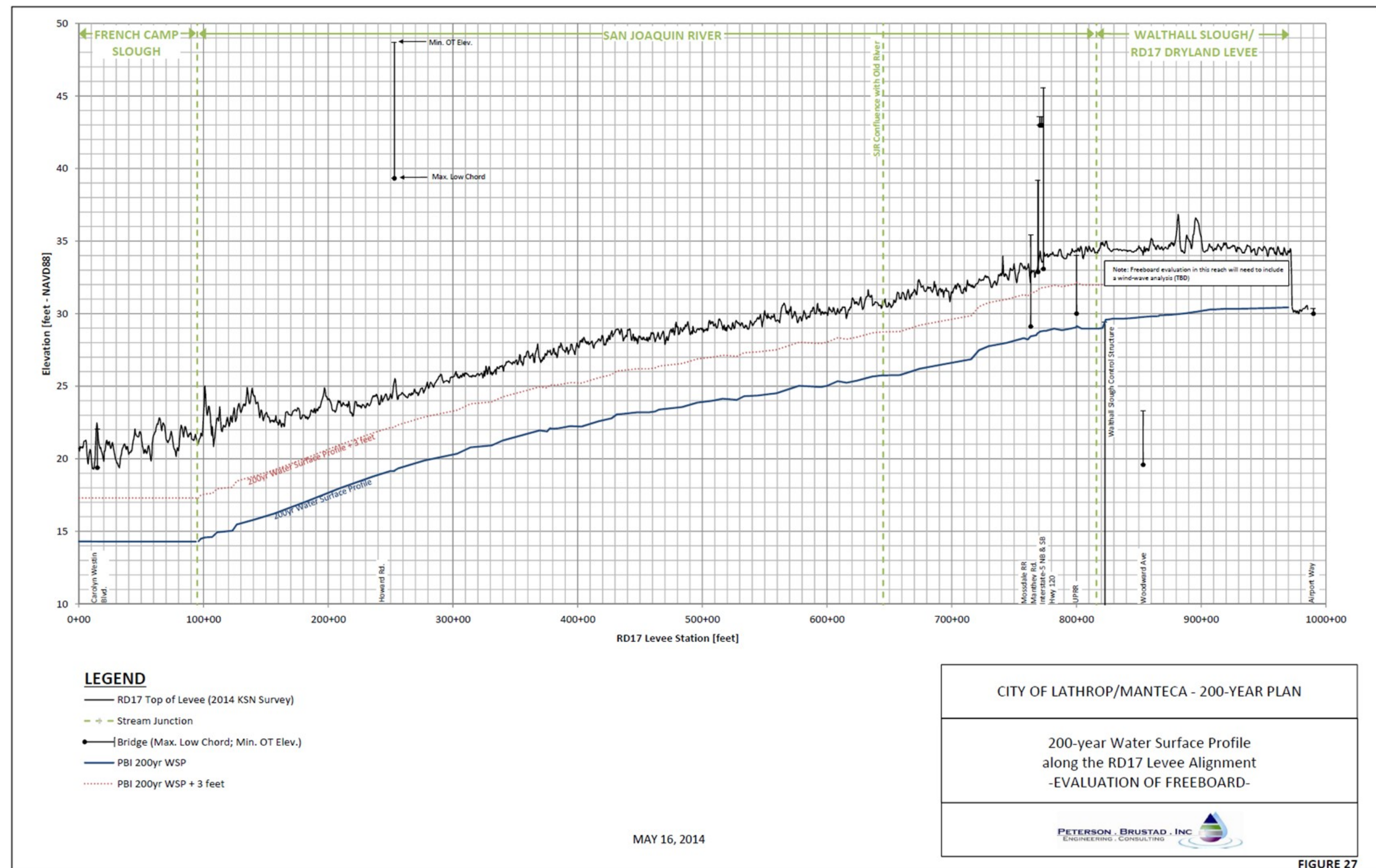


Figure 7 - RD 17 Freeboard Profile

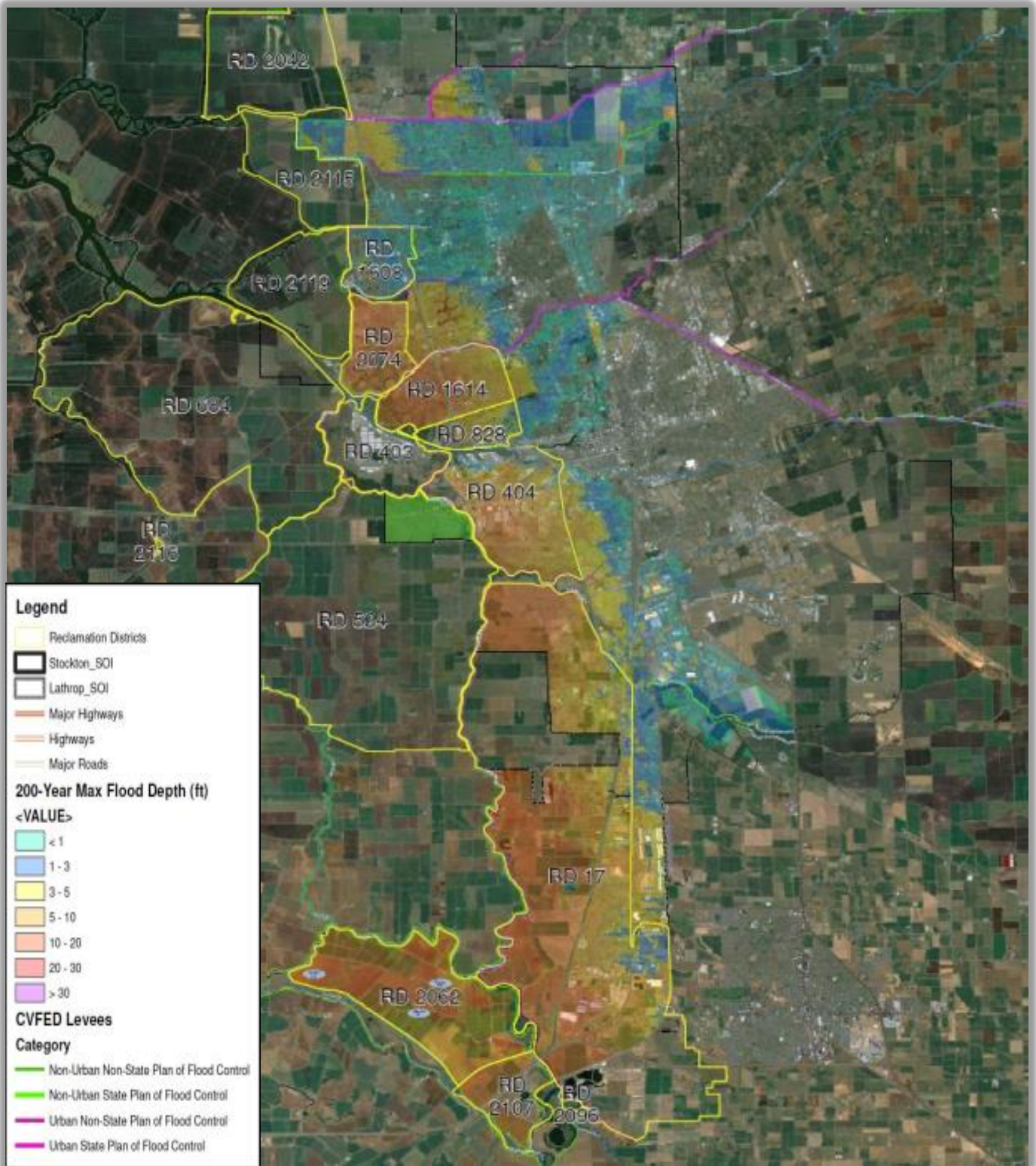


Figure 9 – Estimated 200-year Inundation Depths for Urban Areas

3.3. Overview of Hazards and Challenges

Discussions with stakeholders have revealed that flood management system problems are primarily associated with either structural system deficiencies, changing hydrology, SB5 compliance, O&M challenges associated with regulatory permitting, funding and staffing, and maintenance of appropriate emergency response capability. Many of these challenges are interrelated. These challenges are discussed below in general, then in specific detail for each of the local agencies and local maintaining agencies in Appendix C.

Hazards associated with structural system deficiencies are due to a myriad of factors including:

- Original design/construction deficiencies
- Floodway capacity
- Seepage
- Geometry (including slope instability)
- Erosion/deterioration
- Levee penetrations
- Encroachments
- Vegetation
- Animal damage
- Sedimentation
- Deferred operation & maintenance
- Land use practices.

These hazards can increase the risk of levee failure during a flood event. Additionally, these hazards can result in levee de-accreditation and jeopardize eligibility in the Public Law 84-99 (PL 84-99) program.

Changing hydrology in the Central Valley has altered the flood flows over the past several decades and threatens greater changes in the future. Many of the initial levee improvements in the Regions were designed to what is known as the 1955 profile (available at <http://www.cvpfb.ca.gov/profiles/index.cfm>). Later improvements have been based on updated hydrologic information developed in the late 1990's. More recently, USACE developed new hydrology as part of their work for the 2002 Comprehensive Study. Finally, DWR is developing another updated hydrologic model as part of the Central Valley Hydrology Study (CVHS) which may be used, when completed, by local agencies to design upgrades to meet ULDC criteria. Updated hydrological models and corresponding design water surface elevations play a role in levees being found "deficient" if freeboard and seepage exit gradient criteria are not met with the latest updated flood profile. Some of the best available current hydrology (see Section 3.1) comes from local studies.

Some of the structural system problems faced by the Regions are due in part to O&M challenges. O&M activities generally include vegetation management, rodent control, and erosion repair.

However, complicated and conflicting regulatory processes and limited allowable maintenance periods make performing routing maintenance nearly impossible. For example, some RDs are prevented from using mechanical means to perform vegetation management and instead have to use goats to remove vegetation due to endangered species concerns. Additionally, permits to place rock on the waterside of a levee are difficult to obtain due to riparian habitat issues. The result is often levees which fail to meet vegetation criteria established by USACE, are rated as Unacceptable in periodic inspections, and ultimately could be ineligible for disaster assistance under the PL 84-99 program due to these deficiencies.

It is important to note that the PL 84-99 program only restores the levee back to the pre-disaster condition. Since project levees are under a federal program (PL 84-99), FEMA will not participate in levee reconstruction after a failure but will participate in emergency response. To further exacerbate the situation, if project levees are deemed ineligible for PL 84-99, FEMA will still not participate in levee reconstruction. Since many project levees are currently ineligible for PL 84-99 rehabilitation and ineligible for FEMA, there is a potential disaster assistance liability for levee reconstruction. Some RD representatives have stated that it may not be worth their effort to seek PL 84-99 eligibility due to the difficulty in achieving eligibility and the ever-changing requirements.

Limited funding and staffing can impact the ability of local agencies to perform maintenance or fund the design and construction of necessary flood control system improvements. The most common source of funding for flood control system maintenance and improvement is from assessments paid by property owners in areas protected by flood control facilities. These assessments typically only cover annual O&M costs, which cannot be used for capital improvements. Additional special assessments need to be approved for large-scale levee improvements.

Assessments can be difficult to obtain via a Proposition 218 election. Even assessments for improvements that propose to remove areas from the FEMA 100-year floodplain (and thus will also remove the requirement for property owners to purchase flood insurance) are difficult to achieve. Many areas in the Regions may need to further upgrade flood management facilities in the future to provide a 200-year level of protection. A Proposition 218 election may be difficult or impossible to pass for these improvements, particularly for areas that are currently out of the FEMA 100-year floodplain since there is little or no financial incentive for property owners to further assess themselves.

To help local agencies fund capital improvements, the State has made grant programs available. However, limited staff resources often make it difficult for local agencies to identify, apply for, and manage these often complex and administratively challenging grants. Additionally, some grant funds come with very stringent and specific requirements, which often makes funding multi-benefit projects difficult due to the burdensome accounting necessary to comply with these grant programs.

It is often challenging to implement appropriate emergency response capability. Identified challenges in maintaining an optimal flood response capability include: standardization of flood safety plan formats & content, recognition of additional physical opportunities for responding to floods and reducing damage, and development of effective flood emergency response improvements.

3.4. Site-Specific Structural Hazards and Challenges

Due to the many LMAs, specific information on structural hazards and challenges is contained in Appendix C. Most information in on site-specific problems that the RD engineers have identified as important based on their experience with their levees.

In most cases, a site-specific hazard requires a specific site-specific, in-place fix of a facility. A failure of a levee on an RD would generally flood only that RD. With each RD constituting a separate damage area, the RD engineers are very aware of the condition of their levees and what improvements are needed. In general, broader “system” improvements would have little impact on the reliability of an RD’s levees. Therefore, “fix-in-place” becomes the general rule in dealing with most of these site-specific problems, especially since it is often the most cost-effective solution. For example, if an eroded levee is the problem, then a slight flood stage reduction from transitory storage provides little benefit.

The following section provides a summary of the types of site-specific structural hazards that the LMAs face.

3.4.1. Types of Site-Specific Structural Deficiencies

Structural hazards are deficiencies with physical flood management facilities (i.e. levees, pumps stations, weirs, etc.). The most common physical flood management facilities in the Regions are levees. The types of structural deficiencies for these levees are briefly described below:

- **Levee Geometry.** Levee geometry standards have been developed to provide adequate freeboard above the design water surface elevation, promote levee stability, and facilitate access and O&M activities. There are varying levee geometry criteria developed by both State and federal agencies for urban and rural levees. These criteria are presented in Table 7.



Table 7 – Overview of Geometry Standards

	California Urban Levee Design Criteria (ULDC)	FEMA Accreditation	USACE PL 84-99	FEMA Hazard Mitigation Plan (HMP)
100-yr Freeboard	3’*	3’	1.5’	1’
Waterside Slope (H:V)	3:1	3:1	2:1	1.5:1
Landside Slope (H:V)	2 or 3:1	2:1	Varies with height of levee & depth of peat (3H:1V to 5H:1V)	2:1
Crown Width	12’ (Minor) 20’ (Major)	12’ (Minor) 20’ (Major)**	16’	16’

*Note ULDC Freeboard is above the 200-year water surface elevation

**According to stakeholders, some levees may be accredited with less than 20’ of crown width

- **Through and under-seepage.** Seepage problems for levee systems are classified as either under-seepage or through-seepage. Under-seepage occurs when water flows in a permeable foundation underneath the levee while through-seepage occurs when water moves from a waterway through a levee. In some cases levee or foundation material will move with the water and cause a levee failure. Levee seepage is often a result of poor foundation materials like pervious sand. A number of other factors may increase the potential for seepage, including the presence of erodible fill, rodent burrows, or other penetrations.
- **Structural Instability.** Structural instability is characterized by slides, cracking, slope depressions, or bulges that could pose a threat to levee integrity. Causes for structural instability include soft foundational soil and poor levee design.
- **Erosion.** Levee erosion can be attributed to either rainfall on the levee or erosive river forces, causing the top of the levee to round and the base of the levee to narrow. Levee erosion problems contribute to levee geometry deficiencies.
- **Encroachments.** Encroachments are defined as a structure on the levee or near the landside levee toe (distance varies by regulation/criteria used). Encroachments can cause stability issues with levees, and are therefore a key component of levee evaluation criteria. Encroachments also limit access for flood fighting and maintenance.
- **Penetrations.** Penetrations generally consist of utility conduits or transportation (i.e. road or railroad) through the embankment or foundation of the levee. Seepage along penetrations has the potential to produce levee breaching.
- **Animal/Rodent Burrows.** Animal and rodent burrows within a levee can pose a serious threat to levee integrity. These burrows can provide additional seepage paths through a levee, which can cause failure of a levee during a flood event. In most cases,

animal/rodent control is treated as an ongoing O&M activity, and not identified as projects in Appendix C.

- **Vegetation.** Maintenance and/or removal of vegetation along the levee is aimed to improve public safety, visibility, and accessibility while preserving the habitat. However, LMAs struggle to comply with differing vegetation criteria as outlined by DWR and USACE. These differing criteria can often result in LMAs receiving acceptable ratings on DWRs O&M inspections, but unacceptable ratings on USACE inspections. A brief summary of the different vegetation standards is provided below.

The USACE’s vegetation policy is outlined in an Engineering Technical Letter (ETL) titled “Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures.” According to the ETL, a vegetation-free zone must be maintained along all levees. The vegetation-free zone is defined as a three-dimensional corridor surrounding all levees, floodwalls, embankment dams, and critical appurtenant structures in all flood damage reduction systems. The ETL requires removal of all vegetation (except grass) on existing levees, plus vegetation within 15-feet of the landside levee toe. Tree canopy’s extending into this zone must be trimmed 8-feet above the ground. However, based on a revised interim policy (USACE, 2014), the USACE will no longer require agencies to remove trees and other vegetation from levees to qualify for disaster relief funding under PL 84-99.

By contrast, DWR’s vegetation policy incorporates a Life Cycle Management (LCM) approach for “legacy” vegetation. This policy is aimed at limiting the financial costs associated with extensive vegetation removal and potentially significant loss of habitat along levees. Under DWRs vegetation management strategy, levees containing legacy trees along the landside or waterside slopes will be managed to allow vegetation and trees to live out their normal life cycles except where they pose a threat. This policy provides for gradually progressing (over several decades) toward the current USACE policy of “eliminating woody vegetation from the Vegetation Management Zone.” The LCM approach protects riparian habitat as long as the vegetation does not impair visibility and accessibility. The levee crown must be kept free of all vegetation since it serves as a patrol road for levee maintenance and flood fighting.

DWRs policy also permits trees on the waterside slope that are farther than 20’ from the crest due to engineering benefits including erosion protection, soil reinforcement, and sediment recruitment, provided visibility requirements are met, and the vegetation does not pose a threat to the integrity of the levee.

3.4.2. ULE and NULE Evaluation Criteria

Some of the LMAs described in Appendix C have been evaluated by DWR’s Urban Levee Evaluation (ULE) and Non-Urban Levee Evaluation (NULE). ULE and NULE evaluations cover only SPFC levees and other closely associated non-project levees, not all non-project levees. Based on analysis, each ULE levee segment is assigned a hazard classification for each of several potential failure modes. The ULE performance criteria rate each levee segment with

respect to how well the levee meets or doesn't meet current urban levee design criteria. The NULE performance criteria rate the likelihood of either levee failure or the need to flood-fight to prevent levee failure. Section 1 of Appendix C shows the various performance rating for the two programs.

3.4.3. *DWR Levee Inspection Report*

Some LMAs are also reviewed annually as part of DWR's Inspection and Local Maintaining Agency Report (DWR 2013). Each annual report contains information on project levee maintenance of the State-federal Flood Control System. Appendix C shows ratings by LMA. However, DWR does not inspect levees for all LMAs in the Regions.

3.5. Non-Structural System Challenges

Physical flood risk management facilities are complimented with non-structural flood risk management programs and systems. Non-structural flood risk management systems include emergency response, flood warning systems, land use policies and regulations, and operation & maintenance (including funding, staffing, and regulatory challenges). While the structural hazards identified in the previous section are typically specific to each city or RD, the emergency response, O&M, and ecosystem challenges are representative throughout both Regions and are typical throughout the Central Valley.

3.5.1. *Emergency Response Deficiencies*

This section provides an overview of the flood response system and the challenges faced by emergency responders in the Regions.

The response to floods has a unique characteristic that makes multi-agency coordination more complex than other types of disaster response. This difference arises from the historic reliance on special-purpose districts (Reclamation Districts) to maintain flood control levees. This additional jurisdictional layer to local government was put in place in the 19th Century primarily to facilitate reclamation activities by multiple landowners in distinct overflow areas.

The separation of the traditional county and city local governments from responsibility of the levees adds complexity to flood emergency response by creating two separate and distinct components to an emergency response. These components are levee flood fight operations and general public safety operations. Recognition of this dichotomy in response jurisdiction is important to any evaluation of the overall response system since each component is performed by a different group of jurisdictions/agencies, has very different response issues and challenges, and is organized at distinctly different geographical scales.

There are no specific emergency response deficiencies that are unique to the Regions from other areas in the Central Valley. There is always a need to improve emergency response in all areas. San Joaquin County is already in the process of improving all aspects of emergency response. For example, a key objective of the developing flood contingency maps was to improve levee flood fight operations conducted by LMAs. Experience had shown that LMAs either had not

committed their knowledge and procedures to paper, or they had their own plans in differing formats and content. Much historical information such as locations of past boils was not being documented and the knowledge base of the experienced individuals that each district tended to rely upon to organize their efforts remained verbal. While LMAs could organize their levee patrols and basic levee problem remediation efforts adequately, there was a lack of formal procedures for ensuring proper coordination with outside agencies and neighboring districts during a flood.

Flood contingency maps also include locations of pre-engineered relief cuts where appropriate. An intentional breach (relief cut) of a levee is often needed to help drain a flooded island. Historically, LMAs had some ideas of relief cuts and other steps which could address flooding concerns, but never had a formal written plan. DWR had also not thought about these issues in a specific way since this was thought to be the LMAs responsibility. When levees ultimately did break, many officials had differing opinions over what to do, despite the fact that these relatively straight-forward engineering issues could have been discussed before the flood.

See Appendix A for the current status of emergency response and Section 6.1 for a summary of key elements that are a part of enhanced emergency response.

3.5.2. O&M Challenges (*Funding, Staffing, Regulatory*)

Operations and maintenance (O&M) deficiencies can lead to structural deficiencies. LMAs face the constant need to address maintenance issues such as burrowing animals, levee erosion, vegetation, encroachments, levee penetrations, vandalism, sedimentation, structure deterioration, and other physical and administrative issues. Issues addressed in one year often resurface in following years. Deferral of maintenance generally compounds the needed work since small problems tend to become larger problems over time. Funding limitations, staffing shortages, and delays due to permitting are the primary reasons for deferred maintenance. Obtaining necessary regulatory permits can be time consuming, expensive, and in some cases are nearly impossible to obtain.

Unlike the Sacramento River basin where State responsibility for channel maintenance is clearly specified in the California Water Code, there is no similar condition for channels for the San Joaquin basin within the Regions. In addition, research for preparation of this RFMP could find no defined maintenance responsibility for some facilities such as the Paradise Cut weir (called Paradise Dam in the USACE operation and maintenance manuals for the adjoining levees. SJAFCA has contacted the CVFPB to request available information on Paradise Cut weir/channel maintenance responsibilities. SJAFCA also requested information on land rights held by the Sacramento-San Joaquin Drainage District for the weir/channel.

Some of the LMAs have relatively small or no assessments compared to the length of levee-miles they are responsible for maintaining. The assessments typically cover routine maintenance

activities associated with rock placement, vegetation management, and rodent control. The Delta Maintenance Subventions Program helps RDs with maintenance activities, although applications to stay in the program are required on an annual basis, which taxes available staff resources.

Maintenance of levees for many of the RDs in the Delta South Region is performed by landowners. In most cases, this means levee maintenance is performed by the farmers who work their land on a daily basis.

Additionally, even with adequate funding and staffing, O&M activities are often blocked by some regulations. While generally exempt from CEQA and NEPA, maintenance activities often trigger permitting requirements with State and federal agencies, such as the US Fish and Wildlife Service and California Department of Fish and Wildlife. Many Districts in the Regions have the potential for the presence of special status species such as the riparian brush rabbit, giant garter snake and Swainson's hawk.

The giant garter snake was listed as threatened under the federal ESA in 1993 and the riparian brush rabbit was listed as endangered in 2000. Consequently, extensive modifications to maintenance practices have been required. Much of the vegetation that was routinely controlled in the past can no longer be controlled due to habitat concerns. Since unauthorized take of these species is not allowed, LMAs should consult with the USFWS under Section 7 or 10 of ESA as appropriate.

The Inspection and Local Maintaining Agency Report of the Central Valley State-federal Flood Protection System (DWR, 2013) notes that an increase in deficiencies "may be attributed to ongoing environmental and financial challenges." The report further states that "restriction on burning as a method of vegetation control also hampered some districts efforts." Vegetation deficiencies make up the majority of deficient levee miles for 2013.

See the California Central Valley Flood Control Association's Rural LMA Work Group topic papers in Appendix D for more discussion on many O&M issues.

3.5.3. *Floodplain Risk Management*

As in much of the Central Valley, agencies planning flood risk reduction have little connection to those having authority with land use decisions. Flood risk planning agencies often have no review capacity for new development. More work is needed for defining flood risks (mapping), raising and waterproofing structures and building berms, obtaining easements on compatible land use types (such as agriculture), flood contingency mapping and others.

Although agricultural use is consistent with floodplain management principles, current floodplain regulations impose restrictions and financial burdens that are making such use increasingly difficult to sustain over time. Specifically, in order to meet the regulatory requirements of investment in agriculture in special flood hazard areas (SFHAs), structures must be wet flood proofed, dry flood proofed, or elevated. These requirements are infeasible or cost

prohibitive, especially in areas protected by levees with flood elevations in excess of 10-feet deep. In addition, all federally backed mortgages for properties in SFHAs require federally mandated flood insurance. A recent Government Accounting Office report, *Additional Guidance on Building Requirements to Mitigate Agricultural Structures' Damage in High-Risk Areas Is Needed* (GAO, 2014), concluded that "...FEMA is missing an opportunity to help farmers who face challenges in effectively complying with its building requirements ..."

3.5.4. Ecological Flood Management Challenges

Historic habitat loss and the presence of several threatened and endangered species, although not solely the result of historic and present flood management activities, create a major challenge for flood managers attempting to manage or improve flood control infrastructure (channels, levees, diversion and grade control structures, detention basins, and dams). At the same time, the limited amounts of current floodplain and bank edge woody habitat, especially along the lower San Joaquin River, is a major constraint for a healthy ecosystem. State and federal laws and policies prohibit unauthorized destruction of endangered species habitat and are aimed to protect endangered species and their habitat. Flood system improvements that impact endangered species may be precluded by State and federal law or require expensive compensation requirements. Conversely, flood system improvements that also improve habitat for endangered species may be prioritized for State and federal flood management funding and eligible for a variety of funding sources reserved for habitat restoration.

Endangered and Declining Species Challenges and Risks

In addition to special status species, there are several other species that are or have been affected by the loss of riverine, floodplain, and riparian habitat. All species may be at risk of further decline without significant habitat improvements. Moreover, loss of these species - particularly commercially important species like Chinook salmon - could have significant impacts recreation, quality of life, and the local and regional economy.

In addition, floodplain wetlands filter degraded water. Fish that rear on floodplains grow to larger sizes and are thus better able to avoid mortality associated with predation and entrainment. Flood managers face the challenge of managing flood system improvements around the needs of endangered species, but they do not have the ability to make all the changes that are necessary to recover species declines.

Habitat Enhancement Challenges

Floodplain and riparian habitat restoration requires a specific set of topographic, hydrologic, and land use conditions in order to provide substantial benefits for species. Creation of frequently inundated floodplain habitat requires the right combination of floodplain position and sufficient flows on a periodic occurrence. Additionally, habitat restoration is often incompatible with urban and certain agricultural land uses. The nature of these constraints varies substantially across the Regions.

Floodway conveyance capacity is already very limited, making it very difficult to create floodplain habitat within the existing floodway without compromising flood conveyance or creating costly levee setbacks. Levee set-backs may work in some rural areas, but are generally incompatible where urban development is in close proximity to the levees. Setback levees can increase the frequency of floodplain inundation and thus the species benefit, but existing hydrology and reservoir operations will continue to limit the frequency of inundation of new floodplain. The challenge will be finding the right locations and conditions for habitat enhancement.

Integration with Other Water Management Activities

Other State and regional planning efforts have identified floodplain restoration along the lower San Joaquin River and in the south Delta as a high priority. These efforts include the Delta Stewardship Council's Delta Plan, the Bay Delta Conservation Plan, the State Water Resources Control Board's Bay-Delta Water Quality Control Plan, and the San Joaquin Tributaries Association settlement process. These later two efforts are contemplating changing reservoir operations and stream flows to increase the frequency of floodplain restoration while the former two efforts entail setting-back levees to create floodplain habitat.

Integrating the Lower San Joaquin River/Delta South RFMP with these other efforts is a challenge for a number of reasons. None of these other efforts have the funding and final approvals necessary to implement floodplain restoration in the Regions. All of these agencies are governed by different boards with different jurisdictions, but none of these boards appears to have the authority to require both changes in flow and floodway geometry that will be necessary to restore frequently inundated floodplain. Given these gaps and uncertainties, it is extremely difficult for this RFMP process to base its planning effort on the stated intentions of these other efforts.

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4. Regional Solution Strategy

The regional solution strategy considers the diverse natures of the Lower San Joaquin River and Delta South regions, both physically and institutionally. The regional solution strategy specifically aims to address the identified hazards and challenges in a realistic, cost-effective manner. The Regions recognize that there isn't enough State, federal, or local funding to accomplish everything that everyone may desire.

The following regional solution strategy outlines major concepts that guided selection and prioritization of potential projects, programs, policies, and other actions presented in later chapters. It should be noted that the strategy focus on reducing flood risk, the primary goal of the CVFPP and the Regions, but opportunities for ecosystem enhancement and other benefits will always be considered in applying the strategy.

4.1. Target Flood Protection

The structure of the regional solution strategy begins with realistic targets for level of flood protection. Not all areas of the regions need, or desire, the same level of protection from the threats of flooding. The regional strategy has identified areas with the following targets:

- **200-year ULOP** – Areas that are motivated towards urban development will seek 200-year ULOP. These tend to be areas in Lathrop, Manteca, and some of the northwestern and southern portions of Stockton.
- **100-year FEMA Accreditation** – Areas that are currently highly developed with only limited infill development potential will typically seek to achieve and/or maintain 100-year level of protection. Depending on potential future legislation or other processes, the areas may seek exemptions for infill development for those areas exceeding 200-year flooding depths exceeding three feet.

The Regional Solution Strategy considers the wide diversity of the Regions

- Multiple types of flooding threats – San Joaquin River, tributaries, and Delta tides
- Population centers and adjacent rural/agricultural land
- Highly built-out areas with potential for infill development vs. areas with larger potential for new development
- Typical problems with flood management facilities (seepage, erosion, etc.)
- Deep and shallow floodplains
- Many independent jurisdictions and diverse interests
- The need for the many LMAs to continue to work to protect their individual areas of responsibility while having interest in the larger regional projects/programs
- The recognition of the interdependence of levees within the Regions
- Geographic differences in ability to pay for improvement projects
- Need to enhance both aquatic and terrestrial habitat given the importance of the regions to special status species

- **100-year FEMA Accreditation Initially/200-year ULOP in Future** – Some areas initially seek to achieve and/or maintain 100-year target level of protection if they do not contemplate major development in the near future. If conditions change in the future, they may seek 200-year ULOP if it appears to be economical. This may be as simple as performing a ULDC analysis to show that their existing levees meet the criteria or may involve more extensive improvements as determined by the ULDC analysis. These areas are typically on the western side of Stockton.
- **Delta Specific PL 84-99** –Most of the RDs in the Delta South region and some at the southern side of the Lower San Joaquin River Region seek Delta Specific PL 84-99 as their minimum levee configuration. However, many RDs seek levee geometry that exceeds the PL 84-99 Delta Standard by at least six inches, a condition of some historical DWR Special Projects funding. Some RDs may ultimately improve their levees to the Bulletin 192-82 non-urban levee configuration which is very similar to that of PL 84-99 Delta Standard, except that it uses the 300-year flood stage rather than the 100-year flood stage. Some districts have their own levee template that exceeds PL 84-99, such as using a 22-foot crest width rather than 16-feet. The regional solution strategy recognizes that there will be individual differences in target for levee configuration, but that a minimum of PL 84-99 Delta Standard is appropriate as a minimum without pointing out minor individual differences.
- **HMP Configuration** –While the HMP configuration may be used in some cases as an interim configuration before RDs seek PL 84-99 Delta Standard, it is not an acceptable configuration for long periods of time – it is an absolute minimum, and interim target. As a step towards PL 84-99 Delta Standard, justifications of benefits need not be made, as proposed in Delta Plan (DSC, 2013). Although some dryland levees in the Regions currently do not meet HMP, all exterior levees should soon meet or exceed this configuration.

PL 84-99 vs. HMP

Delta Specific PL 84-99 guidance calls for levee side slopes of 3 horizontal to 1 vertical on the landside and 2 horizontal to 1 vertical for the waterside. Depending on foundation conditions, landside slopes may be flattened to 5 horizontal to 1 vertical. The minimum crest width is 16 feet and freeboard above the 1 percent annual chance (100-year) water level is 1.5 feet.

The **Hazard Mitigation Plan (HMP)** configuration calls for a minimum crest width of 16 feet, water side levee slope of 1.5 horizontal on 1 vertical, landside slope of 2 horizontal on 1 vertical, and only 1 foot of freeboard above the water level with a 1 percent annual chance of occurrence.

Figure 10 shows these target areas of flood protection for the various RDs and other areas within the Regions.

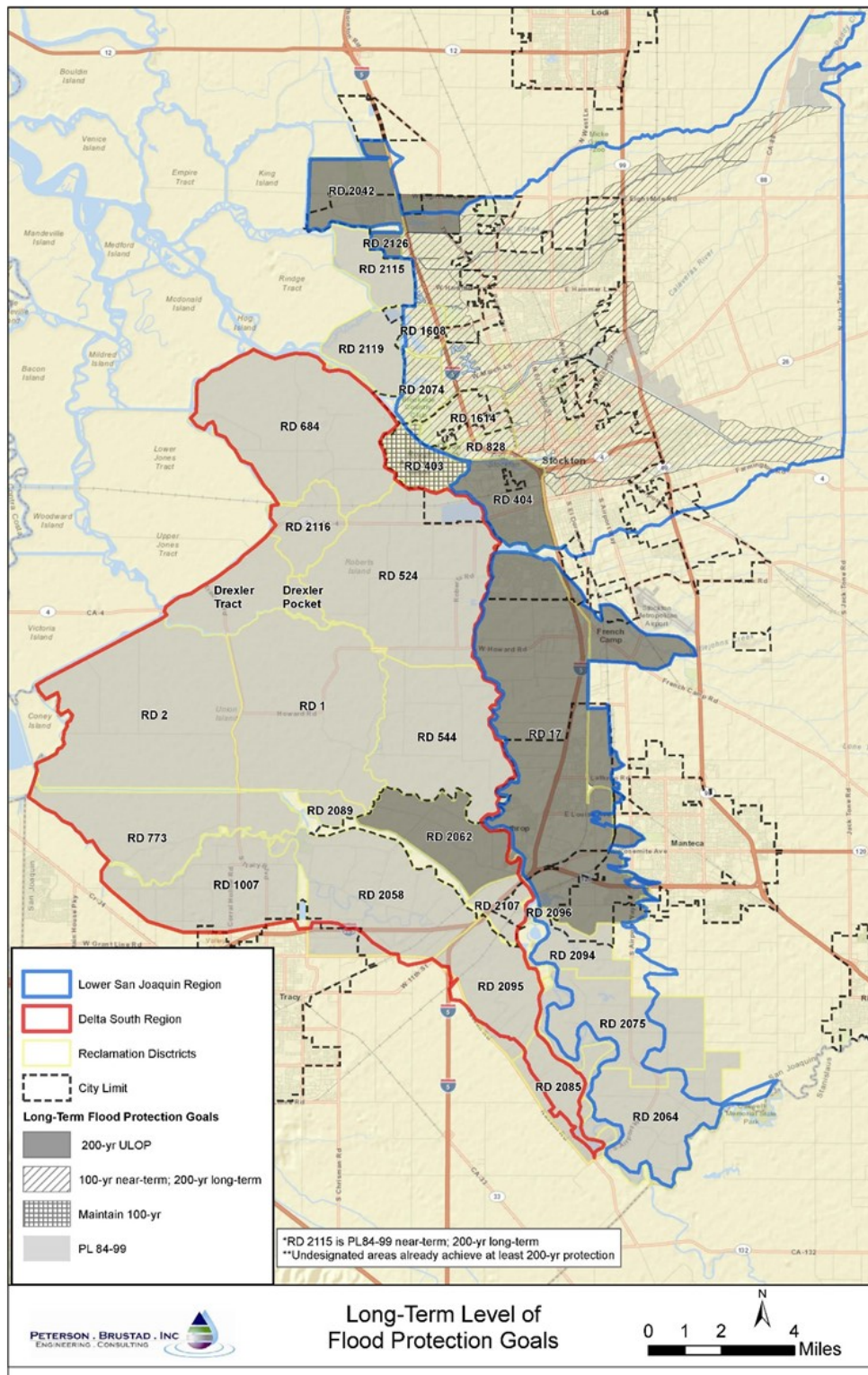


Figure 10 – Target Levels of Flood Protection

4.2. Consider a Full Range of Measures to Reduce Flood Risk

The regional solution strategy does not exclude any of the typical methods to reduce flood risk. In the big picture, these methods include improvements to fortify existing facilities, building new facilities, storage or diversion to reduce flood flows, increasing channel capacity, and limiting the consequences of flooding. More specifically, the RFMP considered a full range of opportunities in the following broad categories:

- Improve existing levees – such as changes in geometry, seepage control, emergency access, penetrations/encroachments
- Build new levees – such as new (or extend) wing levees to prevent flood waters from flowing around the ends of existing levees
- Setback levees – such as building new levees across a river meander loop
- Increase channel capacity – such as dredging, vegetation control, raising levees (part of changes in geometry above), setback levees, and structure modifications
- Storage – changes in operation of upstream reservoirs, increasing upstream reservoir storage capacity, and providing transitory storage in floodplains
- Diversion – diverting a portion of flood flows down improved corridors, such as Paradise Cut and Mormon Slough Bypass Channel, to lower flows in the main river channel – requires special consideration to downstream hydraulic impacts
- Channel closures – new structures to block water from high tides from entering areas, thereby reducing flood stage in protected areas, such as Smith Canal Gate and a closure structure at Fourteen Mile Slough
- Interior drainage – improvement of pump stations and other interior drainage facilities
- Improvement of other structures – such as bridges or other structures used for emergency access
- Zoning or easements – limiting development and the consequences of flooding
- Range of residual risk management actions – generally non-structural actions for emergency response, operation & maintenance, floodplain management, or changes in policies and procedures
- Evaluations (ULDC, SWIF, or others).

Habitat enhancements should be considered to enhance the benefit of each of these. However, some categories provide more opportunities for habitat enhancement and benefits than others.

4.3. Role of the Lower San Joaquin River Feasibility Study

The USACE's Lower San Joaquin River Feasibility Study (LSJRFS) is working towards a National Economic Development (NED) plan that will define federal interest in flood risk reduction in the Stockton Area. Although it provides valuable information on federal interest in achieving 200-year ULOP, the regional solution strategy does not see it as a "project" to be implemented in its entirety at one time. As a project, it would be extremely difficult for the local entities to provide their cost-share for a single project. On the other hand, portions or all of the NED plan may be implemented in increments over time. Therefore, the regional solution strategy is to view the completed feasibility study as a master plan to guide future investments as areas are ready to proceed to 200-year ULOP. Since the feasibility study defines federal interest, it is also a step in obtaining federal cost-share as individual projects proceed to construction.

Based on local experience with the existing levees identified for improvement in the NED plan, a level of improvement less expensive than that identified by the USACE may ultimately be possible. Local experience indicates more detailed subsurface investigation as part of a ULDC analysis may prove that the USACE was conservative in some areas in identifying levee improvements. Some areas may show levees that need lesser improvements or in some cases levees may already meet the ULDC criteria. Discovering that shorter reaches of levee need improvement would make improvements much more affordable for federal, State, and local agencies, without compromising the level of flood protection.

4.4. Mitigate Hydraulic Impacts

The regional solution strategy requires mitigation of hydraulic impacts to less than significant.

4.5. Regional Conservation Approach

Although the Regions support incorporating habitat enhancements and other multi-benefits into future flood projects where feasible, they strongly believe that the time to commit to those enhancements is during future project development planning. Committing to potential enhancements now during the RFMP is premature since the RFMP effort was limited to use of existing information. More detailed analyses are needed to determine costs and benefits of potential projects, with and without habitat enhancements.

Opportunities for significantly expanding habitat and improving ecosystem functions are not equal for all areas within the Regions. Although some habitat can be incorporated into many of the potential projects throughout the Regions, a focused regional approach is illusive for all areas within the Regions at this level of study. Restoration along the lower San Joaquin River would provide benefits to the full range of aquatic species including Chinook salmon, steelhead, Sacramento splittail, riparian brush rabbit, and Swainson's hawk. Opportunities in four broad areas of the Regions were considered to arrive at the regional conservation approach:

- Delta islands generally do not provide ideal conditions for significantly expanding habitat and ecosystem functions. Reconfiguring levees to flood portions of these islands for habitat would generally produce water that is too deep. Other than incorporating habitat

into levee improvements, the regional conservation approach does not support significant expansion of habitat and ecosystem functions by flooding portions of the Delta islands. Agriculture on the islands is a prime source of funding for maintenance of levees and also provides valuable habitat. Enhanced riparian corridors may be feasible along portions of Delta channels.

- The Floodplain Restoration Opportunity Analysis prepared by DWR as part of the Central Valley Flood Protection Plan provides maps that help identify floodplain restoration opportunities in most areas of the Regions, but it does not provide an assessment of the drainages in the eastern portion of the Region (e.g. Bear Creek, Calaveras River, etc.). Rural areas along the drainages on the eastern side of the planning could be suitable for floodplain restoration, but adjacent urban development limits its potential extent. In addition, the flashy hydrology associated with these low elevation watersheds is not likely to result in the duration of inundation required to provide food web or habitat benefits to species like Chinook salmon and Sacramento splittail. However, floodplain or riparian restoration along the Calaveras River may have very significant benefits for steelhead.
- The San Joaquin River corridor downstream from Paradise Cut is constrained by the levee system and adjacent development along portions of this reach. There have been suggestions of setting back the levee at a meander on the east side of the San Joaquin River, adjacent to Old River. However, local studies have shown that this setback would have adverse hydraulic impacts along the San Joaquin River with the existing levee removed. Leaving the existing levee in place, but breaching it in places to provide new access to the floodplain is not currently supported by RD 17 because the existing levee would still need to be maintained, along with the new setback levee, to prevent hydraulic impacts. At the current level of planning, the local LMA does not plan on pursuing this levee setback, but plans on investigating other ecosystem enhancement opportunities. Some of these opportunities may be enhancement of in-channel islands and bench areas between or on the levees or by participation in habitat enhancements at other locations.

Adding wooding bank edge habitat in this reach would be valuable since little such habitat currently exists. Like the Delta island area described above, there is some opportunity to incorporate habitat improvements with levee improvements, especially along the west side of the San Joaquin River. For example, the planned seepage reduction work, about 1 mile in length, on RD 684 (Roberts Island) will be accomplished by building a “fish friendly” levee incorporating seepage control, flatter waterside slopes, and vegetation on the levee along the San Joaquin River. This improvement was made possible in part by a grant from DWR. The regional conservation approach encourages incorporating habitat into levee improvements when opportunities arise, especially when special funding is available. However, without major State or federal funding support, the Regions will have difficulty affording significant expansion of habitat and ecosystem

functions along the San Joaquin River. While opportunity to enhance the river corridor exists throughout most of the main stem San Joaquin River, local interest depends on more detailed cost studies during project development.

- The corridor from the Vernalis gage along the San Joaquin River and through Paradise Cut presents opportunities for significant expansion of habitat and ecosystem functions. This consists of looking for opportunities to expand the floodplain with setback levees and providing edge habitat along the San Joaquin River and in expanding Paradise Cut. Various parties have noted the potential for setback levees along the San Joaquin River upstream from Paradise Cut, especially on the east side in the vicinity of RD 2075. Corridor improvements along these reaches would benefit both flood management and the ecosystem. However, due to the rural land use funding, these improvements require significant contributions from other cost-share partners beyond the adjacent LMAs. The Paradise Cut expansion would present hydraulic impacts that could be mitigated by downstream levee work. For example, many of the RD levees downstream from Paradise Cut have ample freeboard, but levees are very steep on the water side. Improvement of these levees could provide flattened slopes, erosion protection, and improved habitat. The regional conservation approach does support expansion of this corridor. Additional work is required beyond the scope of this RFMP to fully define how this corridor can contribute to the flood risk reduction and ecosystem benefits.

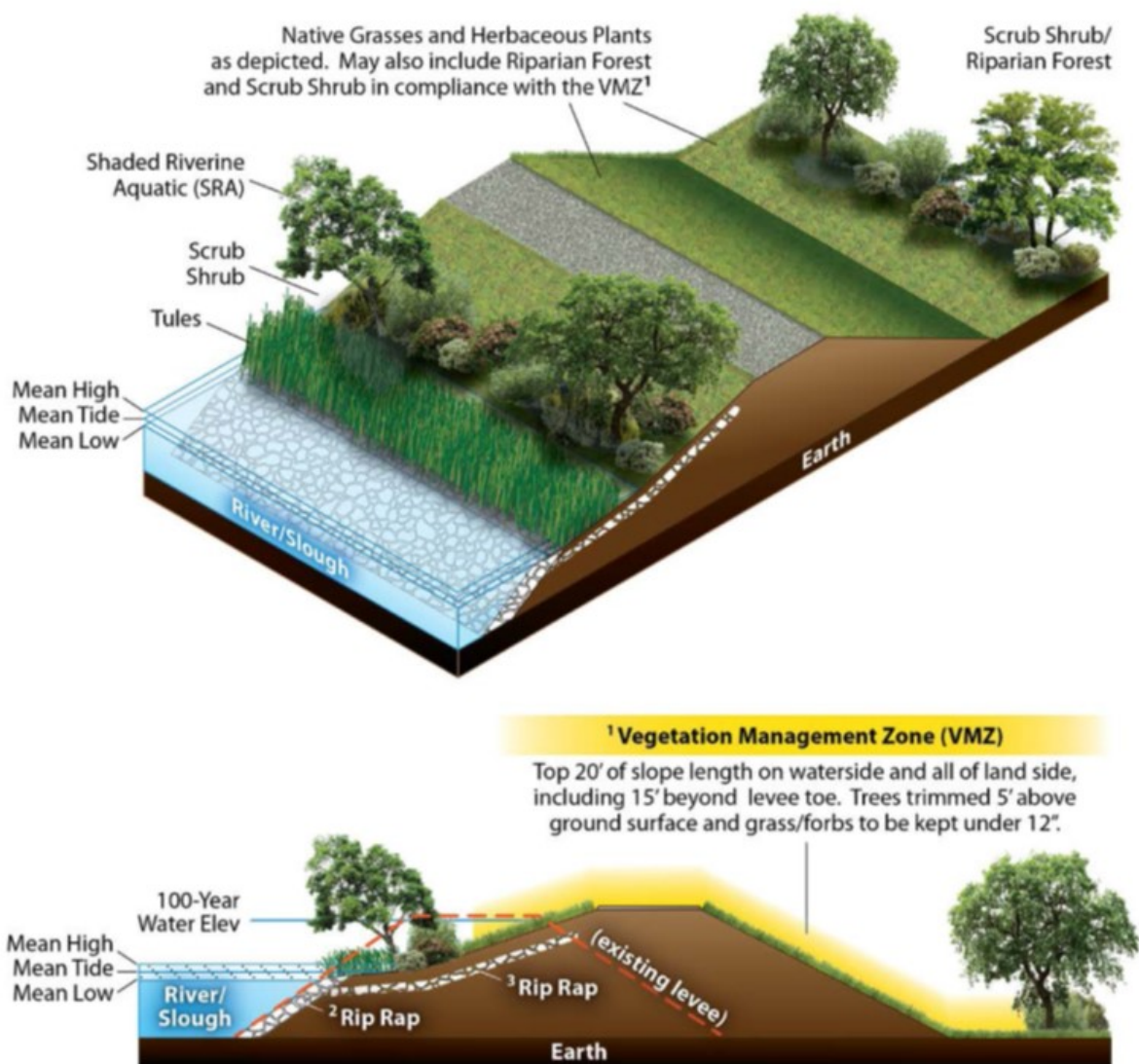
Flood improvement projects anywhere in the Regions have the option of participating in habitat improvements along the San Joaquin River corridor. Given these opportunities, each of the following bullets should be considered for ecosystem protection/enhancements for all flood improvement projects. In addition, detailed information from the State's Conservation Strategy, when available, should help define opportunities.

- First, avoid & protect existing habitat while implementing projects to reduce flood risk.
- Look for opportunities to apply onsite best management practices for habitat enhancement into each potential project, especially where there is little existing habitat. Habitat improvement could be accomplished by making plantings on levee water or land sides where they do not impact levee integrity, burying erosion protection and providing vegetation if levee slopes are flat enough, establishing seasonally inundated benches, and others.
- Along the river and tributary corridors, look for opportunities to apply habitat conservation practices such as:
 - Green levees – reinforcing the toe berm by setting back the levee cross section to allow vegetation on the waterside slope. Some applications refer to this as a “fish friendly” levee (see Figure 11 as an example). These improvements can provide valuable channel margin habitat, shaded riparian habitat or even native grasses.

- Building levee set-backs at bends in the river.
- Installing gates that could allow water to be temporarily diverted onto sections of the floodplain at key times, but provide for continued farming.
- Establishing conservation easements on seasonal agricultural lands to protect agriculture, reduce risk associated with new urban development, and provide habitat for sensitive species.
- Protecting mature riparian trees throughout the Regions.
- Creating seasonally inundated floodplain benches on the water side of the levee.
- Enhancing in-channel islands.
- Conducting other activities that increase the frequency of floodplain inundation without reducing conveyance capacity for large flood events.
- Establishing transitory storage and managed wetlands that are compatible with continued agricultural production.
- Creating a program that compensates farmers to create habitat as mitigation for flood control projects.
- Recognizing the value of farmland as important habitat.
- On the Paradise Cut corridor:
 - Support the Paradise Cut “base case”, an expansion proposed by River Islands with the construction of a new levee 900 feet to 1200 feet north of existing levee (see project description in Section 5.2.1.
 - Participate in the proposed study and support the further expansion of Paradise Cut as determined by the study.
 - Include mitigation of downstream hydraulic impacts made necessary by the expansion. This mitigation provides new opportunities for incorporating habitat.
 - Seek discussion on the concept of the Paradise Cut expansion at a continuation of the series of Paradise Cut symposiums that began in December 2013. The second symposium was held September 11, 2014. Due to the conceptual nature of a potential Paradise Cut expansion, no major findings came from this symposium, but no major opposition was voiced. Currently, the Regions do not plan on leading the Paradise Cut expansion due to current lack of specific objectives to be achieved by an expansion and lack of a project champion. The Region would like

to participate in periodic meetings on any future investigations of Paradise Cut, such as DWR's BWFS.

- o Additional meetings and symposiums should be held at key points during the above mentioned study.
- When a levee upgrade is needed to deal with seepage or slope stability issues, design of reconstruction will consider ways to incorporate new channel margin habitat. This consideration will vary by project and feasibility. Figure 11 through Figure 13 are examples of levee cross sections prepared by DWR for multi-benefits. DWR's 2014 Delta Special Projects PSP will focus \$ 75 million on multi-benefit projects in the Delta.



Notes:

¹ - 2012 Central Valley Flood Protection Plan - Conservation Framework

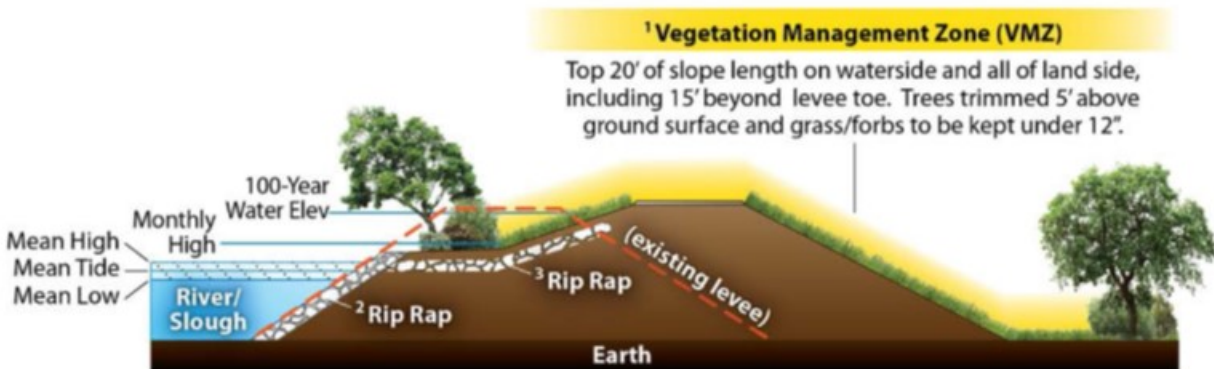
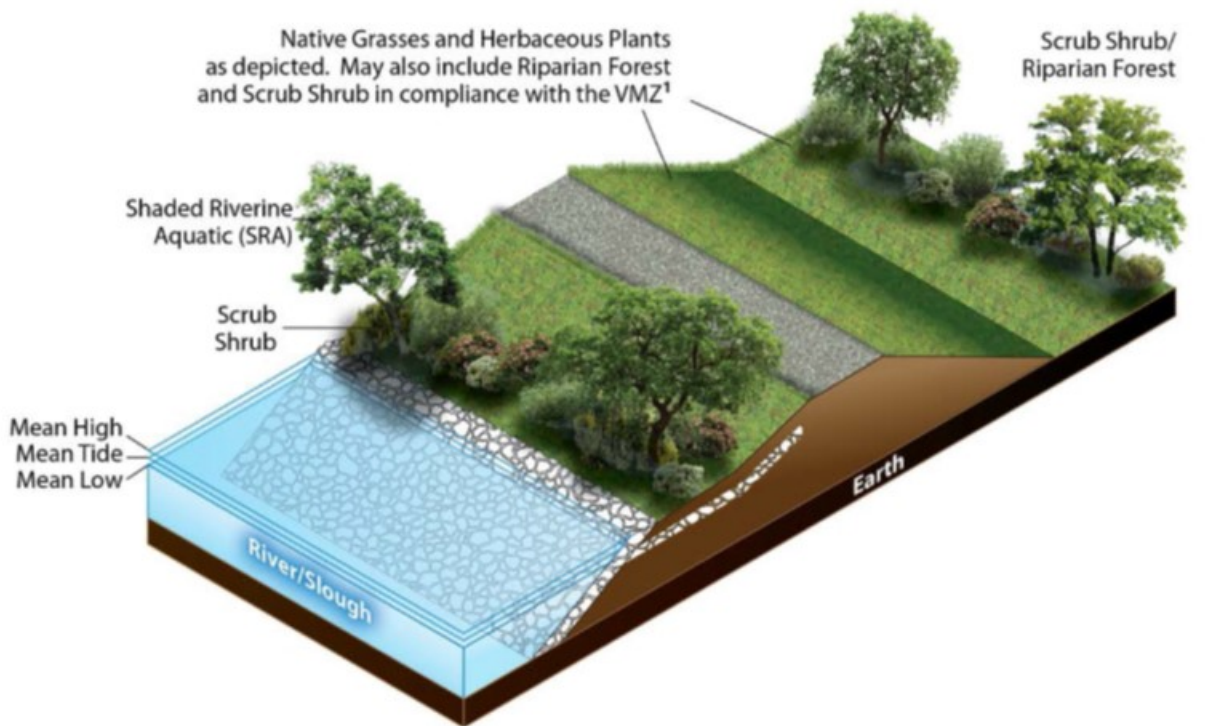
² - 10" minus rock added to fill rip rap voids, discouraging predatory fish

³ - Topped with soil slurry to fill voids

Disclaimer:

Drawings are idealized for how habitat should be incorporated into multi-benefit levee projects in order to benefit native delta species and are not meant to be used for levee design. Each levee improvement site will be considered on a case-by-case basis and may not include all features shown. Drawings are not to scale.

Figure 11 – Fish Friendly Levee Habitat from DWR 2014 PSP



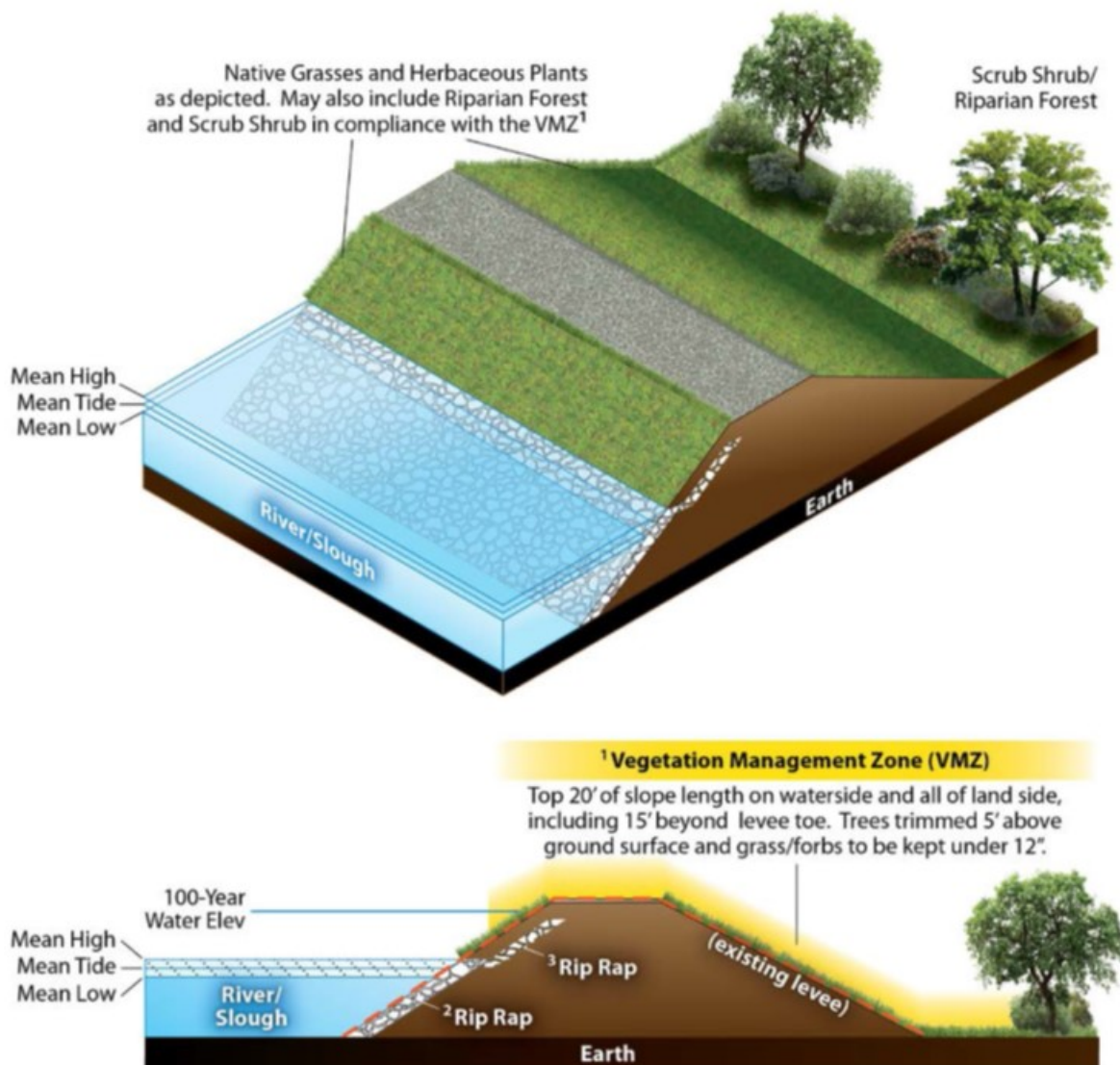
Notes:

- ¹ - 2012 Central Valley Flood Protection Plan - Conservation Framework
- ² - 10" minus rock added to fill rip rap voids, discouraging predatory fish
- ³ - Topped with soil slurry to fill voids

Disclaimer:

Drawings are idealized for how habitat should be incorporated into multi-benefit levee projects in order to benefit native delta species and are not meant to be used for levee design. Each levee improvement site will be considered on a case-by-case basis and may not include all features shown. Drawings are not to scale.

Figure 12 – Shaded Riverine Habitat from DWR 2014 PSP



Notes:

- ¹ - 2012 Central Valley Flood Protection Plan - Conservation Framework
- ² - 10" minus rock added to fill rip rap voids, discouraging predatory fish
- ³ - Topped with soil slurry to fill voids

Disclaimer:

Drawings are idealized for how habitat should be incorporated into multi-benefit levee projects in order to benefit native delta species and are not meant to be used for levee design. Each levee improvement site will be considered on a case-by-case basis and may not include all features shown. Drawings are not to scale.

Figure 13 – Minimal Setback from DWR 2014 PSP

4.6. Land Use Considerations

4.6.1. Land Conservation

The San Joaquin Multi-Species Habitat Conservation and Open Space Plan (SJMSCP) is a master plan with the key purpose of balancing the need to conserve open space for wildlife and converting open space to accommodate a growing population while minimizing costs to project proponents and society at large. SJMSCP is administered by San Joaquin Council of Governments Inc., a non-profit corporation established by San Joaquin County and the cities of Escalon, Lathrop, Lodi, Manteca, Ripon, Stockton and Tracy. The Council of Governments' website includes the plan (<http://www.sjcog.org/index.aspx?nid=173>).

The program collects a fee (currently \$ 13,295 on top of fees mentioned below for the County and cities for development on agricultural lands) for each acre of land that is developed in the County. The money is used to purchase farmland and other lands for conservation in predetermined areas. Depending on the land that is developed, the conserved land is generally acquired on a 1:1 to 1:3 (1 acre developed and 3 acres acquired for conservation) basis.

San Joaquin County imposes a 1:1 mitigation requirement for the conversion of any agricultural land to urban uses, but is only applied to applications for a General Plan Amendment or a rezoning. The ordinance allows a project to pay an in lieu fee of \$8,675 per acre if a "diligent effort" has been made and an easement cannot be obtained.

Stockton imposes a 1:1 mitigation requirement. Projects under 40 acres are able to pay an in lieu fee of \$9,600 per acre. The program is expects to conserve 20,000 acres over 20 years. The cities of Lathrop, Manteca, and Tracy adopted agricultural mitigation programs that require 11,000 acres of future development to pay \$2,000 per acre. The general plans of the county and cities include parks and other open space that will not be developed for residences. In addition, significant areas of the Regions are under the Williamson Act.

Levee placement is also a method to control development. For example, by proposing the wing levee at the south side of RD 17 rather than improving levees along the San Joaquin River upstream of RD 17, the area of development is limited to the RD 17 footprint, preserving upstream lands in agriculture.

These existing programs will end up conserving substantial areas that will not be urbanized. Given the existing requirements and fees, the Regions expect that more than one acre will be conserved for each acre developed. The Regions will work with these programs to explore ways to direct where conservation lands are acquired. Conversations with a SJMSCP representative indicate that directing the location of the conservation is possible, but that it needs to happen as part of a development agreement for specific lands that seek to develop. Directing conservation lands to the Vernalis to Mossdale corridor along the San Joaquin River, for example, may be possible.

The concept of imposing a development fee to pay for future increases in flood protection as development occurs may be a method to develop without increasing risk. For example, participation in a Paradise Cut expansion to lower the flood stages in the San Joaquin River could be such a method. The Lower San Joaquin River Region will continue to work specifically on how these programs can be used within the developing area of RD 17.

4.6.2. *The Value of Agricultural Conservation and Habitat*

Simply preserving agricultural lands could serve as a multi-benefit flood management project, because agricultural lands, particularly pasture, silage, and field crops, can provide habitat for a variety of terrestrial, avian, and aquatic species while also reducing flood risk for urban areas. Keeping floodplains in agriculture, rather than urban development, is a key opportunity for reducing flood risk over time.

Agricultural lands can provide important habitat and flood management benefits, whether they are within a floodway or outside a floodway and protected by rural project levees. Agricultural lands within Paradise Cut are prime examples of agricultural lands within floodways and demonstrate that periodic flooding can be compatible with continued agricultural production. Paradise Cut provides some of the most important remaining habitat for the endangered riparian brush rabbit.

Agricultural lands that are protected by levees can also provide important habitat for a variety of species, except for fish. Levees protecting field crops near riparian areas are particularly important for Swainson's hawk. Agricultural fields along the lower San Joaquin River and throughout the Delta also provide important habitat for shorebirds and waterfowl, particularly during the rainy season or when they are intentionally flooded by farmers.

4.7. Climate Change

With projections of diminishing snowpack, potentially increasing precipitation intensities, and raising sea levels, the Regions are well aware that climate change can significantly impact the future of flooding. Although the climate change hydrology being prepared by DWR was not available for this RFMP, the Regions expect that projected peak flows will be significantly higher than the current hydrology, especially along the San Joaquin River.

The eventual release of the climate change hydrology may cause the Regions to revisit some of the projects outlined in this RFMP. In the meantime, the Regions have adopted an adaptive management approach that will make incremental changes to the flood system to accommodate higher flows and higher tides. Examples of some of climate change adaptations currently built into this RFMP include:

- Many Delta RDs have a goal of achieving the PL 84-99 Delta standard, but are overbuilding levee height by six inches.

- Some Delta RDs have a goal of achieving the PL 84-99 Delta standard, but will eventually build to their own template with a wider crest. This will allow easy incremental raises of levee height as tide levels increase.
- The USACE NED plan addresses projected sea level change by including raises in levee height where needed.
- Levees in most urbanizing areas include a separation from the landside toe of the levee and new development that is much larger (100 feet or more) compared with the 10-foot separation currently acceptable for most existing SPFC facilities. This larger separation facilitates future levee work if needed.
- Over-wide levees provide an extra margin of adaptability for future levee modifications if needed for increased flood flows and sea level rise. The 300-foot wide levees on RD 2062 and the “double-wide” levees for RD 2074 are examples.
- Some RDs have levee heights that are currently well above projected 200-year flow levels. These include, for example, RD 17 and many of the RDs downstream from Paradise Cut.
- Expansion of Paradise Cut would provide a significant reduction (in the order of 20 inches) in flood stages along the San Joaquin River. This project would provide resiliency to the flood system to help accommodate future climate change.
- The Mormon Channel Bypass is a project that could remove up to 1,500 cfs from the Stockton Diverting Canal and the lower Calaveras River to help accommodate higher flows from future climate change.
- Upstream transitory floodplain storage included in the RFMP could help lower flows for the more frequent floods. Reservoir reoperation will provide some benefit in reducing flood peaks.
- The possibility of expanding upstream surface storage remains an option to help the Regions adapt to climate change. It cannot be taken off the table until studies evaluate its viability given the new climate change hydrology.
- Chapter 9, Next Steps, identifies that this RFMP is considered a living document that may be revised as conditions change. The new climate change hydrology may be a reason to revisit some projects in this RFMP. The Regions had originally thought that Phase 2 RFMP funding may be a way to further craft regional projects considering the new climate change hydrology. Although not included in the DWR scope for Phase 2 RFMP, some future investigation will need to further consider climate change impacts on flooding.

4.8. Scoring of Project/Program Types

Scoring of broad categories of projects and programs can provide some insight to those that are the best suited for the Regions. Unlike an alternatives analysis that considers different ways of accomplishing the same objective, the potential projects developed for this RFMP do not represent alternative ways of addressing the same deficiency. The potential projects are more like tools in a tool box, where all have some utility depending on the job to be performed. However, some of those tools may never be used within a reasonable time.

These tools are not comparable, and none should be totally screened out at this stage of study. For example, erosion protection does not take the place of a cutoff wall to control seepage. And, a PL 84-99 levee does not take the place of a 200-year ULOP levee. Each project program is measured against six equally weighted criteria – each can be scored from 1 (low performance) to 5 (high performance):

- **Compatibility with CVFPP and Regional Goals** – The primary goal for flood risk reduction and the four supporting goals. A potential project/program that substantially contributes to meeting these goals would score a 5.
- **Effectiveness** - Effectiveness is the extent to which project/program alleviates a specific problem. For example, a levee improvement to address seepage would score a 5. An upstream floodplain transitory storage project that does not substantially reduce flood flows to the protected area would score a 1. This is similar to the “effectiveness” criterion used by the USACE to evaluate many alternatives.
- **Economic Feasibility** – Economic feasibility means that the benefits of the project outweigh the costs of the project. Since no new technical work could be done for this RFMP, economic feasibility was weighed based on work conducted by the USACE for the LSJRFS, prior local studies, experience and opinions of local engineers, and the willingness of the protected areas to pay the costs. Economic feasibility is similar to the “efficiency” criterion used by the USACE to evaluate many alternatives.
- **Implementation Feasibility** – Implementation feasibility shows the degree to which a project is technically feasible, is an appropriate solution to a specific problem, that investments are likely attainable, and can be completed in a reasonable period of time. Implementation feasibility is similar to the “completeness” criterion used by the USACE to evaluate many alternatives.
- **Benefit to Regional Economy** – Benefit to region economy provides a measure of how well a project supports regional economic stability.
- **Stakeholder Support** – Stakeholder support is a measure of how well a project is accepted by State and local entities and the public. A project that is compatible with existing laws, regulations, and public policies is more likely to gain stakeholder support. When

stakeholders oppose a project, the project would score a 1. Stakeholder support is similar to the “acceptability” criterion used by the USACE to evaluate many alternatives.

Table 8 presents a scoring of projects/programs, simply to help focus effort in selecting potential projects to meet the needs of the Regions in a reasonable period of time. The study team developed the scores based on input from LMA representatives. The lowest scoring types of projects will be retained for possible future consideration in more detailed studies. The RFMP makes the most use of the highest scoring projects/programs, generally those scoring above 20 out of 30 possible, especially in the near-term.

Projects/programs scoring less than 20 are judged to be less important in the near-term. They still may have viability, but are unlikely to be the first projects moved forward for implementation. Some of these potential improvements have been moved to later implementation tiers and some to studies (see Chapter 7).

Table 8 – Initial Project/Program Scoring

Initial Project/Program Scoring							
Project/Program Type	Compatibility with CVFPP	Effectiveness	Economic Feasibility	Implementation Feasibility	Regional Economic Stability	Stakeholder Support	Total
							Comments/Rationale
Improve Levees	5	5	5	5	5	5	30 Many levee improvements are needed to fix specific problems and will be one of the most used projects in the Regions due to the extent of existing levees
New Levees	5	5	5	5	5	4	29 New levees have a limited use in the Regions, but are necessary in locations where high flood flows can flow around the ends of existing levees
Setback Levees	5	5	3	5	4	2	24 Although the opportunities for setback levees are limited, they can be an effective tool, especially when levee repairs can be paired with ecosystem restoration
Storage							
Operational	3	2	5	3	2	5	20 Changes in operations, such as F-CO, can relatively easily provide some reduction in flood stage within the regions, but water supply interests object to yield reductions
Expanded Reservoirs	3	3	2	1	4	3	16 These projects have very long lead times. They may be a viable option in the distant future, but an evaluation of their performance for reducing flood peaks was not available
Transitory	3	1	4	3	3	4	18 Transitory storage can provide some benefit to the Regions during more frequent smaller floods, but provides little benefit during larger floods
Channel Closures	5	5	5	4	5	5	29 Like levee improvements or new levees, channel closures in the Stockton area are an effective means in blocking high tide stages
Interior Drainage	1	2	3	5	4	3	18 Although interior drainage is not an objective of the CVFPP, it is of importance for the protected areas behind the levees
Channel Capacity	3	2	2	2	3	3	15 There appears to be limited potential to increase channel capacity except in association with the regional corridors discussed below. Some ongoing dredging is performed as part of annual maintenance
Regional Corridors	5	4	2	1	4	2	18 Regional corridors provide good potential to reduce flood risk and to benefit the ecosystem
Zoning/Easements	5	1	4	1	1	1	13 Controls over land use can be used to some benefit to preserve agricultural land or provide other incentives for ecosystem benefit, but not for controlling development in the Regions
Residual Risk	5	5	5	5	5	5	30 Emergency response, operations and maintenance, and other ways to manage residual risk are necessary regardless of the physical improvements to the flood management system
Evaluations	5	5	5	5	5	2	27 200-year ULDC analyses and SWIF analyses can be very effective to save substantial amounts of construction and O&M dollars

5. Structural Actions

The structural actions identified in this RFMP primarily came from LMAs, the cities, and San Joaquin County. The majority of the structural actions are site-specific improvement to existing levees. These are improvements that need to be made based on input from the LMAs, those most familiar with specific levees. In addition, this chapter includes structural projects of regional significance that could benefit at least several LMAs.

This chapter simply identifies projects envisioned for implementation over the next 25 years, with no priority for implementation. The proposed implementation sequencing of these projects is shown in Chapter 7. The most critical projects are grouped together in Tier 1, the first five years of implementation.

5.1. LMA-Specific Projects

This section summarizes the potential LMA-specific flood risk reduction projects for each LMA. Table 9 shows a summary of these LMA-specific projects for the Delta South Region.

Table 9 – Projects by LMA, Delta South Region

Delta South Region - Array of Projects by LMA (Estimated Costs in \$ million)														
LMA	HMP Geometry	PL84-99 Geometry	Penetrations & Encroachments	Seepage/Slope Instability	Erosion	Other Geometry	Dryland Levee	Channel Improvement	Interior Drainage	Improvements to 200-year ULOP	Other Structures	Analysis		Total
												ULDC	Others	
RD 1			0.3	43.0	3.1		33.3						0.1	79.8
RD 2		0.5	1.0	85.0	10.0	30.0	26.0						0.1	152.6
RD 524		0.9	5.0	5.0	3.7						0.4			15.0
RD 544		12.0	5.0	70.0	1.5								0.1	88.6
RD 684		1.0		5.1			0.4							6.5
RD 773		7.9			10.9	42.2								61.0
RD 1007						30.4		10.0			2.0			42.4
RD 2058				36.5	0.8	2.6							0.1	39.9
RD 2062										170.0			1.5	171.5
RD 2085				34.0	0.3									34.3
RD 2089		0.5		29.5	2.5			1.0					0.1	33.6
RD 2095				22.8	0.5									23.3
RD 2107		2.8												2.8
Total	0.0	25.6	11.3	330.9	33.2	105.2	59.7	11.0	0.0	170.0	2.4	0.0	1.8	751.1

Table 10 shows a summary of LMA-specific projects for the Lower San Joaquin River Region.

Table 10 – Projects by LMA, Lower San Joaquin River Region

Lower San Joaquin River Region - Array of Projects by LMA (Estimated Costs in \$ million)														
City/LMA	HMP Geometry	PL84-99 Geometry	Penetrations & Encroachments	Seepage/Slope Instability	Erosion	Other Geometry	Dryland Levee	Channel Improvement	Interior Drainage	Improvements to 200-year ULOP	Other Structures	Analysis		Total
												ULDC	Others	
Stockton/SJC		61.0				0.5		63.5		1,027.0	41.0	5.0	2.3	1,200.3
RD 17							18.0			150.0				168.0
RD 403														-
RD 404			2.0	1.1	0.6				2.7					6.4
RD 1608				1.5				2.5						4.0
RD 1614									2.4					2.4
RD 2042												1.5		1.5
RD 2064		0.8		46.0	5.4									52.2
RD 2074				7.6	5.0		19.0							31.6
RD 2075				20.3	4.5	32.0								56.8
RD 2094				11.5		9.2	13.8							34.5
RD 2096								0.4	0.2		0.7		0.1	1.4
RD 2115		3.4			1.3							1.5		6.2
RD 2119		2.0		4.6										6.6
RD 2126									1.0					1.0
Total	0	67.2	2.0	92.6	16.8	41.7	50.8	66.4	6.3	1,177.0	41.7	8.0	2.4	1,572.8

The two tables show estimated costs for each type of project such as erosion protection, interior drainage, and levee geometry improvements. Estimated costs are totaled for each LMA and for each type of site-specific improvements. Although seepage/slope stability improvements constitute the greatest costs, most of these improvements are a lower priority for the Delta South Region due to their high cost and lower flood protection goal – they aren’t the most critical projects in the near-term. All costs are estimated in 2014 dollars. Descriptions of each project in these tables can be found in Appendix C. For example, referring to Table 10 for RD 1608, Appendix C includes descriptions of projects for seepage/slope instability and channel improvements.

A few projects included in Table 10 for Stockton/SJC are further described below due to their unique nature compared with the other projects in the table. More detailed descriptions of these projects are also included in Appendix C.

Lower San Joaquin River Feasibility Study – NED Plan

In 2009 the LSJRFS was initiated by USACE to study deficiencies in the flood control system for the lower San Joaquin River from the confluence with the Stanislaus River downstream to the Lodi wastewater treatment plant. The LSJRFS also includes the eastside tributaries to the lower San Joaquin River. The LSJRFS is anticipated to be complete in spring-2016 and may provide justification for federal cost sharing on selected project features that are in the federal interest.

The LSJRFS considered numerous incremental improvement alternatives to provide protection to North Stockton and Central Stockton which reasonably maximize net benefits. The elements shown below are currently the collection of incremental improvements to be selected as the NED plan. Incremental improvements for North Stockton, and Central Stockton are shown in Table 11 and Figure 14. The NED plan includes provision sea level rise by raising levees.

Table 11 – LSJRFS NED Plan

Benefit Area	LSJRFS NED Plan Incremental Improvements
North Stockton	• Cutoff walls and geometric/height fixes for Mosher Slough, RD 1608, RD 2074, and along the east boundary of RD 2115, and along the right bank of the Lower Calaveras River • Closure Structure at Fourteenmile Slough • Levee raises along Tenmile Slough, Mosher Slough and Fourteenmile Slough to accommodate sea level rise
Central Stockton	• Cutoff walls and geometric/height fixes for the left bank of the Lower Calaveras River and right bank of the San Joaquin River and French Camp Slough along RD 404 • Smith Canal Gate

NOTE: This provides an overview of the NED plan from the LSJRFS. The Smith Canal Gate is discussed in more detail later in this section as stand-alone project.

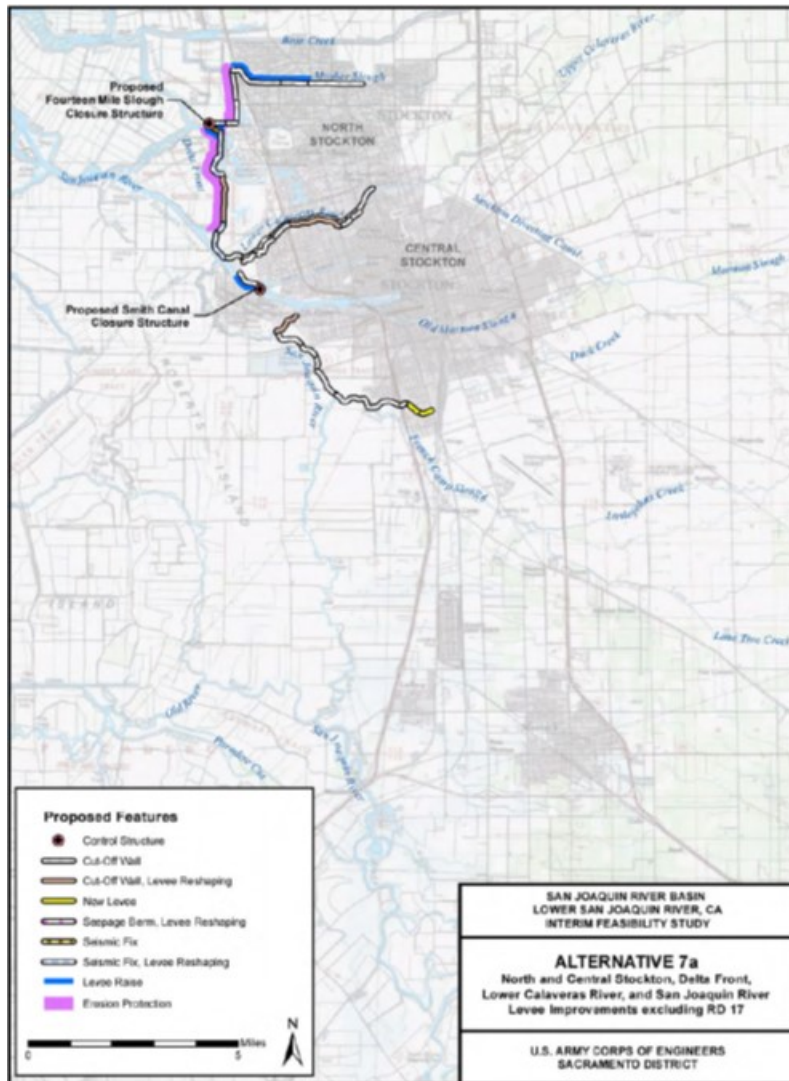


Figure 14 – LSJRFS, NED Plan

Smith Canal Gate

The Gate on Smith Canal is part of the LSJRFS NED plan. The levees along Smith Canal are highly encroached and do not meet criteria necessary for FEMA accreditation, placing approximately 8,100 homes in the floodplain. To remedy this, SJAFCA is currently leading the design of a proposed gate structure at the mouth of Smith Canal following a successful Proposition 218 vote to provide the local funding portion of this project and receipt of a DWR design grant. Future funding requires a grant for the State share of the construction cost.

The proposed project will construct a gate structure at the mouth of Smith Canal along the San Joaquin River/Stockton Ship Channel in Stockton. The gate structure will be operated to block

back-flooding from the San Joaquin River and Delta during winter months (November 1st to April 30th) when high river flows and stages typically occur in the Smith Canal area.

The fixed portion of the gate structure will consist of a dual sheet pile wall filled with granular material. Preliminary concepts indicate the opening in the gate structure will be miter gate structure, consisting of a 50-foot wide navigation lock controlled by hydraulic cylinders. The location concept for the proposed structure is shown in Figure 15.

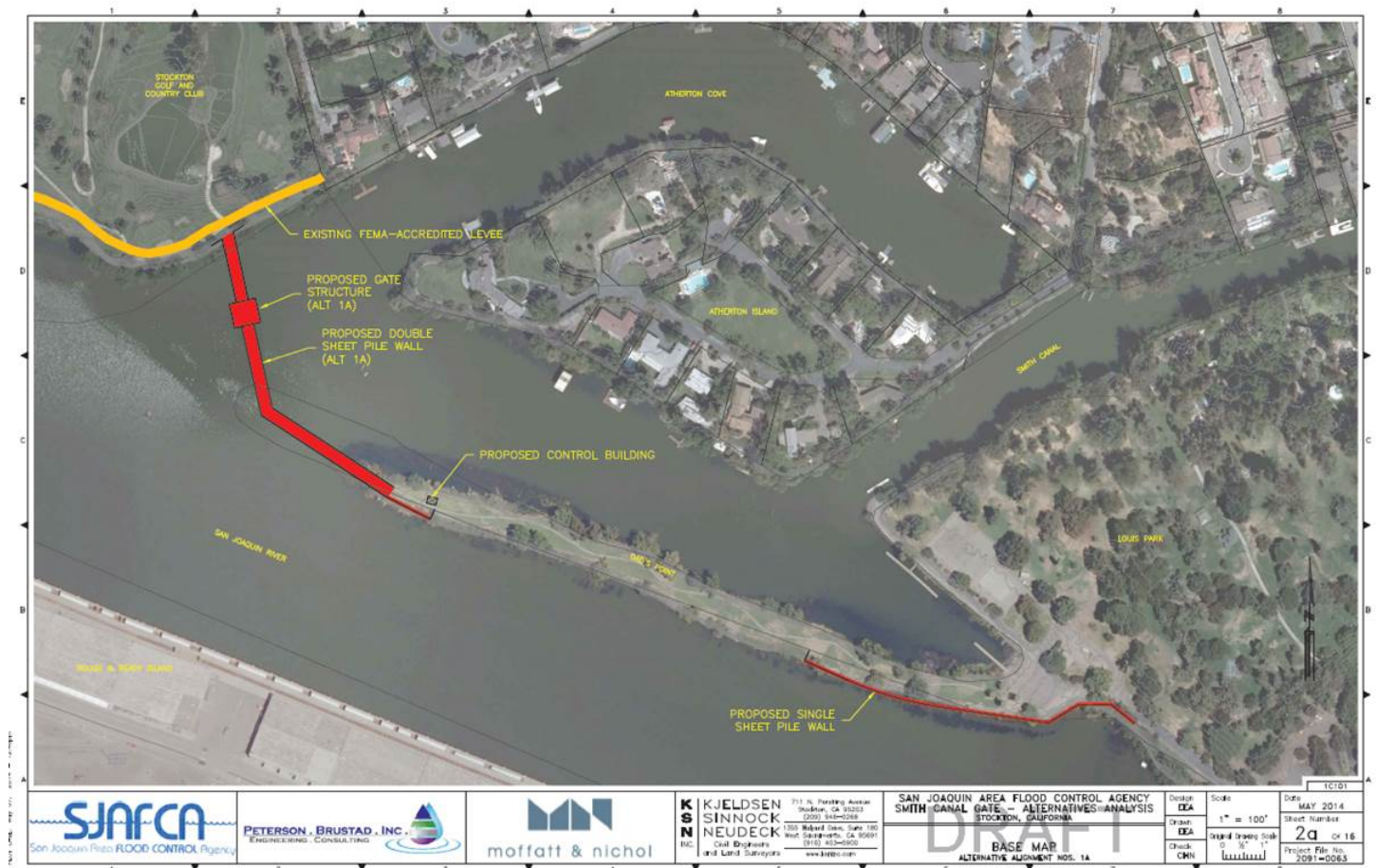


Figure 15 - Smith Canal Gate

Mormon Slough Bank Erosion Repair

Mormon Slough has experienced bank erosion from several past flood events. This project aims to repair Mormon Slough along with preventative measures to mitigate future bank erosion from near Escalon-Bellota Road downstream to the Stockton Diverting Canal. Figure 16 shows the reach for bank erosion repair.



Figure 16 – Mormon Slough Bank Erosion Repair

Mormon Channel Bypass

Mormon Channel was blocked off in the early 1900s by the USACE to reduce sedimentation in the Stockton Ship Channel. Flows removed from Mormon Channel were diverted into the Stockton Diverting Canal which merged with the Lower Calaveras River. With upstream dams now in place, sedimentation of the Stockton Ship Channel from Mormon Slough is no longer a concern.

This project would divert up to 1,500 cfs to Mormon Channel via a weir at the head of the Stockton Diverting Canal, thereby reducing the flood flow in the Stockton Diverting Canal and the Lower Calaveras River. This would reduce flooding potential of these systems and provide some resiliency to accommodate future climate change.

Reestablishing a flood corridor along Mormon Channel could establish some terrestrial habitat value. These improvements could also include nature trails and bike paths. Figure 17 shows the location of the Mormon Channel Bypass.

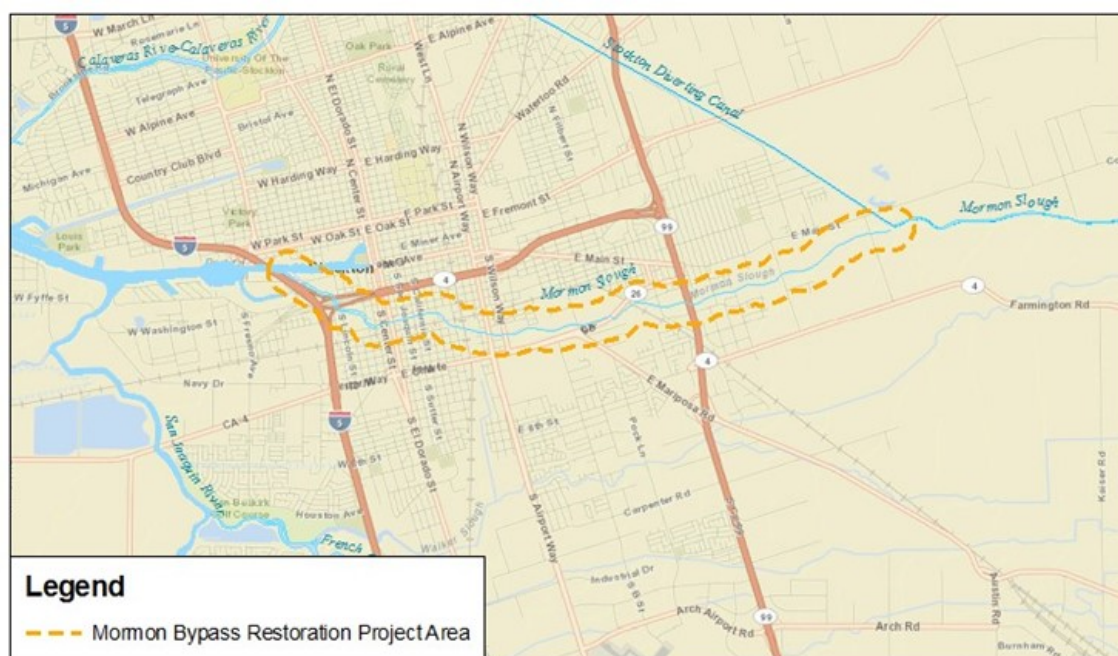


Figure 17 – Mormon Channel Bypass Restoration Project Area

5.2. Potential Flood Risk Reduction Projects of Regional Significance

Projects of regional significance are projects such as the expansion of Paradise Cut and other projects that can benefit multiple LMAs. The following sections describe these potential projects. Most of these projects are not among the most critical projects for the Regions, and are therefore anticipated to be implemented after Tier 1 projects.

5.2.1. Expansion of Paradise Cut

Paradise Cut is an existing bypass that diverts flow out of the lower San Joaquin River, upstream of Old River. This reduces the hydraulic load on levees downstream on the San Joaquin River, particularly along RD 17 and Central Stockton. Due to sedimentation and other factors, the current capacities of Paradise Cut and the lower San Joaquin River just downstream of Paradise Cut do not meet their original design capacities.

In an attempt to remedy this situation, numerous studies have evaluated the benefit and potential hydraulic impacts of expanding Paradise Cut. Potential ecosystem benefits have also been considered.

The first likely improvements/modifications to be made to Paradise Cut are known as the “Base Case Improvements” and are to be implemented by the River Islands Development. A description of the Base Case is provided below. The River Islands development (RD 2062) is required to construct the Base Case improvements pursuant to conditions of a settlement agreement with NRDC (et. al.) which include:

- Setback the north levee of Paradise Cut between the railroad and Interstate 5 on RD 2107
- Setback levee along RD 2062 between Interstate 205 and Old River (setback approximately 900 to 1,200 feet)
- Remove bench (excavate approximately 5 feet over 40 acres) downstream of the weir.
- Increase Paradise Cut flow capacity to nearer the design flow

This is shown graphically in Figure 18.

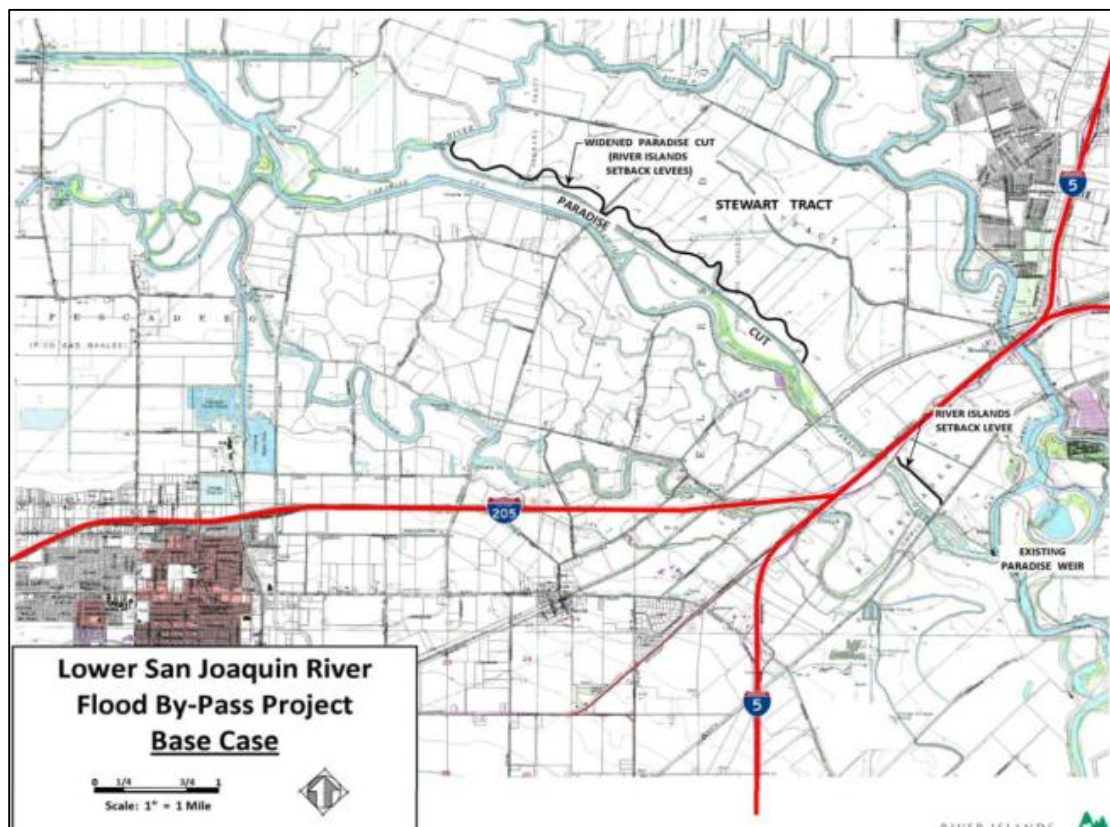


Figure 18 – Paradise Cut Base Case

Although the Base Case improvements will partially restore the capacity of Paradise Cut, these improvements alone will not fully address the capacity deficiencies in Paradise Cut and the lower San Joaquin River. Further expansion of Paradise Cut will require building a new setback levee to replace the existing south levee of Paradise Cut. Modeling studies indicate that an expansion of Paradise Cut has the potential to lower the flood stages by about 20 inches along the San Joaquin River downstream of the bypass (RD 17 and Stockton). This stage reduction would increase overall flood system resiliency for future climate change. While not being an official proposal, some stakeholders have suggested that a Paradise Cut expansion could provide a potential vehicle for increased development within RD 17 without increasing flood risk.

The expanded bypass would also lower San Joaquin River flood stages upstream from the Paradise Cut weir, but this benefit would gradually decrease as distance from the weir increases. For example, about 3 miles upstream from the weir, the flood stages would be about 12 inches lower than the condition with no Paradise Cut expansion. The expanded bypass would also significantly increase terrestrial ecosystem restoration opportunities and improve water supply reliability by providing improved access to irrigation water.

Only conceptual alternatives currently exist for additional expansion of Paradise Cut beyond the Base Case improvements. A distance for the setback has not been determined, but could be from a few hundred feet to a 1000 feet or more. The length of the Paradise Cut weir could be expanded to further increase the flow capacity down Paradise Cut and reduce flow in the San Joaquin River. A second weir upstream of the existing weir has also been contemplated. The possibility of lowering the weir to create more frequent flows into Paradise Cut draws strong objections from downstream stakeholders and will not be further considered as part of this RFMP. The existing levee could be left in place as “high-ground” terrestrial habitat, by breaching the existing levee in places to allow flow on both sides.

Widening the bypass would require obtaining easements or purchase of privately held property adjacent to the bypass. Additionally, diverting increased flows down Paradise Cut will increase the hydraulic load on levees in the Delta South Region. These levees typically have generous freeboard above the 100-year flood stages, but are susceptible to erosion and seepage. There are concerns about existing capacity and future vegetation and sedimentation of some channels downstream from Paradise Cut. In order to be widely supported by stakeholders in both Regions, future modifications to Paradise Cut will need to address these challenges.

A Paradise Cut Corridor Management Plan needs to be prepared to further define the project and strengthen stakeholder support. The Management Plan would investigate opportunities for improved flood management and environmental management of the Paradise Cut Corridor. Levee setbacks, and overbank flood storage projects would be analyzed with the intent to improve flood risk management while improving the environment for fish, wildlife, and plants.

A broadly supported alternative for modifying Paradise Cut beyond the Base Case improvements being implemented by the River Islands development does not currently exist. The next step to

get support from the stakeholders in the Lower San Joaquin River and Delta South regions is to develop a comprehensive plan for increasing the capacity of Paradise Cut that includes a potential footprint of the expansion and improvements to downstream levees to mitigate the hydraulic impacts. This plan could be coordinated with a Paradise Cut Corridor Management Plan.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders, SSIA	DWR	TBD	Flood Management	Ecosystem Restoration, Residual Risk Management, Economic Sustainability, Water Supply Reliability	Conceptual	\$5M Corridor Management Plan \$340M - \$440M (CVFPP)

5.2.2. San Joaquin National Wildlife Refuge Expansion

Some stakeholders have suggested upstream transitory storage options as a potential measure to reduce flood flows on the lower San Joaquin River. If areas conducive to periodic flooding were strategically allowed to flood at the right time (i.e. near the peak of the hydrograph), flood attenuation could lower peak flows downstream. Such a project could benefit all downstream areas.

The USFWS has proposed to expand the approved acquisition boundary of the San Joaquin River National Wildlife Refuge (NWR) and acquire up to 22,156 additional acres from willing sellers within the proposed expansion area. The portion of the expansion downstream from the Stanislaus River is within the Regions. The project aims to:

- Protect and restore a diversity of rare and native habitats and their associated populations of fish, wildlife, invertebrate, and plant species of the San Joaquin River
- Protect, restore, and develop a diversity of habitats for migratory birds such as neotropical songbirds, wading birds, and shorebirds
- Protect and restore floodplain values and benefits associated with the San Joaquin River, including improved water quality, flood storage, and increased water recharge
- Protect, restore, and develop habitats for and otherwise support recovery of federal and State listed species and help prevent the listing of candidate species and species of management concern
- Provide high-quality opportunities for wildlife-dependent recreation

The Regions support the refuge expansion in concept for its ecosystem benefits, especially downstream from the Stanislaus River, but see little direct flood reduction benefits. Considering DWR modeling studies, transitory storage along the San Joaquin River upstream from the Regions provides flood benefits primarily for the most frequent, smaller flood events. Therefore, the refuge expansion is of lower priority for the Regions.

Figure 19 illustrates the USFWS's proposed expansion of the refuge.

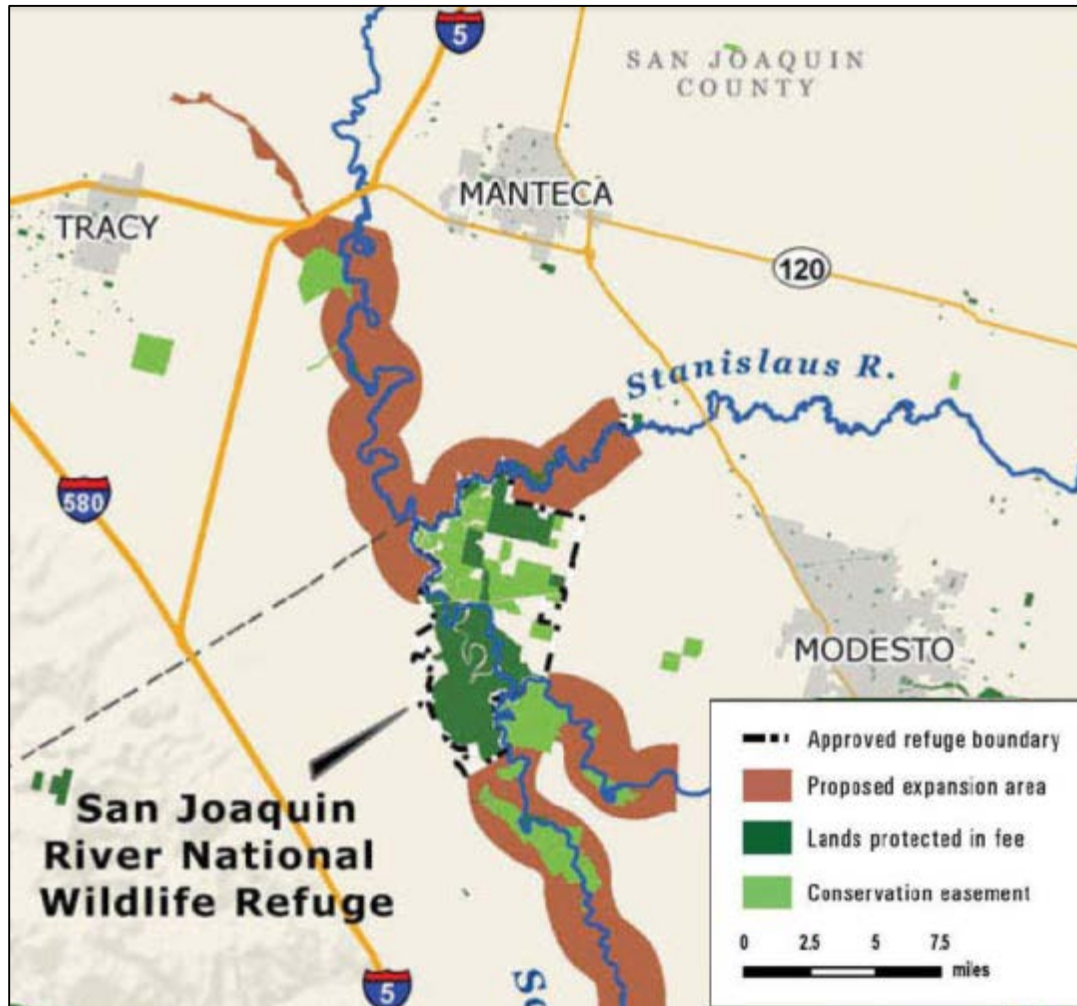


Figure 19 – Potential San Joaquin National Wildlife Refuge Expansion

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders / USFWS	USFWS	TBD	Conservation Habitat Restoration	Flood Risk Reduction	Planning	\$\$\$\$*
*\$\$\$\$ = Cost is estimated to be above \$10M						

5.2.3. *Dos Rios Ranch Floodplain Expansion and Restoration*

DWR has partnered with other local, State and federal agencies and River Partners to fund the acquisition of Dos Rios Ranch, a 1,603-acre agricultural property west of Modesto. Finalized in mid-April 2013, the \$21.8 million acquisition is part of a multi-phase project designed to improve flood protection, increase inundated floodplain, and restore wildlife habitat at the confluence of the San Joaquin and Tuolumne Rivers.

DWR funding includes nearly \$2.5 million in Proposition 84 grant funds for removal of farm levees to reconnect rivers with farmland being restored to floodplain habitat.

Phase 1 of the project was the purchase of land by River Partners, and was recently complete. Phase 2 will comprise three major components: restoration planning and permitting, habitat restoration, and levee breaching study. The project will restore flooding and transient floodwater storage to 948 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along six river miles.

The Regions support the project in concept, but see limited direct flood reduction benefits, primarily during the most frequent, smaller flood events. Therefore, the project is of lower priority for the Regions.

Figure 20 illustrates the location of the Dos Rios project in relation to the Regions.

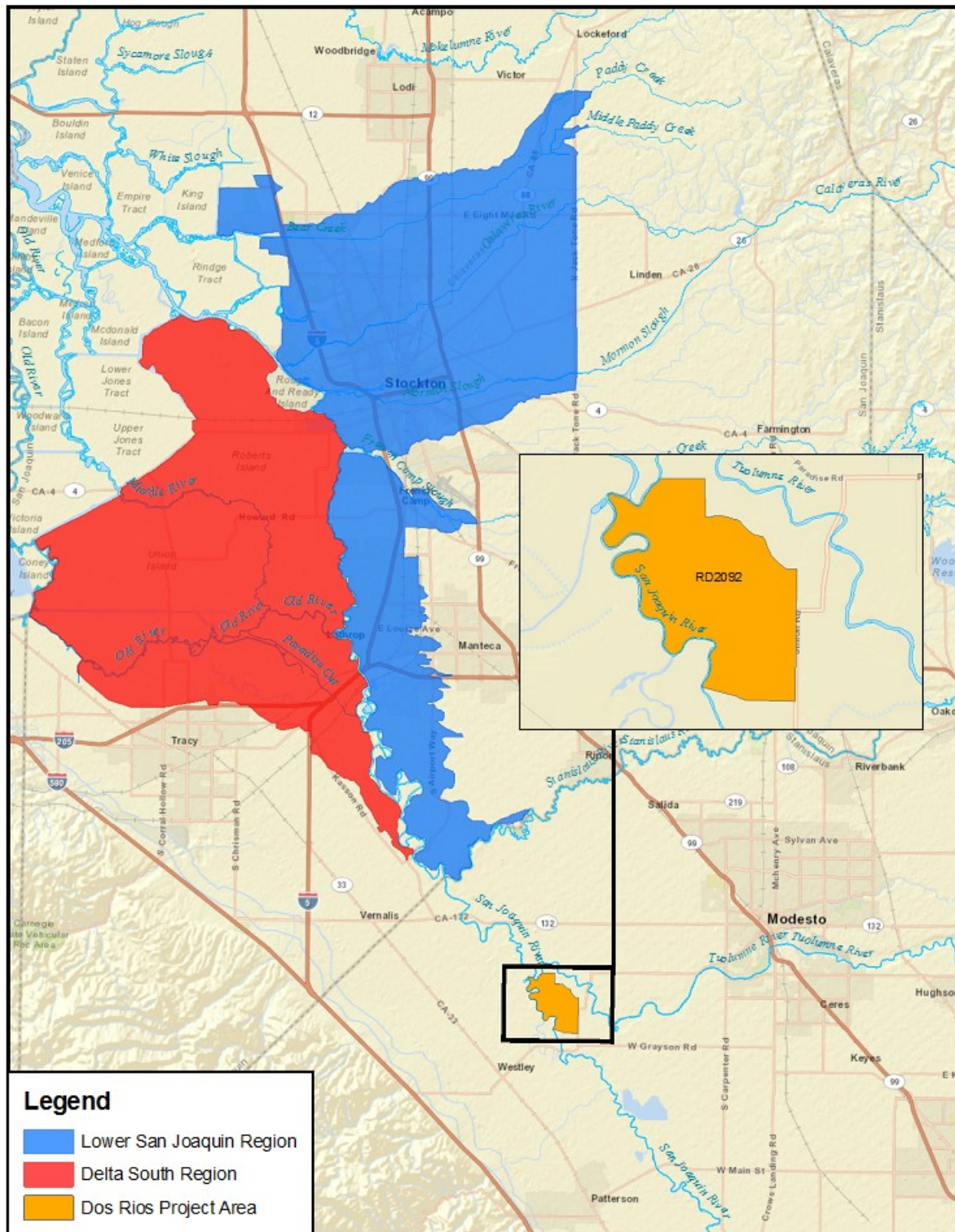


Figure 20 – Dos Rios Floodplain Expansion and Restoration Area

5.2.4. San Joaquin River Reservoir Storage Improvements

Due to project scoring in Section 4.8, this project was retained as a potential future study. During the 1997 flood, only two of the major flood control dams in the Central Valley were forced to engage their spillways. Those two were Friant Dam on the Upper San Joaquin River, and New Don Pedro Dam on the Tuolumne River. Figure 21 shows the locations of the reservoirs.

One possible measure to reduce peak flows in the lower San Joaquin River would be to increase physical storage in upstream reservoirs. This could be coupled with coordinated- and forecast-based operation of flood control reservoirs (Section 5.2.5).

The following potential storage improvements are provided as examples. Finding flood storage anywhere in the watershed could be considered. Storage could come from expansion of existing reservoirs or constructing new reservoirs. DWR's Enhance Flood System Capacity approach in the CVFPP estimated that about 400,000 acre-feet of new flood storage would be required to effectively manage the 100-year (1% annual chance) flood. Investigations should evaluate smaller and larger storage volumes with an eye to increasing flood system resiliency to better accommodate climate change.

Millerton Lake

Friant Dam is located on the San Joaquin River, about 20-miles northeast of Fresno. The waterbody created by the impoundment is known as Millerton Lake. The existing structure, built in 1945, is a 319-ft high concrete gravity dam with a storage capacity of 520,000 acre-feet.

Potential modifications to Friant Dam include a 20-, 60- or 140- foot raise to increase storage.

A 20-foot raise would increase the storage capacity by approximately 105,000 acre-feet. This would require raising the dam and modifying the spillway and spillway chute. It would also require construction of an approximately 3,000-foot long dike across a low ridge saddle at the southwest margin of the existing reservoir.

A 60-foot raise would entail raising the dam and modifying the spillway and spillway chute. It would also require construction of an approximately 8,500-foot long dike across a low ridge saddle at the southwest margin of the existing reservoir.

More extensive efforts would be required for a 140-foot raise, which would result in approximately 700,000 acre-feet of additional storage capacity.

An alternative to raising Friant Dam could be the potential Temperance Flat Dam or storage on other tributaries.

Don Pedro Reservoir

Don Pedro Reservoir is an artificial lake formed by the construction of the New Don Pedro Dam on the Tuolumne River. The 2,030,000 acre-feet of water stored here is used by the Modesto Irrigation District (MID) and the Turlock Irrigation District for the irrigation of several hundred square miles of productive Central Valley farm land. Some of the water is treated by the MID and used as drinking water in Modesto.

Additional capacity in this reservoir or in the upstream tributaries improve downstream flood protection on the Tuolumne River and San Joaquin River.

New Hogan

The storage capacity of New Hogan Dam was analyzed as part of the LSJRFS to determine the level of protection of the dam. This evaluation indicated that the flood storage capacity of New Hogan can contain the 200-year storm event. Therefore, no changes in storage are required to achieve the State's goal of 200 year-level of protection.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders, SSIA	USACE, DWR, USBR	TBD	Flood Management	Water Supply	Planning	\$2M

5.2.5. Coordinated- and Forecast-Based Operation of Reservoirs

This measure is applicable to all upstream reservoirs, however the information presented on this project is focused on the two reservoirs mentioned above. The rainfall event during December 1997 resulted in nearly simultaneous high releases by all reservoirs on the San Joaquin River system and uncontrolled emergency releases at New Don Pedro and Friant Dams. Reservoir operators made initial release decisions on an individual basis. It is believed that coordinating these outflows may have significantly reduced flooding in the Central Valley.

Prior to the large storms in late December 1997, many reservoirs had water elevations at or slightly into their flood storage before the storm arrived. The uncontrolled releases from these reservoirs may have been avoided if the reservoirs released water ahead of the storms, thus increasing available flood storage. Forecast-based operations were not used in 1997, but with advances in technology, are now becoming feasible.

This project would encourage State and local operators to pursue coordinated- and forecast-based operations to enhance and more effectively operate existing reservoirs. This project may work in conjunction with projects to increase physical storage in the existing reservoirs as discussed previously. Figure 22 shows the reservoirs upstream of the Regions which collectively can impact peak flows in the San Joaquin River.

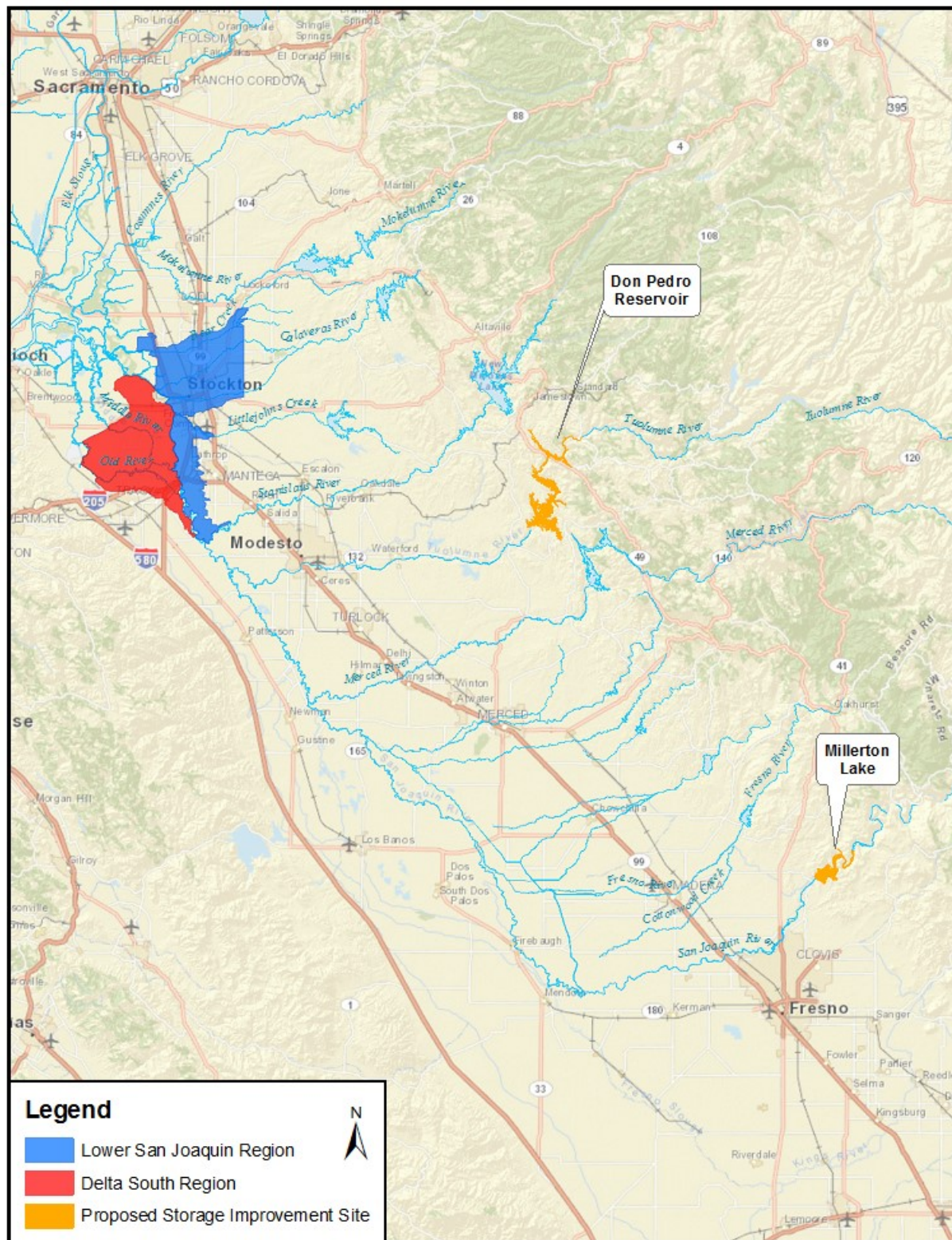


Figure 21 – Potential Reservoir Storage Improvements

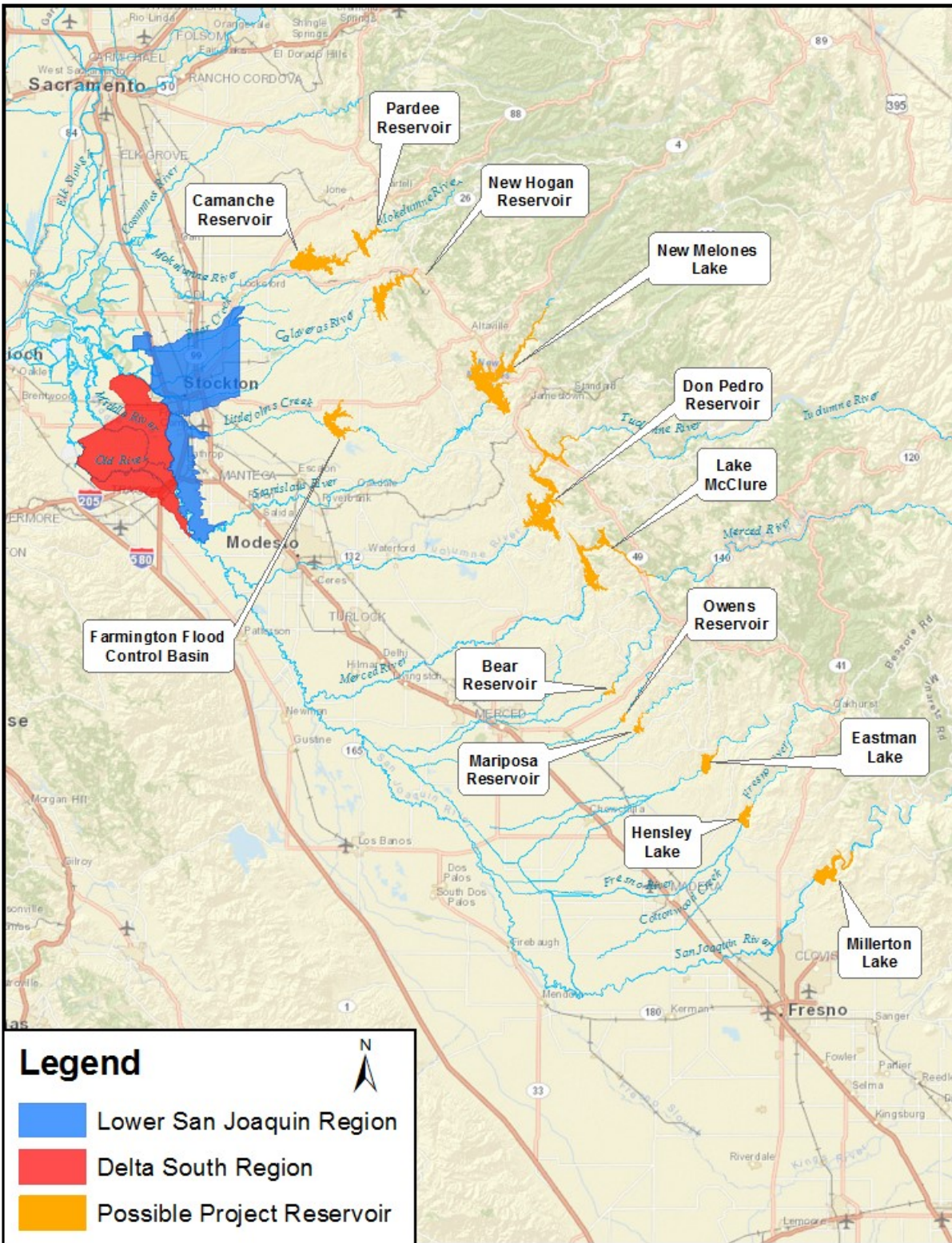


Figure 22 – Reservoirs for Coordinated- and Forecasted-Based Operations

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6. Residual Risk Management Actions

Regardless of improvements to the physical flood management facilities, some risk of flooding is always present. This chapter describes the ongoing and proposed residual risk actions needed to supplement the structural actions described in Chapter 5.

In addition to the traditional flood emergency response, flood operations and maintenance, and floodplain risk management, this chapter also outlines recommended process and policy modifications to improve residual risk management. The following actions are actions beyond those currently in place.

6.1. Enhanced Flood Emergency Response

This component supports additional planning and response efforts in preparation of flood events beyond current levels, and supports real-time communications. The enhanced flood emergency response components include:

- All-weather roads on levee crowns [\$1 million Lower San Joaquin River Region and \$11.1 million Delta South Region]
- Additional flood information collection and sharing [\$15 million Lower San Joaquin River Region and \$12 million Delta South Region]
- Local flood emergency response planning [\$20 million Lower San Joaquin River Region and \$10 million Delta South Region]
- Additional forecasting and notification [\$10 million Lower San Joaquin River Region and \$10 million Delta South Region]
- Improve San Joaquin County Alert System [\$25,000 per year or \$625,000 over 25 years]

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.

(DWR, Central Valley Flood Protection Plan, 2012)

As mentioned previously, San Joaquin County has been a leader within the Central Valley in flood response readiness. Implementation of the San Joaquin County Enhanced Flood Preparedness Strategy (see Appendix A) will also involve addressing several additional issues as noted below:

- **Rural Evacuation Maps.** The Enhanced Flood Preparedness Strategy requires that separate evacuation maps be developed for rural areas. The previous strategy only required separate maps for urban areas and placed limited evacuation information on LMA flood contingency maps. Completing this expanded evacuation planning process will allow the County to more fully address two key evacuation issues for rural, agricultural, areas. These issues are evacuation of dairies and bulk hazardous materials prior to the arrival of flood waters.
- **Regional Flood Fight Supply System.** Current supply inventories maintained by all jurisdictions must be determined. Locations and inventories of second level supply depots must also be determined and pre-planned supply delivery points also re-confirmed. The logistics system must be enhanced to allow responders to determine the best placement of supply staging areas and the fastest manner to meet emergency requests. This new system must be integrated with existing logistics tracking and mutual aid systems put in place through the initial San Joaquin County Flood Emergency Response Preparedness Strategy.
- **Flood Fight Mutual Aid Policies.** As part of the DWR regional grant, the County and its cities must further clarify policies for providing mutual aid to LMAs for flood fight operations. In particular, policies for providing direct funding for private contractors, bulk materials, and flood fight equipment needed to minimize flood damage will be clarified and incorporated into the operational area logistics system.
- **Training Program.** As part of the DWR regional grant, a comprehensive training and exercise program will be developed for implementation by all jurisdictions with flood response functions.
- **Opportunities.** As mentioned previously, San Joaquin County has made significant progress toward mitigating residual flood risk via the flood contingency maps. However, several beneficial actions have occurred in the past year that provide opportunities for the County and its cities and LMAs to implement the Enhanced Flood Preparedness Strategy. These actions include: standardizing the local flood response plans, applying for the 2013 DWR Delta emergency response grant, and developing sustainable mechanisms to continually update flood fight documents. These activities are described below:
 - **Standard Local Flood Response Plan Templates.** The issuance AB156 compliance guidance and grant guidance by DWR for local flood emergency

response projects has stimulated discussion on the need for “local tactical flood response plans” and the proper format, content, and characteristics for such plans.

- o **Funding Opportunities to Implement the Enhanced Flood Preparedness Strategy.** Propositions 1E and 84 passed by the voters in 2006 provided, among other things, for \$135 million in funding for enhancing flood emergency response in the State. In 2013, DWR issued the first grants to locals from these funds for local flood emergency response projects. A “statewide” grant with total funding of \$5 million was issued in March 2013, and a “Delta specific” grant with total funding of \$5 million was issued in August 2013. Funds for a second round of the Delta specific grant in 2014 have already been identified which provides some assurance of continued funding. This situation provides a possible opportunity for the Lower San Joaquin River/South Delta Regions to begin to implement the San Joaquin County Enhanced Flood Preparedness Strategy over the next few years.
- o **Joint Planning and Plan Maintenance Mechanisms.** The RFMP process provides an opportunity for local jurisdictions to form mechanisms and procedures for ensuring completion and maintenance of emergency response products. Procedures and protocols used to jointly develop the regional plan should be adjusted for use after the completion of the RFMP to perform joint planning.
- o **Flood Contingency Maps.** Several flood contingency maps still need to be prepared for areas of the Regions. These maps improve levee flood fight operations conducted by LMAs by placing needed information for each LMA on a single sheet. The maps document historical information and knowledge and procedures. Where appropriate, the maps also show locations of relief cuts (intentional pre-engineered levee breaches) that can be constructed to help drain a flooded area.

6.2. Flood Operations and Maintenance

This component provides for future O&M of the flood protection system together with regular activities to keep flood system facilities in good working order. The enhanced O&M components include:

- Identification and repair of after event erosions [\$25 million Lower San Joaquin River Region and \$25 million Delta South Region].
- Develop practices and procedures to implement enhanced O&M [\$15 million Lower San Joaquin River Region and \$15 million Delta South Region].

- Increase in San Joaquin County Flood Control and Water Conservation District O&M budget to resolve current budget deficiencies [\$2 million per or year \$50 million over 25 years].

Inspecting the flood system after any major flood event to identify new areas of levee erosion and repair them will help control erosion areas before they become major repair projects. Costs will vary by year, and several years may pass before a flood event causes erosion. This maintenance component is especially important for rural levees where O&M budgets are more constrained than for urban levees.

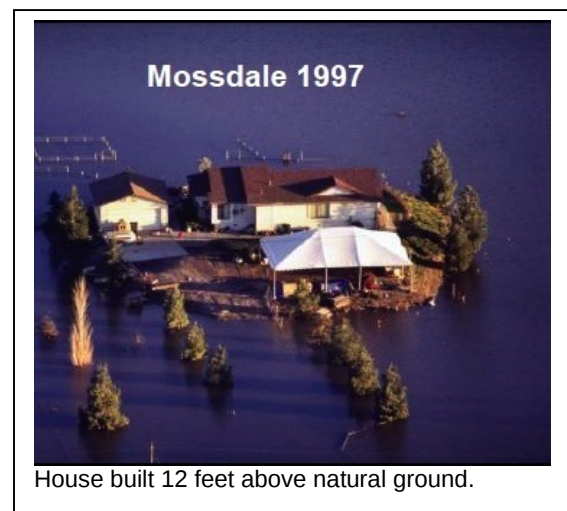
The Regions are in need of efficient and sustainable long-term operations and maintenance practices and procedures guided by the State. Some of these practices and procedures may require legislative action, new institutional arrangements, and additional revenue generation. This includes developing criteria and guidance for maintenance practices to facilitate maintenance and environmental compliance so required maintenance can be completed in a cost-effective and timely manner. Formalizing best management practices and/or obtaining programmatic permitting coverage to make the maintenance practices more efficient are potential components. While consolidation of LMAs may present some cost and communication efficiencies, none of the LMAs within the Regions expressed any desire to pursue consolidation. Securing sustainable funding is a key to enhanced O&M. The San Joaquin County Flood Control and Water Conservation District has identified a \$2 million per year shortfall in O&M funding. Other LMAs would also benefit from increased funding, but amounts were not defined for this RFMP.

In addition, the Regions support the O&M recommendations contained in the California Central Valley Flood Control Association's Rural LMA Work Group topic papers (see Section 6.5 and Appendix D for more discussion).

6.3. Floodplain Risk Management

This component focuses on activities in the floodplain to reduce the existing flood threat and support changes in land uses to reduce future flood threat in rural areas. This component includes:

- Raising and waterproofing structures and building berms [\$7 million Lower San Joaquin River Region and \$20 million Delta South Region]
- Land use and floodplain management [\$20 million Lower San Joaquin River Region and \$10 million Delta South Region]



- Flood Contingency Mapping [\$40,000 Lower San Joaquin River Region and \$100,000 Delta South Region]
- Governance Investigation [\$1 million combined for both Regions]

Within the Lower San Joaquin River Region, the raising and waterproofing of structures would be focused on RD 2096, Weatherbee Island, where the entire community is in a deep floodplain. Raising and waterproofing of structures within the Delta South Region would be for individual structures scattered across the Region.

A focus of land use and floodplain management is the delineation and evaluation of floodplains to assist local decision makers in their planning efforts and keeping this information up-to-date. The effort should also include work towards reforming the National Flood Insurance Program to provide for a more equitable implementation, especially for rural/agricultural areas (see Section 6.4.2 for a description).

While primarily emergency response tools, flood contingency maps can also assist in floodplain risk management by avoiding actions that conflict with emergency response.

The Regions do not plan to actively pursue changes in the governance structure in the near future, but have provided a \$1 million cost in this RFMP as a place holder for a potential future study. Section 0 provides more detail on governance considerations.

6.4. Recommended Process and Policy Changes

Regional flood management would be enhanced by several process and policy changes. Many of the following suggestions require action by State and federal agencies to change processes and policies, since changes are beyond the authority of the Regions. The Regions are willing to work with State and federal agencies on process and policy changes for flood management improvement throughout the Central Valley.

The following subsections describe these recommended actions.

6.4.1. *Programmatic Environmental Impact Report to Streamline O&M Permitting*

As mentioned in Section 3.5.2, obtaining permits for O&M are a major challenge for the LMAs. A programmatic environmental impact report (EIR) to allow LMA's to provide a permitting framework for the maintenance of levees and flood control structures would benefit the Lower San Joaquin River and Delta South regions. While various forms of "permit streamlining" have been attempted by many entities over the past several decades, the Regions are unaware of where these efforts have been used on a large, complicated system like the flood management system in the Central Valley. However, the Regions support the State's work to implement this action.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders	TBD	TBD	Flood Management	Ecosystem Management	Planning	\$\$\$* (high)
*\$\$\$ = Cost is estimated to be above \$1M						

6.4.2. Changes to NFIP for Agricultural Areas

As discussed in Section 3.5.3, changes are needed to the NFIP that will promote the sustainability of agriculture, as well as elsewhere in California and across the United States. The proposed changes described below are consistent with floodplain management principles and will minimize the risk of increased urbanization of the floodplain by facilitating continued agricultural use:

- Amend federal law to allow FEMA to establish a flood zone designation for agriculturally based communities, which would allow for replacement or reinvestment in infrastructure needed to sustain existing agricultural use in floodplains.
- Direct or support action by FEMA to develop and use insurance actuarial rates that reflect the reduced flood risks of agricultural use properties.
- Establish State and federal post-disaster agricultural recovery programs that recognize the national importance of sustainable agriculture, the consistency of agriculture with the wise use of floodplains, and that recovery from occasional flooding due to levee failures in SFHAs should be an integral part of such sustainable land use.
- The State of California should explore the viability of creating a rural flood insurance program which would allow communities to opt-out of the high-rate FEMA flood insurance.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders	TBD	TBD	Flood Management	TBD	Conceptual	\$\$* (medium)
*\$\$ = Cost is estimated to be less than \$1M						

6.4.3. *Legislative Changes to Facilitate Federal Disaster Assistance for Inactive PL 84-99 Levees*

As discussed previously, the PL 84-99 program only restores levees back to the pre-disaster conditions in the event levees with an active status fail. Since project levees are under a federal program (PL 84-99) they are not eligible for FEMA levee recovery assistance (i.e. rebuilding levees, pumping out of an island, etc.). Even if project levees are deemed ineligible for PL 84-99, FEMA is still not required to participate in recovery assistance. Since most project levees are currently deemed ineligible for PL 84-99, and ineligible for FEMA, there currently exists a huge potential disaster assistance liability.

Legislative changes at the federal level are needed to facilitate FEMA disaster assistance to PL 84-99 levee systems.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders	TBD	TBD	Flood Management	TBD	Conceptual	\$\$* (medium)
*\$\$ = Cost is estimated to be less than \$1M						

6.4.4. *Improve DWR Grant Funding Guidelines to be More Flexible for Multi-Benefit Projects*

Many local agencies rely on DWR funding to help implement a range of flood related projects. However, some DWR grant guidelines are only for specific purposes. When multiple grants are used, it is difficult for local sponsors to use these separate “pots” of money for a multi-benefit project.

The amount of accounting effort and grant management necessary to show that money from one grant was used for the “flood” portion of a project, and other funds were used for “other” benefits can be burdensome to local agency staff. Revisions to guidelines to accommodate and consider the multi-benefit potential of a particular project would simplify funding an entire project.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders	TBD	TBD	Flood Management	-	Conceptual	\$\$* (Low)
*\$\$ = Cost is estimated to be less than \$100,000						

6.4.5. Improve Flood Governance

The primary governance structure for flood management activities in the Regions currently rests with many LMAs. This diverse governance was partially modified with the Joint Exercise of Powers Agreement between the City of Stockton and San Joaquin County in May 1995 with the formation of SJAFCFA. SJAFCFA's jurisdiction consists of the coincident jurisdictions of its member agencies, which equates to the entirety of San Joaquin County and the City of Stockton, excluding the other incorporated cities in the county.

The existing governance structure with the on-the-ground responsibilities resting with the LMAs works extremely well for site specific O&M and project improvements do to the local knowledge and ability to respond quickly to developing problems. Although the small group meetings explored the possibility of consolidating two or more LMAs, no LMA representatives had a motivation to pursue consolidation. None of the LMAs were interested in taking on more O&M responsibilities, even with increased budgets that could accompany these responsibilities.

However, the Regions could benefit from a regional governance structure to help the LMAs secure funding and focus efforts to work towards regional projects and programs. This is especially true when looking to the future and questioning if the existing governance structure is adequate for the next 50 years.

The *San Joaquin County Urban Flood Protection Governance Study Report* was completed in July 2010. Although the report did not lead to direct changes in flood protection governance, it does provide a starting point for additional work to refine/expand flood governance for the Regions. Since there is not a strong motivation for any entity in the Regions to pursue a new governance structure, changes in the current governance structure is currently a low priority.

Project Identified By:	Agencies Responsible	Project Partners	Primary Benefit	Secondary Benefit(s)	Current Status	Estimated Total Cost
Stakeholders	TBD	TBD	Flood Management	-	Conceptual	\$1M*
<i>*The Regions do not plan on pursuing a governance study at this time.</i>						

If a governance study is conducted in the future, the study should consider the following issues in building on the above mentioned Governance Study Report:

1. Consider a governance structure that covers the entire watershed. Neither IRWMPs nor Flood management JPAs cover more than their individual areas of interest, say a groundwater basin for an IRWMP and the floodplains protected by levees for flood management. The Texas legislation for watershed authorities (Texas SB1), which

mandated governance consisting of urban, rural, and environmental interests may be a good model.

2. Flood management is governed by a patchwork of agencies at multiple levels. USACE/CVFPB built the levees, LMAs maintain them, cities and counties control land use behind them, and counties/DWR/USACE manage emergencies. The patchwork has limited organizational capacities, affecting their individual abilities to address big problems.
3. Local flood management funding can be via taxes, property assessments, or development impact fees. Taxes take 2/3 voter approval, assessments take 50%+1 voter approval, and impact fees can be enacted by a city or county, but have limited reliability for borrowing purposes. Voter approval is very difficult to secure.
4. The State's flood management concern focuses on areas protected by the State Plan of Flood Control, and reducing State liability.
5. USACE's concern is for the project that provides the highest national economic development, which can eliminate many projects with attractive benefit cost ratios. Their policies preclude funding improvements in sparsely populated areas.
6. Delta rural RDs are a special case. These are hydrologically separate areas with consolidated authority and responsibility, they know what needs to be done, and they have a close relationship with their landowners. Their problem is with the limits to payment capacity and affordability, but their governance works well.
7. Urban areas often have a patchwork of responsible agencies, with no agencies responsible for the whole problem. These agencies often have overlapping property assessments and taxes, which confuses voters and begs the question of why problems aren't solved. ULOP will require cities and counties to "certify" their protection system, yet they have little or no control over that protection system. The LMAs aren't necessarily motivated in improving their levees to a higher standard to facilitate urbanization due to liability and funding concerns.
8. Integrated solutions are made difficult by differing expertise. Water supply people and flood control people speak a different language ("acre-feet", versus "cubic feet per second") and are concerned with different issues - the laws are different, the battles are different, and the players are different. USACE and CVFPB do not get involved in water supply. In addition, DWR has vastly different organizations for water supply and flood management.
9. Few local agencies have the mission, authority, or funding to improve habitat. All agencies mitigate for their impacts, but little more. Habitat advocacy comes in the form

of State and federal regulatory requirements, and State, federal, and NGO funding motivators. Seldom are local funding sources established for habitat, beyond mitigation.

6.5. Recommendations of the Rural LMA Work Group

In late 2012, the California Central Valley Flood Control Association established the Rural LMA Work Group to support regional flood management planning efforts. The purpose of the work group was to identify and describe problems that are unique to rural areas and propose solutions/actions for inclusion in the RFMPs. This effort was based on the belief that sustainable, systemwide flood management must consider the role of rural communities and agricultural areas which provide the opportunity to realize multiple objectives identified in the CVFPP.

With thoughtful, proper planning and implementation, rural lands, particularly farmlands, can provide both environmental benefits and flood risk reduction benefits during extreme events for urban areas, while simultaneously meeting the intrinsic purposes and goals of agricultural interests.

The existing flood management paradigm in the Central Valley depends heavily on the sustainability of these rural leveed systems. Recognizing the importance of these rural areas, the Workgroup identified key topics of importance whose impacts on rural levees are unique. The RFMP supports the topic papers and their recommendations. These topic papers prepared by the Rural Work Group can be found in Appendix D.

7. Implementation Schedule and Consistency with the SSIA

This chapter shows the implementation schedule for projects/programs and evaluates how they are consistent with the State Systemwide Investment Approach (SSIA) outlined in the 2012 CVFPP. This chapter also includes a comparison of cost between the RFMP and the SSIA for the Lower San Joaquin River and Delta South regions.

7.1. Prioritized Implementation Schedule

The prioritization of potential projects is focused on the general timeframes when the projects are expected to be implemented. The use of “prioritization” in this RFMP is not a ranking from the highest scoring project to the lowest ranking. Instead, prioritization refers to the order of implementation. Tier 1 projects are those expected to be implemented in the next five years. These are the most critical projects that need to be implemented in the near-term. Tier 2 projects are those that are expected to be implemented in the six to twelve year period. Tier 3 projects are those expected to be implemented beyond twelve years in the future.

The order of implementation is based primarily on the need for risk reduction and the readiness of the project for implementation. These rely on the experience of the engineers and LMA representatives that know their levees. The following two sections show the estimated implementation tiers for proposed projects and programs for the Delta South Region and the Lower San Joaquin River Region.

7.1.1. *Implementation Schedule for Delta South Region*

Project/program implementation is made up of three parts; 1) the LMA-specific projects, 2) the projects of regional significance (benefit multiple LMAs), and 3) the residual risk management actions that apply to all LMAs. The implementation schedule including estimated costs over time for each of these is shown in the following tables.

- Table 12 shows site-specific projects for the individual LMAs. See Section 5.1 and Appendix C for a description of each project. Appendix C also shows a summary of the types of site-specific projects without the RD designations. This allows the reader to see that most of the erosion protection occurs in tier 1 while most of the work to correct seepage/slope instability occurs in tier 3.
- Table 13 shows the projects of regional significance that influence many of the LMAs. The projects would also influence areas in the Lower San Joaquin River Region, but are shown here because their physical location is within the Delta South Region.
- Table 14 shows the residual risk management actions for the Delta South Region.

Table 12 – Delta South Region LMA-Specific Projects Schedule and Costs

Projects by LMA				\$ million			
				Tier 1	Tier 2	Tier 3	Total
RD 1							
		Improve Dryland Levee (Border RD 2089)				1.3	1.3
		Erosion Protection		3.1			3.1
		Seepage/Stability Repair		43.0			43.0
		Study Setback Levees		0.1			0.1
		Penetrations		0.3			0.3
RD 2		Dryland Levee Improvements (Border RD 2)				32.0	32.0
		PL 84-99 Improvements		0.5			0.5
		Dryland Levee Improvements				26.0	26.0
		Erosion Protection		10.0			10.0
		Geometry Improvements				30.0	30.0
		Seepage Repairs			85.0		85.0
		Penetrations/Encroachments			1.0		1.0
RD 524		Study Setback Levees			0.1		0.1
		PL 84-99 Improvements		0.9			0.9
		Erosion Protection		3.7			3.7
		Seepage Repairs		5.0			5.0
RD 544		RR Crossing (ER Access)			0.4		0.4
		Penetrations			5.0		5.0
RD 544		PL 84-99 Improvements		12.0			12.0
		Erosion Protection		1.5			1.5
		Seepage Repairs		10.0		55.0	65.0
		Encroachments			5.0		5.0
		Slope Stability			5.0		5.0
		Study Setback Levees			0.1		0.1
RD 684							
		PL 84-99 Improvements		1.0			1.0
		Setback Levee		2.6			2.6
		Seepage Repairs		2.5			2.5
RD 773		Improve Dryland Levee		0.4			0.4
							0.0
		PL 84-99 Improvements		7.9			7.9
RD 1007		Erosion Protection		10.9			10.9
		Geometry Improvements				42.2	42.2
RD 1007		Geometry Improvements				30.4	30.4
		Restore PC/Old River				10.0	10.0
		Protect Tracy WWTP			2.0		2.0
RD 2058							
		Erosion Protection		0.8			0.8
		Seepage Repairs			25.1		25.1
		Geometry Improvements		2.6			2.6
		Slope Stability			11.4		11.4
RD 2062		Habitat Mapping		0.1			0.1
		Phase 2 ULOP		60.0			60.0
		Phase 3 ULOP			110.0		110.0
RD 2085		Study Paradise Cut		1.5			1.5
		Erosion Protection		0.3			0.3
RD 2089		Seepage Repairs			34.0		34.0
		PL 84-99 Improvements		0.5			0.5
		Erosion Protection		2.5			2.5
		Seepage/Stability Repair				29.5	29.5
		Restore Capacity to Salmon Slough				1.0	1.0
RD 2095		Study Setback Levees		0.1			0.1
		Erosion Protection		0.5			0.5
RD 2107		Seepage/Stability Repair			22.8		22.8
RD 2107		PL 84-99 Improvements				2.8	2.8
Total				184.1	306.8	260.2	751.1

Table 13 – Delta South Region Projects of Regional Significance Schedule and Costs

Regional Projects for All LMAs					\$ million			
					Tier 1	Tier 2	Tier 3	Total
	Paradise Cut Expansion				5	80	250	335
	Middle River Siltation study				0.3			0.3
				Total	5.3	80	250	335.3

Table 14 – Delta South Region Residual Risk Management Schedule and Costs

Residual Risk Management					\$ million			
					Tier 1	Tier 2	Tier 3	Total
	Flood O&M							
	Identify After-event Erosion				5	6	14	25
	Develop Enhanced O&M				3	3.6	8.4	15
	Enhanced Emergency Response							
	All-weather Road RD 1				2			2
	All-weather Road RD 2				2			2
	All-weather Road RD 684				0.4			0.4
	All-weather Road RD 773					6		6
	All-weather Road Rd 2058				0.1			0.1
	All-weather Road RD 2089					0.6		0.6
	Additional Info. Collect/Share				1.5	1.8	8	11.3
	Local ER Planning				2	2.4	5.6	10
	Additional Forecasting/Notific.				2	2.4	5.6	10
	Floodplain Risk Management							
	Flood Contingency Map RD 1				0.02			0.02
	Flood Contingency Map RD 2				0.02			0.02
	Flood Contingency Map RD 524				0.02			0.02
	Flood Contingency Map RD 773				0.02			0.02
	Flood Contingency Map RD 2089				0.02			0.02
	Raise Structures					20		20
	Land Use and Floodplain Man.				2.5	3	4.5	10
				Total	20.6	45.8	46.1	112.5

7.1.2. *Implementation Schedule for Lower San Joaquin River Region*

Like for the Delta South Region, project/program implementation for the Lower San Joaquin River Region is made up of three parts; 1) the LMA-specific projects, 2) projects of regional significance (benefit affect multiple LMAs), and 3) the residual risk management actions that apply to all LMAs. The implementation schedule including estimated costs over time for each of these is shown in the following tables.

- Table 15 shows site-specific projects for the individual LMAs (and Stockton) for the Lower San Joaquin River Region. See Appendix C for a description of each project. Appendix C also shows a summary of the types of site-specific projects without the RD designations.
- Table 16 shows the projects of regional significance that influence many of the LMAs in the Lower San Joaquin River Region. Many of these would also provide benefits to the Delta South Region.
- Table 17 shows the residual risk management actions for the Lower San Joaquin River Region.

Table 15 – Lower SJ River Region LMA-Specific Projects Schedule and Costs

Projects by LMA/City				\$ million			
				Tier 1	Tier 2	Tier 3	Total
Stockton Metropolitan Area/(County)							
	Raise Duck Cr. Levees			0.0			0.0
	Raise Little Johns Levees			0.5			0.5
	Replace Bridge (Bear C.)				0.6		0.6
	Replace Bridge (Mormon Slough)				0.6		0.6
	Bear Cr. System PL 84-99 Imp.			17.0	20.0		37.0
	Calaveras System PL 84-99 Imp.			10.0	14.0		24.0
	Restore Mormon Channel					50.0	50.0
	Morman Bank Repair				13.5		13.5
	WWTP Floodwall (RD 404)					1.5	1.5
	Raise WW Pond Dikes				2.0		2.0
	200-year map/masterplan Benefit Area 1			2.1			2.1
	200-year ULDC Analysis			0.2	5.0		5.2
	USACE NED (use as master plan)					1027.0	1027.0
	Smith Canal Closure			36.0			36.0
RD 17							
	Walthall Levee Extension				18.0		18.0
	200-Year ULOP			20.0	130.0		150.0
RD 404							
	Cutoff Wall (Seepage)			1.1			1.1
	Erosion Protection			0.6			0.6
	Interior Drainage			2.7			2.7
	Resolve Levee Penetrations				2.0		2.0
RD 1608							
	Sediment Removal			2.5			2.5
	Seepage (Slurry Wall)			1.5			1.5
RD 1614							
	Internal Drainage (pump station)			2.4			2.4
RD 2042							
	ULDC Analysis			1.5			1.5
RD 2064							
	PL 84-99 Improvements			0.8			0.8
	Erosion Protection					5.4	5.4
	Seepage Repair					46.0	46.0
RD 2074							
	Improve Dryland Levee			19.0			19.0
	Erosion Protection			5.0			5.0
	Seepage Repair				7.6		7.6
RD 2075							
	Geometry Improvements					32.0	32.0
	Erosion Protection					4.5	4.5
	Seepage Repair					20.3	20.3
RD 2094							
	Improve Dryland Levee					13.8	13.8
	Geometry Improvements					9.2	9.2
	Seepage/Stability Repairs					11.5	11.5
RD 2096							
	Geotechnical Assessment			0.1			0.1
	Pump Station Electrical				0.2		0.2
	Restore Channel Capacity				0.4		0.4
	Raise Structures (listed under Risk Red.)						0.0
RD 2115							
	PL 84-99 Improvements				3.4		3.4
	Erosion Protection					1.3	1.3
	ULDC Analysis				1.5		1.5
RD 2119							
	PL 84-99 Improvements				2.0		2.0
	Seepage Repair				4.6		4.6
RD 2126							
	Internal Drainage (pump power)				1.0		1.0
	ULDC Analysis			1.0			1.0
Total				123.9	226.4	1222.5	1572.8

Table 16 – Lower SJ River Region Projects of Regional Significance Schedule and Costs

Regional Projects for All LMAs					\$ million			
					Tier 1	Tier 2	Tier 3	Total
	Master Plan of San Joaquin River Corridor				2.0			2.0
	San Joaquin National Wildlife Refuge Expansion						15.0	15.0
	Floodplain at Dos Rios (transitory storage)					8.5		8.5
	Study Reservoir Storage Improvements					2.0		2.0
	Coordinated Reservoir Ops				1.5	2.0	2.5	6.0
	Dredge SJ River from Paradise Cut to Stanislaus R					60.0		60.0
				Total	3.5	72.5	17.5	93.5

Table 17 – Lower SJ River Region Residual Risk Management Schedule and Costs

Residual Risk Management					\$ million			
					Tier 1	Tier 2	Tier 3	Total
	Flood O&M							
	Increase SJ County O&M				10.0	12.0	28.0	50.0
	Identify After-event Erosion				5.0	6.0	14.0	25.0
	Develop Enhance O&M				3.0	3.6	8.4	15.0
	Enhanced Emergency Response							
	Improve SJ County Alert System				0.1	0.2	0.4	0.6
	All-weather road RD 2064				1.0			1.0
	Additional Information Collect/Share				2.0	2.4	10.6	15.0
	Local ER Planning				4.0	4.8	11.2	20.0
	Additional Forecasting/Notific.				2.0	2.4	5.6	10.0
	Floodplain Risk Management							
	Raise Structures & Protect Utilities					7.0		7.0
	Flood Contingency Map for RD 2115				0.0			0.0
	Flood Contingency Map for RD 2126				0.0			0.0
	Land Use and Floodplain Management				5.0	6.0	9.0	20.0
				Total	32.2	44.4	87.2	163.7

7.1.3. *Simplified Implementation Schedule for Both Regions*

Figure 23 shows the cumulative estimated implementation costs for each region over time. The plot for each region includes the site-specific projects, the projects of regional significance, and the residual risk management actions.

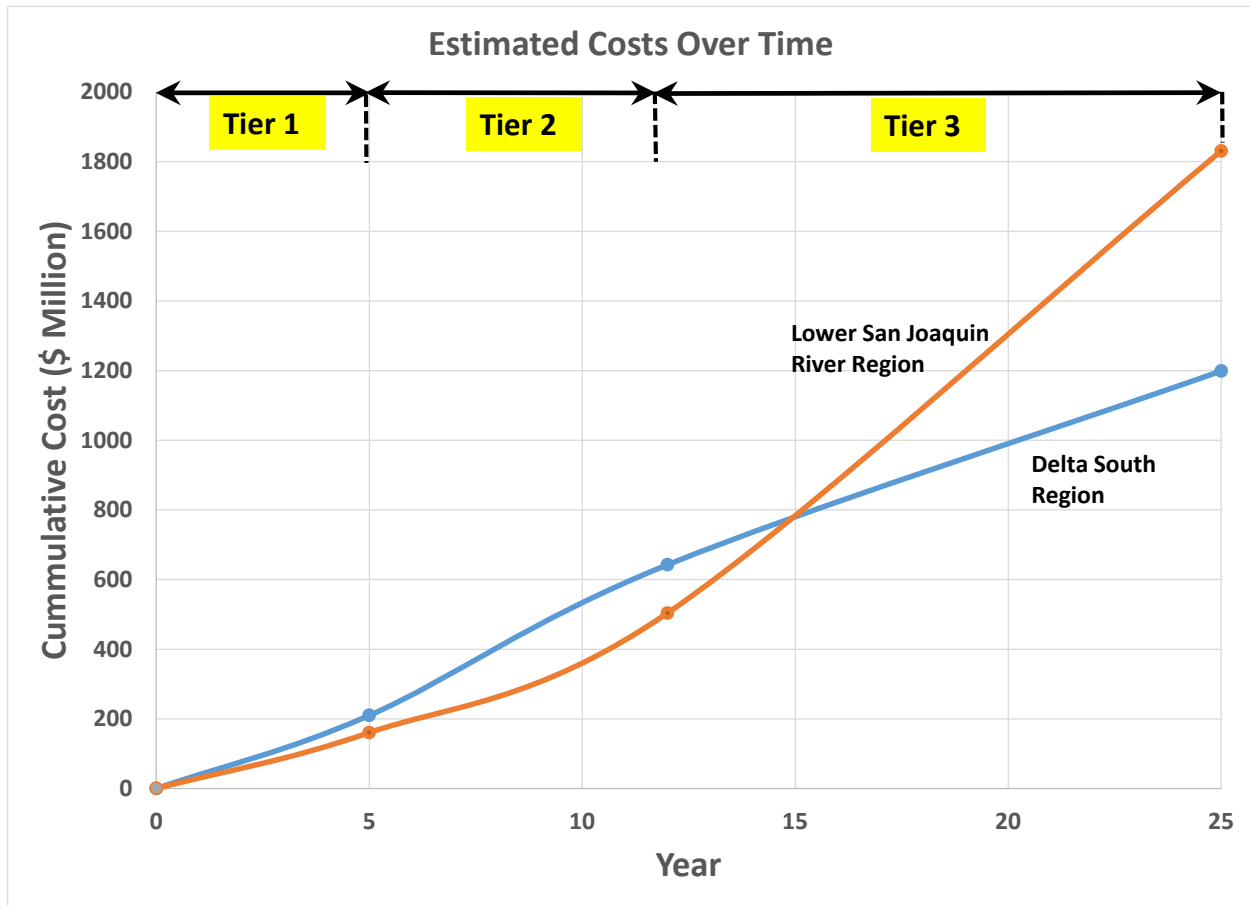


Figure 23 – Simplified Implemented Schedule

7.2. Consistency with the SSIA

The SSIA sets a strategy for responsibly meeting the State's objectives to improve public safety, ecosystem stewardship, and economic sustainability, while recognizing the financial challenges facing local, State, and federal governments. The SSIA is relevant to the RFMP because potential projects that are consistent with SSIA objectives may be more likely to receive State support.

The Regions believe that all the potential projects and nonstructural actions identified in the RFMP are consistent with the SSIA. Flood system improvements are proposed for urban and rural/agricultural areas in line with those shown in the SSIA. Following is an overview of how projects and programs identified in this RFMP are consistent with the SSIA:

- **Goals** – The goals of the RFMP mirror those of the CVFPP.
- **Ecosystem Opportunities** – Both the SSIA and the RFMP have considered opportunities for ecosystem enhancements. The river and tributaries corridors provide opportunities for setback levees, river edge habitat, and other site specific enhancements. The Regions believe that the San Joaquin River corridor from the Vernalis gage to the head of Paradise Cut and along an expanded Paradise Cut provides the most unconstrained opportunities for enhancements. Outside these reaches, opportunities are limited to enhancements associated with levee improvements for flood risk reduction. Also, the Regions will consider opportunities to enhance ecosystem benefits of existing in-channel islands and river margins as part of adjacent flood projects. However, the Regions believe that the time to commit to those enhancements is during future project development planning.
- **Delta Projects** – While the primary goal of the CVFPP specifically refers to structural and nonstructural actions for protecting the Delta, Section 3.9 of the CVFPP outlines the SSIA Considerations for the Sacramento-San Joaquin Delta for areas outside the SPFC Regions. By DWR's own design, the Delta South Region is within the SPFC planning area and was originally identified as a separate region for the RFMP effort. The SSIA appears to remain silent about specific levee improvements within the Delta South Region, but did include a cost allowance for potential hydraulic impacts for the broader Delta (within and outside the SPFC planning area) from upstream actions. The RFMP includes both levee improvements and projects to mitigate for upstream hydraulics. As such, the projects for mitigation of hydraulic impacts are compatible with the SSIA. The Regions believe that the levee projects are compatible with the SSIA, or at the least, not incompatible.
- **Paradise Cut** – The SSIA (page 3-15 of CVFPP) calls for evaluation of the construction of a new bypass in the south Delta (expansion of Paradise Cut and/or other south Delta waterways). For the RFMP, the planning team investigated available information on Paradise Cut and Mormon Channel bypasses. The team held two symposiums on

Paradise Cut and the RFMP includes a Paradise Cut base-level expansion and further evaluation for a larger expansion. The SSIA says that, “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.” The Paradise Cut expansion has the potential to lower flood stages along portions of the San Joaquin River by about 20 inches and provide valuable habitat for special status terrestrial species.

- **Stockton Metropolitan Area** – The SSIA (page 3-9 of CVFPP) includes improvements to SPFC levees along the San Joaquin River and tributaries, evaluation of gates and flood control structures, and potential evaluation of other non-project levees. The RFMP includes all of these as projects. While the SSIA included 200-year ULOP levees along Bear Creek, the RFMP includes improvements to PL 84-99 due to local knowledge about performance of these levees. In addition, the USACE Lower San Joaquin River Feasibility Study did not include Bear Creek or Mormon Channel improvements in its NED plan. Instead, improvements were recommended along the lower portion of Mosher Slough. The USACE also included improvement of other levees, especially along the Delta front. However, regardless of where levee improvements are proposed for the metropolitan area, they are compatible with the SSIA objective of reducing flood risk. Due to local affordability issues, some areas of the metropolitan area that are already developed will maintain 100-year protection in the near-term and strive for 200-year protection in the future if found to be cost-effective.
- **Rural/Agricultural Areas** – The SSIA (page 3-10 of CVFPP) recognizes that improving rural levees to federal engineering guidance and design standards may be cost prohibitive. The State also wants to discourage incompatible development within floodplains of rural/agricultural areas. The RFMP is consistent with these concepts as rural areas generally target the PL 84-99 standard for their levees.
- **Development within RD 17** – The RFMP acknowledges that RD 17 is a developing area as it already includes about 42,000 people and qualifies as an urban area (over 10,000 people). The Regions believe that this developing area is different than the rural/agricultural areas above since its levees already protect an urban population. The regions believe that the intent of DWR’s language for discouraging incompatible development was intended for rural/agricultural levees and not for a levee that is already protecting an urban population. The SSIA seems to agree with this opinion since it included 200-year ULOP levee improvements for RD 17. The Regions believe that the projects included in the RFMP are consistent with the SSIA. At the same time, the Regions are looking into local agricultural land conservation programs and the possibility of directing where land can be set aside to benefit the Regional Strategy described in Section 4.6.

- **Flood Storage** – The SSIA (page 3-15) did not identify specific reservoir or transitory storage, but leaves the door open to including them in the feasibility studies. The RFMP includes a study of new reservoir storage. Transitory storage did not show major benefits for flood stage reduction, but the RFMP includes projects for the multiple benefits they provide. Any of these storage concepts are consistent with the SSIA.
- **Reservoir Operational Changes** – Both the SSIA and the RFMP include Forecast-Coordinated Operations (F-CO) and Forecast-Based Operations (F-BO).
- **Mitigation of Hydraulic Impacts** – Both the SSIA and the RFMP include features to mitigate potential flood stage increases due to other flood system improvements.
- **Non-State Plan of Flood Control Levees** – Both the SSIA and the RFMP acknowledge and account for improvements to both urban and nonurban non-SPFC levees.
- **Allowance for Climate Change** – Both the SSIA and the RFMP acknowledge potential future increases in flood stages due to climate change. The USACE’s NED plan for the urban areas includes sea level rise evaluations. Most Delta RDs have a levee target that allows for more freeboard than prescribed by PL 84-99. In some cases, Delta RDs are ultimately shooting for a wider levee crest that will facilitate easy levee raising in the future. Some of the urban RDs along the Delta front in Stockton have a wide buffer zone between levees and development to provide more room for future levee improvements. See Section 4.7 for more explanation of the Regions’ adaptive approach to deal with climate change.
- **Residual Risk Management** – Both the SSIA and the RFMP include a range of residual risk management actions ranging from emergency response, flood operations and maintenance, and floodplain risk management.
- **All-Weather Roads** – The SSIA included all-weather roads in the enhanced emergency response component of the above residual risk management. The RFMP found that all-weather roads were considerably more expensive than indicated in the SSIA for the Delta South Region due to the need for access ramps, turnarounds, passing areas, and other features.
- **Land Use** – The Regions have several methods to control development and provide conservation of agriculture land. The General Plans include open areas, buffer zones (150 feet for example in places in Lathrop). Collectively, these exclude major areas from development. This is consistent with the SSIA theme of limiting increasing risk due to development. Also, the RFMP is considering ways to compensate for increasing levels risk from development by providing levels of flood protection above 200-year ULOP. Paradise Cut may be one method to achieve that.

- **Recommendations for Process and Policy Changes** – The RFMP has recommended several changes in process and policy (see Section 6.4) that could significantly improve flood management in the Central Valley and contribute to system sustainability that should be compatible with DWR’s intent to improve the 2017 CVFPP over the 2012 CVFPP.
- **Cost Comparison** – The SSIA estimated the total cost of improvements in the Delta South Region to be between \$584 million and \$736 million. The RFMP estimated a cost of \$1.2 billion in the Delta South Region, with range of plus or minus 30 percent. The SSIA estimated the total cost of improvements within the Lower San Joaquin River Region to be between \$732 million and \$933 million. The RFMP estimated a cost of \$1.8 billion in the Lower San Joaquin Region, with a range of plus or minus 30 percent. Table 18 show a breakdown of these costs into urban improvements, rural improvements, projects of regional significance, and residual risk management. The cost difference between the SSIA and the RFMP does not indicate incompatibility, but with level of detail and in obtaining stakeholder input.

Table 18 – Estimated Cost Comparison for SSIA and RFMP

Delta South Region	Estimated Costs in \$ Millions	
	SSIA	RFMP¹
Urban Improvements	\$0 to \$0	\$172 ²
Rural Improvements	\$47 to \$52	\$580
Projects of Regional Significance ³	\$427 to \$549	\$335
Residual Risk Management	\$110 to \$135	\$112
Total Costs	\$584 to \$736	\$1,199
Lower San Joaquin River Region		
Urban Improvements	\$626 to \$809	\$1,416 ⁴
Rural Improvements	\$17 to \$19	\$157
Projects of Regional Significance ³	\$7 to \$8	\$94
Residual Risk Management	\$82 to \$97	\$163
Total Costs	\$732 to \$933	\$1,830
Total Estimated Costs for Both Regions	\$1,316 to \$1,669	\$3,029
¹ Estimated cost for RFMP are plus or minus 30 percent ² All local developer costs (River Islands, RD 2062) ³ SSIA uses the term, “System Projects” instead of “Projects of Regional Significance” ⁴ Expect to lower cost based on ULDC analyses		

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8. Financial Plan

The Financial Plan for the Regions is contained in Appendix E. The following sections provide a brief summary of the Financial Plan.

8.1. Regional Economic Profile

Communities within the Regions are anticipated to experience rapid and sustained growth in both population and employment. The three major jurisdictions are predicted to add approximately 74,000 new housing units and 72,000 new jobs by 2040. This is growth that is already officially planned, not growth expected from any anticipated investment in future flood management.

The agricultural economy that predominantly defines the Regions is critical to the economic viability of the supporting urban centers throughout the Regions. The role of food production within the Central Valley is critical to the economic security of the Regions and the State as a whole.

The San Joaquin Valley has also established itself as a major logistics/warehousing node for Northern California by leveraging its transportation infrastructure and proximity and accessibility to several other regional markets which make it an ideal location for distribution. A significant portion of the Regions' warehouse distribution stock has been added in recent years as evidenced by falling vacancy rates and over 2.4 million square feet of net absorption of industrial space in 2013, indicating the continued strengthening of this sector. The goods movements and logistics role is important to economic viability and important to the economic security of the State as a whole.

Flood risk reduction projects and management actions are needed to protect all these economic sectors. The Regions strongly believe that this local economy of statewide importance should not be forsaken due to lack of investment in flood system improvements. The potential flood system improvements are not the reason for the economic growth. In addition, flood system improvements are needed simply to protect existing lives and property.

8.2. Funding Sources

Within the Regions, flood management investments from federal, State and local sources have been made and are also currently underway. California's *Flood Future* report (and associated Attachment I: *Finance Strategies*) provides an excellent overview and description of the general funding regime currently being utilized to enhance California's flood system. The Attachment also identifies and describes many of the funding and financing mechanisms available to local agencies to fund flood control infrastructure and services. Appendix E to this RFMP also

provides a summary of State, federal, and local (SJAFCA, San Joaquin County Flood Control & Water Conservation District, and Reclamation District) funding.

8.3. Project Funding Strategies

The Regions have previously made efforts to implement their own unique combination of federal, State and local funding sources to manage flood risk overtime. The objective of the Financial Plan is to present a resource of information, make an assessment of the ability to fund new improvements within the Regions, and present general strategies and next steps for different groupings of improvements that the Regions, as a whole and stakeholders individually, can use to develop more detailed project specific financial plans in the future.

8.3.1. Regionally Significant Projects

These projects are significant in that they provide benefits to lands throughout the Regions and some also incorporate multi-benefit benefits beyond flood management. Due to the complexity of these projects and the uncertainty concerning potential partners, funding for these projects needs to be addressed as these projects move from the conceptual stage to the feasibility analysis stage.

Future project-specific financial plans should attempt to incorporate a myriad of potential non-local funding sources available through various programs. There will be opportunities for projects to blend funding from various programs from the federal and State level. The challenge for these projects will be to compile a strategy for blending these funding sources together by parsing out the scopes of work in an efficient manner and matching the available funding to those scopes to maximize opportunities. To the extent that the Regions have identified certain benefits from these proposed projects and can claim these benefits to leverage funding for other regional priorities, then transferring local dollars from future funding capacity captured in the Regions toward these projects may make sense.

Ultimately, the lead entity that shepherds projects forward should seek leverage funding from the State through a forthcoming System Wide Flood Risk Reduction program. The State has indicated that funding for feasibility level work could provide up to 100% cost-share. It will be important to ensure that feasibility studies be scoped to include the development of financial plans as part of the analysis.

Feasibility level financial planning work should include:

- Identification of the beneficiaries of the proposed improvements
- Development of a methodology to allocate the costs and associated benefits of the needed improvements
- Development of a detailed funding and financing plan that clearly articulates the funding mechanisms that will be utilized, the lead entities and agencies responsible for

implementing them and any needed financing associated with project implementation. Any evaluation should clearly account for and articulate those improvements above and beyond those currently identified and being funded as part of other programs and identify opportunities to leverage multiple funding sources.

8.3.2. *Specific Projects/Efforts*

The Regions have identified projects and flood management efforts that have been described in the RFMP by project type. The following Table 19 and Table 20 presents summaries of the costs by funding source (i.e. federal, State and local sources) and further summarize the costs as near-term (those costs identified as Tier 1 and 2 costs) versus the total cost long-term costs. Because of the limited availability of federal funding, as further discussed below, the near-term costs have only been categorized with funding from State or local sources. Costs from federal sources have only been categorized as funded in the long-term.

State cost sharing has been assumed based upon available DWR funding program cost sharing guidelines, however, it is important to note that DWR cost sharing criteria typically considers project attributes that include the project's location, potentially the specific project sponsor, specific project benefits and other project specific features that go beyond simply the project type. Therefore, the assumed State cost sharing amounts shown in the tables could be above or below the actual State cost sharing for a specific improvement as implemented by a local project sponsor. The balance of a project's cost is assumed to be funded from local sources. Federal funding has been assumed on a limited basis for the total project costs, however, there are many factors that will affect the ability of the Regions to garner federal funding.

Table 19 – Delta South Region Projects/Programs by Costs by Funding Source

<u>Regional Projects for All LMAs</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
Paradise Cut Expansion	80.75	4.25	85	0	318.25	16.75	335
Middle River Siltation study	0.15	0.15	0.3	0	0.15	0.15	0.3
Total	80.9	4.4	85.3	0	318.4	16.9	335.3

<u>Residual Risk Management</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
Flood O&M							
Identify After-event Erosion	5.5	5.5	11	0	6.25	18.75	25
Develop Enhance O&M	0	6.6	6.6	0	0	15	15
Enhanced Emergency Response							
All-weather Road RD 1	1.5	0.5	2	0	1.5	0.5	2
All-weather Road RD 2	1.5	0.5	2	0	1.5	0.5	2
All-weather Road RD 684	0.3	0.1	0.4	0	0.3	0.1	0.4
All-weather Road RD 773	4.5	1.5	6	0	4.5	1.5	6
All-weather Road Rd 2058	0.075	0.025	0.1	0	0.075	0.025	0.1
All-weather Road RD 2089	0.45	0.15	0.6	0	0.45	0.15	0.6
Additional Info. Collect/Share	2.475	0.825	3.3	0	5.65	5.65	11.3
Local ER Planning	2.2	2.2	4.4	0	5	5	10
Additional Forecasting/Notific.	2.2	2.2	4.4	0	5	5	10
Floodplain Risk Management							
Flood Contingency Map RD 1	0	0.02	0.02	0	0	0.02	0.02
Flood Contingency Map RD 2	0	0.02	0.02	0	0	0.02	0.02
Flood Contingency Map RD 524	0	0.02	0.02	0	0	0.02	0.02
Flood Contingency Map RD 773	0	0.02	0.02	0	0	0.02	0.02
Flood Contingency Map RD 2089	0	0.02	0.02	0	0	0.02	0.02
Raise Structures	0	20	20	0	0	20	20
Land Use and Floodplain Man.	0	5.5	5.5	0	0	10	10
Total	20.7	45.7	66.4	0	30.225	82.275	112.5

<u>Projects by LMA/City</u> <u>Summary of Improvement Type by Source</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
HMP Geometry	0	0	0	0	0	0	0
PL 84-99 Geometry	17.10075	5.70025	22.801	0	19.20075	6.40025	25.601
Penetrations & Enroachments	8.4645	2.8215	11.286	0	7.9002	3.3858	11.286
Seepage/Slope Stability	184.8	61.6	246.4	0	248.175	82.725	330.9
Erosion	24.9	8.3	33.2	0	24.9	8.3	33.2
Other Geometry	1.95	0.65	2.6	0	78.9	26.3	105.2
Improve Dryland Levee	0.3	0.1	0.4	0	44.775	14.925	59.7
Channel Improvements	0	0	0	0	7.7	3.3	11
Internal Drainage	0	0	0	0	0	0	0
Improve to 200-year ULOP	127.5	42.5	170	0	127.5	42.5	170
Other Structures	1.68	0.72	2.4	0	1.68	0.72	2.4
Analysis	0.9	0.9	1.8	0	1.35	0.45	1.8
Total	367.6	123.3	490.9	0.0	562.1	189.0	751.1
Total DS Regional Plan Costs by Source	469.2	173.4	642.6	0.0	910.7	288.2	1198.9

Table 20 – Lower San Joaquin River Region Projects/Programs by Costs by Funding Source

<u>Regional Projects for All LMAs</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
Master Plan for Mosdale to Stanislaus Corridor	1	1	2	0	1	1	2
San Joaquin National Wildlife Refuge Expansion	0	0	0	7.5	3.75	3.75	15
Floodplain at Dos Rios (transitory storage)	4.25	4.25	8.5	4.25	2.125	2.125	8.5
Study Reservoir Storage Improvements	1	1	2	0	1	1	2
Coordinated Reservoir Ops	1.75	1.75	3.5	0	3	3	6
Dredge SJ River from Paradise Cut to Stanislaus R	45	15	60	0	45	15	60
Total	53	23	76	11.75	55.875	25.875	93.5

<u>Residual Risk Management</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
Flood O&M							
Increase SJ County O&M	0	22	22	0	0	50	50
Identify After-event Erosion	5.5	5.5	11	0	6.25	18.75	25
Develop Enhance O&M	0	6.6	6.6	0	0	15	15
Enhanced Emergency Response							
Improve SJ County Alert System	0.1375	0.1375	0.275	0	0.3125	0.3125	0.625
All-weather road RD 2064	0.75	0.25	1	0	0.75	0.25	1
Additional Information Collect/Share	2.2	2.2	4.4	0	7.5	7.5	15
Local ER Planning	4.4	4.4	8.8	0	10	10	20
Additional Forecasting/Notific.	2.2	2.2	4.4	0	5	5	10
Floodplain Risk Management							
Raise Structures & Protect Utilities	3.5	3.5	7	0	0	7	7
Flood Contingency Map for RD 2115	0.01	0.01	0.02	0	0	0.02	0.02
Flood Contingency Map for RD 2126	0.01	0.01	0.02	0	0	0.02	0.02
Land Use and Floodplain Management	5.5	5.5	11	0	0	20	20
Governance Investigation	0.5	0.5	1	0	0	1	1
Total	24.7	52.8	77.5	0.0	29.8	134.9	164.7

<u>Projects by LMA/City</u> <u>Summary of Improvement Type by Source</u>	Near Term (Tier 1 & 2)			Long Term Total (All Tiers)			
	\$ million			\$ million			
	State	Local	Total	Fed	State	Local	Total
HMP Geometry	0	0	0	0	0	0	0
PL 84-99 Geometry	50.4	16.8	67.2	0	50.4	16.8	67.2
Penetrations & Enroachments	1.5	0.5	2	0	1.4	0.6	2
Seepage/Slope Stability	11.1	3.7	14.8	0	69.45	23.15	92.6
Erosion	4.2	1.4	5.6	0	12.6	4.2	16.8
Other Geometry	1.8615	0.6205	2.482	0	32.7615	10.9205	43.682
Improve Dryland Levee	27.75	9.25	37	0	38.1	12.7	50.8
Channel Improvements	12.3	4.1	16.4	0	46.48	19.92	66.4
Internal Drainage	3.15	3.15	6.3	0	3.15	3.15	6.3
Improve to 200-year ULOP	112.5	37.5	150	765.05	308.9625	102.9875	1177
Other Structures	26.04	11.16	37.2	25.155	27.09	-13.545	38.7
Analysis	5.65	5.65	11.3	0	8.475	2.825	11.3
Total	256.5	93.8	350.3	790.2	598.9	183.7	1572.8
Total LSJ Regional Plan Costs by Source	334.2	169.6	503.8	802.0	684.6	344.4	1830.9

8.4. Local Funding Capacity for Additional Improvements & Services

Given the existing constraints, namely Propositions 13 and 218, of local jurisdictions to generate additional local funding for improvements and services (O&M), the two most feasible ways for local jurisdictions to generate funding are from voter approved taxes and assessments and self-imposed development impact fees. The study team performed a rough assessment (see Attachment 1 to Appendix E) to determine the relative remaining local funding capacity of the Regions to fund additional flood control improvements and services.

It's important to note that the analysis presented in Attachment 1 to Appendix E does not take into consideration other taxes and assessments currently burdening the area along with future needs for other infrastructure and public services. It will be important to consider an area's ability to generate additional taxes and assessments and other uses of taxing capacity. The analysis employs two approaches to estimate local funding capacity. The analysis determines a baseline funding capacity and a maximum funding capacity.

Given the methodologies employed, the Lower San Joaquin Region has additional funding capacity based upon the current state of development in the Region. The variance between the baseline and maximum capacity approaches suggests that to the extent the Lower San Joaquin Region was to implement assessments at similar levels to those assessments recently imposed throughout the Central Valley, a significant amount of funding could be generated. It is important to note that the capacity of different zones within the Regions vary significantly due to existing assessments already in place.

Based on the methodology employed, the Delta South Region has a more limited amount of additional funding capacity. This is due to the relatively undeveloped nature of the property in the Region. Generally, developed parcels are able to carry more infrastructure funding burden than undeveloped agricultural property. Ultimately, the analysis concludes that there is not a significant amount of additional funding capacity in the Delta South Region. This additional amount of funding would not be sufficient to fund the projected project costs identified within this report.

Table 21 provides a comparison of the estimated funding capacity to the projected near-term (Tier 1 & 2) and long term net local funding needs with each Region.

Two approaches for determining funding capacity were employed; A Baseline Approach and Maximum Capacity Approach.

The Baseline Approach assumes that current average assessments per acre assessment levied by those RD's in the region that currently levy assessments could be extrapolated to all acreage in the region.

The Maximum Capacity Approach assumes that the average assessment per acre levied by 13 relatively new assessment districts throughout the Central Valley could be applied to all acreage in the region. This is considered the Maximum Capacity for planning purposes within this report.

Table 21 - Comparison of Local Funding Need to Capacity

Comparison of Local Funding Need to Capacity		Regional Flood Management Plan Financial Plan: Funding
Region		<i>Estimated Maximum Funding Capacity</i>
Lower San Joaquin		
Estimated Capacity of Region		\$23,080,000
Current Annual Funding		\$8,410,000
Net Local Additional Capacity		\$14,670,000
Total Estimated Financing Capacity		\$182,000,000
Estimated Local Costs Near Term		\$169,600,000
Estimated Local Costs Long Term		\$344,400,000
Delta South Region		
Estimated Capacity of Region		\$3,180,000
Current Annual Funding		\$1,500,000
Net Local Additional Capacity		\$1,680,000
Total Estimated Financing Capacity		\$21,000,000
Estimated Local Costs Near Term		\$173,400,000
Estimated Local Costs Long Term		\$288,200,000

The applied methodology estimates financing capacity up to \$182 million over the 25-year study period. This can be compared with the estimated near-term local cost of \$169 million and long-term local cost of \$344 million. The applied methodology estimated financing capacity up to only \$21 million over the 25-year study period. This can be compared with the estimated near-term local cost of \$173 million and long-term local cost of \$288 million.

A specific analysis of the funding capacity of new development is beyond the scope of the financial plan. Given the variance between the baseline and maximum funding capacity estimated in the Lower San Joaquin Region, additional investigation into specific projects and the exploration of funding sources that leverage the projected growth in the region is warranted. In addition, an appropriate allocation of project costs to specific beneficiaries is needed.

Because of the complex nature of the improvements, and the interrelationships between the various zones in the Regions, it would be wise for the Regions to develop allocation and funding guidelines and principals that help focus future detailed financial strategies for specific projects. Future regional planning efforts could address this effort. It is important to note however, that

while additional funding capacity may exist, capturing the capacity, given the constraints of Proposition 218, will be inefficient and likely present significant challenges for the Regions.

Additional investigation and the exploration of new funding sources that further leverage the existing land uses in the Delta South Region may not ultimately yield a significant amount of additional funding. Efforts to generate additional funding maybe better focused on garnering support for State led subventions and special projects funding. Further, targeted investments in the Delta South Region that are coupled with and tied to regionally led efforts consistent with the SSIA will help support efforts that benefit the entire region.

8.5. Financial Conclusions & Recommendations

Recent studies and reports providing analysis, commentary, and policy recommendations related to funding flood management have had a common theme emphasizing the importance of creating sufficient and sustainable funding sources to manage flood risk over time. DWR's California Flood Future Report identifies existing funding constraints and presents recommendations for actions that could lead to new funding sources. PPIC's *Paying for Water in California* identifies and describes those same constraints with respect to local funding and presents recommendations that would help local entities address the funding gaps identified within the report. Ultimately, creating a sustainable and politically actionable funding source for flood management will require some action by the State Legislature to change the current constitutional and statutory constraints on raising new revenue. The Regions and the State should explore the following financial related recommendations, some of which could be implemented in the near-term. In the long-term, the State should continue efforts to implement recommendations made in recent studies focusing on long term stable funding for flood management.

Recommendation 1: *Align funding program incentives to the Goals and Objectives of the CVFPP.* In many cases, providing local agencies with more favorable cost sharing and crediting provisions will help position the State to secure limited federal funding. Increasing the amount of federal funding available will help the limited State and local funding available for small communities and rural areas that face significant financial challenges in meeting the goals established in the CVFPP.

Proposition 1E requires the State to "Secure the maximum feasible amounts of federal and local matching funds to fund disaster preparedness and flood prevention projects in order to ensure prudent and cost-effective use of these funds to the extent that this does not prohibit timely implementation of this article." The interpretation of this section of Proposition 1E should be evaluated in the larger context of the State's objectives and should be reflected in the State's financial strategy with a realistic understanding of the constraints of both federal and local funding. The interpretation that the State should work to maximize the amount of local funding could undermine the State's ability to secure a significant amount of federal funding. Maximizing the amount of federal funding may require that the State to provide local agencies with favorable cost sharing and crediting provisions under State funding programs.

Recommendation 2: Support efforts for flood insurance reform for agricultural land uses. In the rural agricultural areas, the capacity to fund additional flood risk projects is constrained. Where a specific set of improvements primarily benefits an agricultural land use and a supporting community; local, State and federal interests may conclude that the benefits of structural improvements do not outweigh the costs. To resolve this issue, and to ensure that an appropriate level of flood risk is achieved in concert with the financial capability of the area, the State should support the Region's efforts for flood insurance reform (see Section 6.4.2) ensuring that the agricultural use of the area is sustainable and allowing for the existing vibrant agricultural economy to thrive.

Recommendation 3: Provide funding for the evaluation and establishment of new local funding mechanisms. The State should consider providing funding to evaluate and implement new local funding mechanisms to generate the local cost-share of projects consistent with the SSIA. The State has made it a clear priority to maximize the value of its investment by leveraging non-State funding sources. Directly funding efforts to establish new funding sources at the local level is consistent with this priority. The upfront costs associated with evaluating new projects, developing financing plans and implementing new funding mechanisms (within the current legal framework) presents a significant hurdle to many local entities. As the State is currently developing new programs which will provide funding for feasibility studies, as a component of this effort, funding for financing plan implementation should also be included.

Recommendation 4: Continue to explore regional, basin or valley-wide funding districts that ensure that all beneficiaries of the flood management infrastructure pay. The State should continue to explore regional, basin or valley-wide funding districts that ensure that all beneficiaries of the flood management infrastructure pay. Any such funding district should recognize the nexus of the flood management system to other essential public services such as safety, water supply and quality, recreation, and environmental protection. The current approach governed by Proposition 218 makes it too onerous to implement such a district at the local level.

Recommendation 5: Explore alternative flood or hazard insurance programs that satisfy both federal lending requirements as well as provide structural mitigation to reduce risk. In the context of NFIP reform and rising flood insurance rates, the State could explore alternative flood or hazard insurance programs that could satisfy both federal lending requirements as well as provide structural mitigation to reduce risk. Various proposals have been discussed and questions arise whether such a program at a State level, absent heavy subsidy, could result in lower overall costs and more manageable constraints. However, one key aspect to a supportable and more sustainable program would be to ensure those required to purchase insurance represent all those properties that could potentially bear a cost as a result of a flood loss. This would include all those beneficiaries as discussed above.

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9. Next Steps

Since DWR funding of this RFMP effort limited the planning to the use of existing information, future investigations, analyses, and designs remain to be conducted before many projects can be implemented. This work will refine project definition, benefits, impacts, cost, and sustainability. Some of the key next steps for the Regions include the following:

1. The Regions will continue to coordinate with DWR through completion of the BWFS and 2017 CVFPP. Regional efforts will focus on representing the RFMP and working to influence the findings of the BWFS and the 2017 CVFPP. The scope of this coordination and continued input will depend on how DWR chooses to involve the regions in Phase 2 RFMP funding, but will likely focus on meeting participation and commenting on DWR documents.
2. Due to lack of existing information, several of the potential projects identified in this RFMP cannot be adequately defined since investigations are required to better define project viability. The Regions will continue to seek funding for these investigations, but the Regions expect many investigations will need to be delayed beyond the next five years of project implementation.
3. Due to the expense of increasing flood protection to 200-year ULOP, some urban areas of the Lower San Joaquin River Region will maintain 100-year protection until upgrading to 200-year ULOP proves to be economical. The Regions will develop a plan to achieve 200-year for these urban areas.
4. The Regions will continue to develop potential projects identified in this RFMP to meet grant guidelines such as adding multiple benefits. These efforts will focus on making the projects better assets for the Regions and to make the projects more attractive for grant funding.
5. The Regions will work with DWR and others to seek changes in process and policies (Section 6.4) to improve residual risk management.
6. The Regions consider this RFMP as a living document that they will periodically update to reflect significant progress in reducing flood risk as projects and programs are implemented. The Regions are not planning wholesale revisions to the RFMP, but expect these updates to be simply addition of addendum sheets to a binder to document significant physical or residual risk changes and to reference source of the information for future use. These addendum sheets will facilitate preparation a more thorough revision of the RFMP if the need ever arises in the future.

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APPENDICES

Appendix A - Regional Setting and Context

Appendix B - Freeboard Profiles

Appendix C – LMA-Specific Hazards and Projects

Appendix D - Rural LMA Work Group Topic Papers

Appendix E - Financial Plan

Appendix F – Comment and Response Log