REGIONAL FLOOD MANAGEMENT PLAN
for the Mid San Joaquin River Region

November 2014

Prepared for:
Reclamation District 2092 and Stanislaus County

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Funded by:

California Department of Water Resources

Prepared for:

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and Stanislaus County

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List of Acronyms

2000 Census	United States 2000 Census of Population and Housing
AB156	Assembly Bill 156
Atlas	Mid-San Joaquin River Regional Flood Atlas
BFE	base flood elevation (associated with 1% or 100-year flood event)
BMP	Best Management Practice
BWFS	Basin-wide Feasibility Studies
Cal OES	Governor's Office of Emergency Services
CCID	Central California Irrigation District
CCR	California Code of Regulations
CDC	California Department of Conservation
CDF	California Department of Finance
CDFW	California Department of Fish and Wildlife
cfs	cubic feet per second
CNDDB	California Natural Diversity Database
CNRR	California Northern Railroad
Comprehensive Study	Sacramento and San Joaquin River Basins Comprehensive Study
CVBJ	Central Valley Business Journal
CVFPB	Central Valley Flood Protection Board
CVFMP Program	Central Valley Flood Management Planning Program
CVFPP	Central Valley Flood Protection Plan
CVHE	Central Valley Habitat Exchange
CVHS	Central Valley Hydrology Study
CVRWQCB	Central Valley Regional Water Quality Control Board
CV-SALTS	Central Valley Salinity Alternatives for Long-Term Sustainability
CWC	California Water Code

DOI	United States Department of the Interior
DPR	California Department of Parks and Recreation
DWR	California Department of Water Resources
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ETL	Engineering Technical Letter
F-BO	Forecast-Based Operations
F-CO	Forecast-Coordinated Operations
FCSSR	Flood Control System Status Report
FEAT	Flood Emergency Action Team
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
FSRP	Flood System Repair Project
GAR	Geotechnical Assessment Report
GLPP	Gomes Lake Pumping Plant
Grasslands WMA	Grasslands Wildlife Management Area
I-5	Interstate 5
ICS	Incident Command System
ID	Irrigation District
IRWM	Integrated Regional Water Management
IWRIS	Integrated Water Resources Information System
JPA	Joint Powers Agreement
LAT	Levee Assessment Tool
LCM	Life Cycle Management
LD	Lacking Sufficient Data
LFPZ	Levee Flood Protection Zone
LHMP	Local Hazard Mitigation Plan
LiDAR	Light Detection and Ranging
LMA	Local Maintaining Agency
Merced ID	Merced Irrigation District
Merced NWR	Merced National Wildlife Refuge
MID	Modesto Irrigation District
Mid SJR Region	Mid San Joaquin River Region
msl	mean sea level
NA	Named Area
NFIP	National Flood Insurance Program
NIMS	National Incident Management System
NRCS	Natural Resources Conservation Service
NSA	Non Structural Alternative
NULE	Non-Urban Levee Evaluation

NWS	National Weather Service
O&M	Operations and Maintenance
OCFCD	Orestimba Creek Flood Control District
OES	Office of Emergency Services
PBI	Peterson-Brustad, Inc.
PIER	Public Interest Energy Research
Planning Area	Mid San Joaquin River Region
POI	Point of Interest
PSP	Proposal Solicitation Package
RAMP	Regional Advance Mitigation Monitoring
RD	Reclamation District
Refuge Complex	San Luis National Wildlife Refuge Complex
RFMP	Regional Flood Management Plan
SB5	Senate Bill 5
SEMS	Standardized Emergency Management System
SFHA	Special Flood Hazard Area
SPFC	State Plan of Flood Control
SJRNWR	San Joaquin River National Wildlife Refuge Complex
SPRR	Southern Pacific Railroad
SRA	State Regional Area
STANCOG	Stanislaus Council of Governments
TDS	total dissolved solids
TID	Turlock Irrigation District
TNC	The Nature Conservancy
TRRP	Tuolumne River Regional Park
WSE	water surface elevation
WIWRP	Westside Integrated Water Resources Plan
WWTP	Wastewater Treatment Plant
ULOP	Urban Level of Flood Protection
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USFWS	United States Fish and Wildlife Service
US Census Bureau	United States Census Bureau

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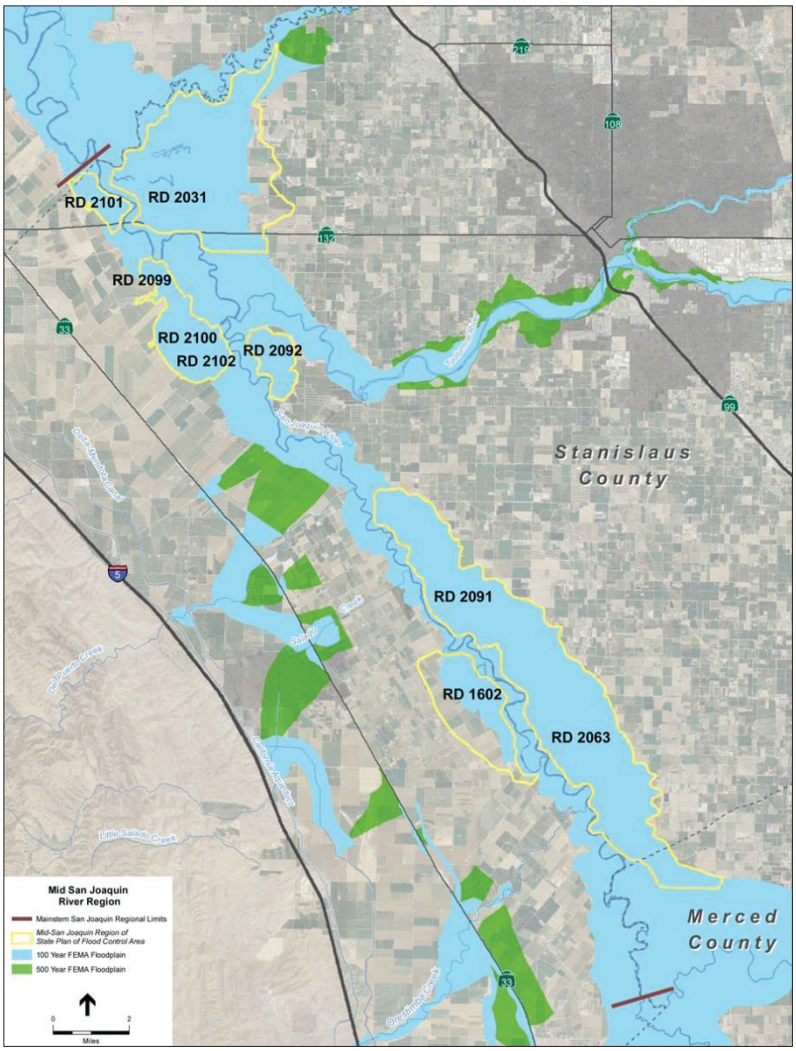
Executive Summary

MID San Joaquin River
REGIONAL FLOOD MANAGEMENT PLAN

Where is the Mid San Joaquin River? The Regional Flood Management Plan (RFMP) for the Mid San Joaquin River (Mid SJR) Region planning area includes the floodplain corridor extending along the mainstem San Joaquin River from its confluence with the Merced River to its confluence with the Stanislaus River, the lower reaches of each of the major tributaries (the Merced, the Tuolumne, and the Stanislaus Rivers) that are protected by facilities within the State Plan of Flood Control (SPFC), and additional floodplain areas that have a nexus to the SPFC, as shown on Figure 1 below.

What is the purpose? The purpose of the RFMP is to develop and articulate a flood-safe vision for the Mid SJR Region that is both practical and ambitious in reshaping the status quo with regards to flood management.

What are the goals of the RFMP? The goals of the RFMP are consistent with the Central Valley Flood Protection Plan goals of improving flood risk management, improving operations and maintenance, promoting ecosystem functions, improving institutional support, and promoting multi-benefit projects.



How was the RFMP developed? Development of the RFMP process was co-led by Reclamation District (RD) 2092 and Stanislaus County. An 18-month public stakeholder engagement process was held from April 2013 to September 2014 where stakeholders were invited to participate in plan development. A total of eight public workshops were held to solicit input on all aspects of plan development. In addition, several briefings of local governments and special interest groups were made to inform various agencies and groups of the process and to gather input.

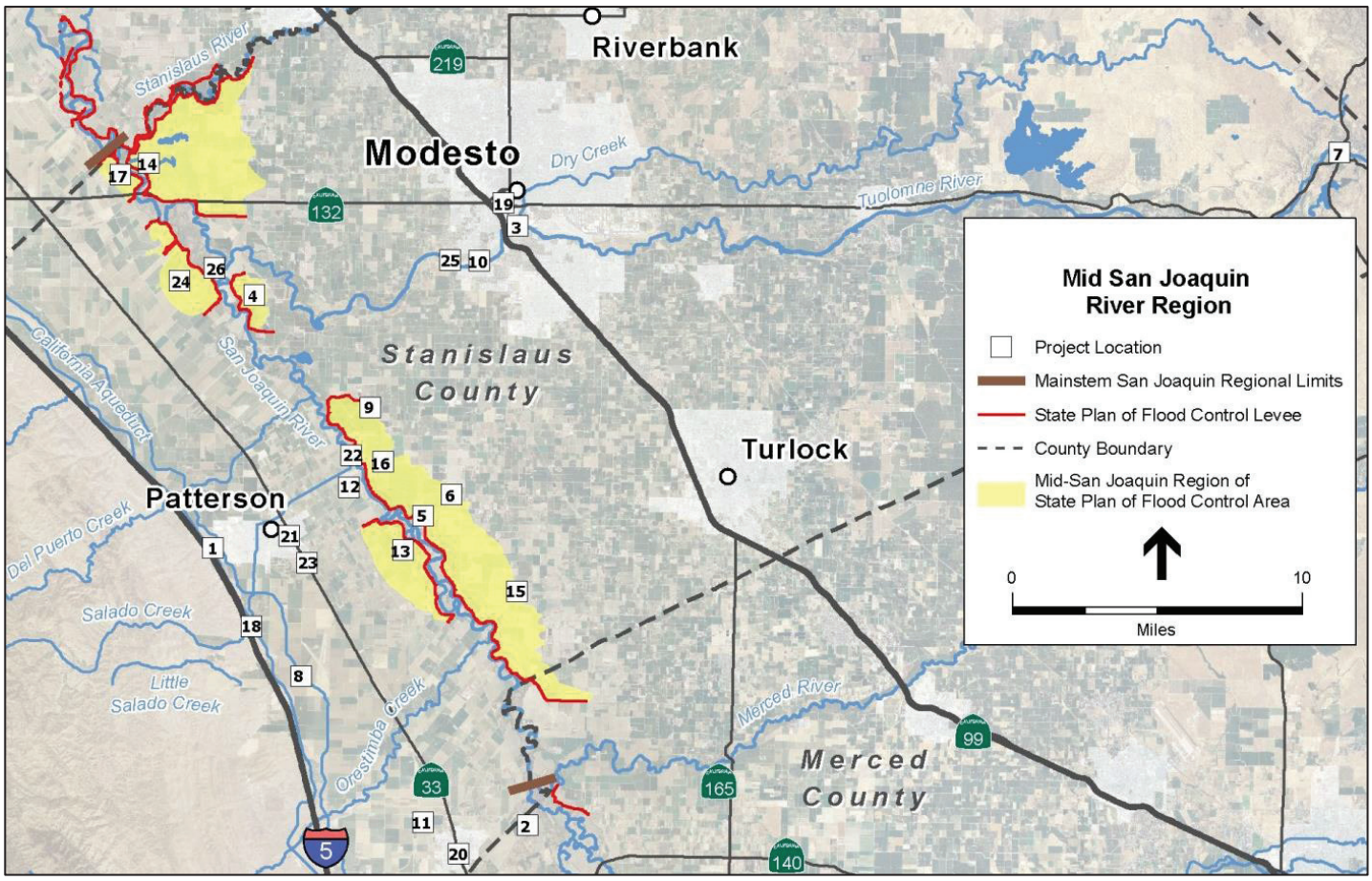
Who was involved? In addition to RD 2092 and Stanislaus County, a host of stakeholders from the region, including agricultural representatives and agricultural landowners, non-agricultural landowners and developers, public agencies, elected officials, environmental and conservation organizations, community groups (particularly those involved in emergency services), educational institutions, and representatives of low-income and/or at-risk populations, particularly those that may be impacted by flooding, contributed to the content of this plan through their participation.

Who has flood management responsibilities in the planning area? Federal and State agencies such as the Central Valley Flood Protection Board, US Army Corps of Engineers, State Department of Water Resources and US Bureau of Reclamation; irrigation districts that include Merced, Turlock and Modesto; nine Local Maintaining Agencies (Reclamation Districts 1602, 2031, 2063, 2091, 2092, 2099, 2100, 2102, and 2101), as shown on Figure 1, located on the previous page; Stanislaus, Merced, and San Joaquin Counties; and the Cities of Patterson, Newman, and Modesto.

Why prepare a RFMP? As shown in Figure 1 on the previous page, a large portion of the planning area contains 100- and 500-year floodplains that are concentrated along the San Joaquin River and its tributaries. Stanislaus County, together with the portions of the Mid SJR Region within Merced and San Joaquin Counties, is estimated to include nearly 78,000 acres within the 100-year floodplain. Most of these lands are in agricultural production, with some habitat land and open space areas. A total of 11,063 people reside within these floodplain lands, with 2,129 people residing within floodplain lands included in the Mid SJR Region's Local Maintaining Agencies (LMAs).

What are the characteristics of the flood management system at present? The current flood management system relies primarily on two key components: 1) a system of aging levees that are able to convey a 25- to 50-year flood event and are subject to significant seepage hazards; and 2) an emergency response system that has strengths, but lacks integration amongst the various groups that respond to emergencies Additionally, many of the LMAs lack Boards; most are struggling to meet operations and maintenance standards and are inactive under PL 84-99; and at least two do not appear to be financially sustainable. Four of the LMAs in the region are currently working towards having their levees removed from the SPFC as integrated ecosystem enhancement and flood management efforts.

How will we make our region flood-safe? Through the stakeholder process, 37 projects were identified as having the potential to reduce flood hazards and provide other benefits to the planning area. A range of project types were identified that include small dam removal, sediment load reduction, floodplain rehabilitation, a levee vegetation management program, studies to better understand flooding hazards, emergency response planning and training, flood education programs, compliance with Senate Bill 5 requirements, and storm drainage enhancements. The locations of projects with a specific project site are shown in Figure 2 located on the following page. These projects were evaluated, ranked, and categorized into three tiers (Highest Priority, High Priority, and Medium Priority) in accordance with criteria developed for this RFMP. Project locations are shown on the next page with location numbers following the project titles.



Highest Priority

City of Newman/Bureau of Reclamation Flood Levee Rehabilitation (2)
Consolidation of O&M (A)
Dennett Dam Removal (3)
Dry Creek Watershed Detention Reconnaissance Study (B)*
Emergency Response Plan – Local Planning and Training (D)
Flood Risk Education (E)
Modesto WWTP - Reduce Flood Risk (9) (10)
Orestimba Creek Flood Risk Management Project (11)
Regional Maintenance Technical Support (H)
SB5 Compliance – City of Modesto (19)*
SB5 Compliance – City of Newman (20)*
SB5 Compliance – City of Patterson (21)*
Tuolumne River Flood Management Feasibility Study (J)*
Tuolumne River Regional Park – Carpenter Road/West Modesto Flood Management and Park Development (25)

High Priority

Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project (4)
Emergency Response Plan – Debris Management (C)
Integrated Levee Vegetation Management – Flood Maintenance and Habitat (F)
La Grange Floodplain Restoration and Spawning Gravel Augmentation (7)
RD 2031 Resilience (14)
RD 2063 Resilience (15)
RD 2091 Resilience (16)
Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge) (24)
WSID Fish Screen and Change in Point of Diversion Project (26)
Westside Creeks On-Farm Multi-Benefit Program (L)

Medium Priority

Black Gulch Storm Drainage Study (1)*
Gomes Lake / Harding Drain Improvements (5)
Hydraulic and Channel Migration Studies (6)*
Little Salado Creek (8)
Patterson WWTP – Reduce Flood Risks (12)*
RD 1602 Resilience (13)
RD 2101 Resilience (17)
Reducing Sediment Loading into the San Joaquin River from Westside Agricultural Lands (G)
Riverfront Park Project (22)
Salado Creek Flood Management Project (18)
Sediment Management Investigation (I)*
Storm Drainage Enhancements along Salado Creek (23)
Tuolumne River Regional Park (K)

Note: Project locations are shown above with location numbers following the project titles. Projects that don't involve a specific site are represented by letters after the project title, and projects with a * following the title indicates that it is primarily or entirely a study.

Who are the key partners? The agencies that would lead and support the development and implementation of the 37 projects that have been identified in the Mid SJR Region are the key partners for the RFMP. Key partners include Stanislaus County; the Cities of Modesto, Patterson, and Newman; all nine reclamation districts; River Partners; Tuolumne River Trust; Gomes Lake Joint Powers Authority; West Stanislaus RCD; San Joaquin River National Wildlife Refuge; Tuolumne River Regional Park Joint Powers Authority; Audubon California; and West Stanislaus Irrigation District.

How will we pay for our regional improvements? The total cost for the flood-safe vision is on the order of $340 million. Local interests within the Mid SJR Region have limited capacity to raise funds to meet the local cost share. Even with investment from the State and federal funding, which is competitive, there is little hope to find the local cost share to fix the flood management system currently in place. Instead, the stakeholders will continue working to develop fund-able flood improvement projects. The state has made a strong case for Multi-Benefit projects, and the Mid SJR Region has ample opportunities to identify and implement integrated ecosystem and flood management improvements.

How would actions envisioned in the RFMP change our flood future (year 2040+)? A few of the projects included in the RFMP were planned or underway even before the RFMP was drafted, but most were not. Without the RFMP, the level of flood literacy in the Mid SJR Planning Area would be dramatically lower. Flood risks would be greater, driven by population growth, floodplain development, and less investment in flood management, including emergency response. With the RFMP, significant flood management challenges will remain due to limited local funding capacity, but projects will be more successful in finding outside funding due to RFMP guidance on funding programs, drawing attention to regional issues and opportunities, and highlighting of key flood management gaps and opportunities for high-return, modest investment projects.

1. Introduction

A cornerstone of the FloodSAFE California initiative, the Central Valley Flood Management Planning (CVFMP) Program provided the structure for the successful development and adoption of the 2012 Central Valley Flood Protection Plan (CVFPP)*. The CVFMP Program was launched in 2008 to guide, manage and implement integrated flood management actions for the Sacramento and San Joaquin valleys as required by passage of legislation in 2007. CVFMP is now assisting in the planning and coordination of major implementation actions of the 2012 CVFPP, including State-led Basin-wide Feasibility Studies (BWFS), locally-led Regional Flood Management Planning, and the Central Valley Flood System Conservation Strategy. Each of these planning efforts will be incorporated into the next update of the CVFPP, which is scheduled for 2017. Implementation of CVFPP actions have already begun and will be expanded after the 2017 Plan is updated. (From http://www.water.ca.gov/cvfmp/, accessed July 1, 2013.)*

This document is a Regional Flood Management Plan (RFMP) for the Mid San Joaquin River (Mid SJR) Region planning area, an area generally described as the floodplain corridor extending along the mainstem San Joaquin River from its confluence with the Merced River to its confluence with the Stanislaus River, the lower reaches of each of the major tributaries (the Merced, the Tuolumne, and the Stanislaus Rivers) that are protected by facilities within the State Plan of Flood Control (SPFC), and additional floodplain areas that have a nexus to the SPFC. As will be further described below, it has been developed through a broad stakeholder process during 2013-2014.

The Mid SJR RFMP is one of six regional Central Valley flood management plans developed as part of this process. The six regional flood management plans include the Mid Sacramento River, Feather River, Lower Sacramento River/Delta-North, Lower San Joaquin River/Delta-South, Mid San Joaquin River, and Upper San Joaquin River. Assets within each flood planning region are protected by the SPFC facilities. Map 1, Regional Overview, of the Mid San Joaquin River Regional Flood Atlas (Atlas) shows the location of each of the nine flood planning regions (in Appendix A, Mid San Joaquin River Region Regional Flood Atlas - Draft). The boundaries of each region were defined based on mapped Central Valley Levee Flood Protection Zones that were delineated in the CVFPP. These zones were based on the floodplain management activities completed through partnerships between the California Department of Water Resources (DWR), the United States Army

Corps of Engineers (USACE), and local agencies from 2007 through 2011 in response to the passage of Propositions 1E and 84 in November 2006 (DWR, 2012).

1.1 Purpose

The purpose of the RFMP is to develop and articulate a flood-safe vision for the Mid SJR Region that is both practical and ambitious in reshaping the status quo with regards to flood management. The plan is founded in an understanding of the broader statewide flood management system and enhancement needs as articulated in the 2012 CVFPP and ongoing State-led efforts, such as the BWFS for the San Joaquin Basin and the Central Valley Flood System Conservation Strategy. But most importantly, the plan is an expression of the interests and priorities of the stakeholders of the Mid SJR Region, developed for the particular landscape and considerations of the region and moderated by the realities of financing requirements and local capacities.

1.2 Process

The process used to develop this RFMP for the Mid SJR Region planning area has been co-led by Reclamation District (RD) 2092 (Dos Rios) and Stanislaus County. Through early outreach in 2012, a list of key cooperators was developed, including:

- Oakdale Irrigation District
- West Stanislaus Irrigation District
- Del Puerto Irrigation District
- Patterson Irrigation District
- El Solyo Irrigation District
- City of Turlock
- City of Modesto
- Reclamation District 2063
- City of Patterson
- Mapes Ranch
- Tuolumne River Trust
- Sierra Club – Yokuts Chapter
- Modesto Irrigation District
- East Stanislaus Regional Water Management Partnership
- Stanislaus County Public Works
- U.S. Fish and Wildlife Service

A technical consultant team was solicited and selected through a competitive bidding process, and a successful grant application was submitted to DWR, and subsequently awarded in Spring 2013. Two initial planning meetings were held in the spring and early summer of 2013 which were broadly publicized to encourage stakeholder involvement. A charter for the process was drawn up, circulated and adopted; it is provided as Appendix B of this Plan. A website was developed for communication among stakeholders, the other regions, and DWR. A series of public workshops was initiated in July 2013 and continued through July 2014. Briefings were held for key players within the region. Coordination with adjacent and other regions occurred through a variety of means throughout the development of the RFMP.

1.3 Stakeholder Engagement

A concerted effort was made to create an inclusive process that would provide multiple opportunities for regional stakeholders to participate in the development of the plan. A Stakeholder Engagement Plan was developed early in the process with input from regional stakeholders and DWR. Part of the engagement plan included the development of a website to provide stakeholders and interested parties a single, easily-accessible source of information about the regional plan process and products.

1.3.1 Regional Stakeholders

As described above, Stanislaus County and RD 2092 co-led the development of this plan. Within Stanislaus County, the Department of Public Works held the lead role with additional involvement from the Department of Environmental Resources, Department of Agriculture, Office of Emergency Services, Chief Executive Office, and the Department of Planning and Community Development. Regional stakeholders contributed to the preparation of the plan. Potential stakeholders within the Mid SJR Region included all individuals and entities with an interest in the region, including resource agencies, local governments, local maintaining agencies (LMAs), flood emergency responders, property owners, community organizations and environmental stewardship groups.

1.3.2 Stakeholder Outreach

The Regional Partners implemented a 16-month public stakeholder engagement process from April 2013 to July 2014 where stakeholders were invited to participate in the development of this plan. A total of eight public workshops were held to facilitate discussions between stakeholders and the Regional Partners regarding all aspects of plan development. The scope of each chapter of the RFMP was first introduced at a public workshop and feedback from attendees was solicited. Afterward, a draft chapter was prepared, posted on the RFMP website in advance of the following workshop where the draft was presented and feedback solicited. The draft chapter was then revised, posted online in advance of and presented at the next workshop. This format was followed for all of the chapters in this document. In addition, several briefings of local governments and special interest groups were made during this 16-month time period to inform various agencies and groups of the process and to gather input.

A host of stakeholders, including agricultural representatives and agricultural landowners, non-agricultural landowners and developers, public agencies, elected officials, environmental and conservation organizations, community groups (particularly those involved in emergency services), educational institutions, and representatives of low-income and/or at-risk populations, particularly those that may be impacted by flooding, contributed to the content of this plan through their participation. A record of participants in plan development is included in this document in Appendix C, Engagement Record.

Additionally, extensive effort was made to gather input from the Native American tribes. Regular correspondence with representatives of the Inter-Tribal Council, Table Mountain Rancheria, North Fork Rancheria of Mono Indians, Tule River Tribe of CA, Tuolumne We-Wuk Indians Tribal Council, and CA Miwok Tribe occurred over the last 16 months. No input from the tribes was received.

Another component of stakeholder outreach includes the Central Valley Flood Protection Board (CVFPB) convening the Regional Planning/System-Wide Coordination Committee (Coordinating Committee) monthly starting in January 2013. The Coordinating Committee meetings are informal, follow a discussion format, and are open to all stakeholders interested in regional flood management planning and systemwide feasibility studies. The meetings have been very effective in facilitating stakeholder coordination and are scheduled to continue for at least two years. Some coordination among RFMP regions has begun and will continue as the implementation of the CVFPP progresses.

1.4 Document Overview

This RFMP contains ten chapters that cover the following items.

Chapter 1, Introduction includes a discussion of what the purpose of the RFMP is, the process by which this document was prepared, and how the stakeholders were engaged.

Chapter 2, Regional Setting describes the setting of the Mid San Joaquin River Region, providing context and background for the chapters that follow.

Chapter 3, Flooding and Flood Hazards describes flood conditions and known flood hazards within the Mid San Joaquin Region planning area.

Chapter 4, Emergency Response provides a description of the current status of flood emergency response to the Mid San Joaquin Region and an assessment of the relative state of flood response readiness of responsible agencies.

Chapter 5, Operations & Maintenance provides an assessment of the Operation and Maintenance practices in the Mid San Joaquin Region.

Chapter 6, Land Use and Environmental Enhancements provides information on the current and anticipated future relationships between land use within the floodplain and flood risks, identifies desirable ecosystem enhancements, and provides linkages between potential flood management actions and ecosystem enhancement.

Chapter 7, Proposed Regional Improvements describes the proposed regional improvements, or projects, and the project concepts that were identified through the stakeholder engagement process that address the flood issues identified in the previous chapters.

Chapter 8, Regional Priorities explains the criteria used to evaluate and prioritize the projects and concepts described in Chapter 7.

Chapter 9, Regional Financial Plan provides a high level overview of the capacity of the Mid San Joaquin Region to fund the projects identified in the RFMP and to identify any deficiencies in funding.

Chapter 10, Outlook for the Future provides a discussion of the Region's future with respect to flood management.

2. Regional Setting

2.1 Introduction

As described in Chapter 1, Introduction, one of the initial steps in the regional flood management planning process was to collect pertinent information on the Mid San Joaquin River regional flood management planning region (Mid SJR Region) and surrounding areas, followed by obtaining valuable input from stakeholders to complete the picture of existing flood management in this portion of the Central Valley. The purpose of this chapter is to describe the setting of the Mid SJR Region, providing context and background for the chapters that follow. Topics covered are those that are relevant to flood management within the Mid SJR Region and surrounding areas that have a nexus with State Plan of Flood Control (SPFC) facilities. This chapter is intended to provide an accurate characterization of the region to support the development of integrated multi-benefit solutions to flood management problems in the Mid SJR Region. The content of this chapter includes information on the following:

- location of the Mid SJR Region;
- the geography of the Mid SJR Region;
- San Joaquin, Merced, Tuolumne, and Stanislaus rivers, as well as the Westside Tributaries (e.g., Orestimba, Salado, Del Puerto, and Dry creeks);
- land use, ecologically sensitive areas, existing habitats, assets, and population within the region and surrounding areas;
- a brief description of the Mid SJR Region river-related recreational resources, needs, and planning processes;
- an introduction to flooding issues and flood management infrastructure within the San Joaquin River Basin and Mid SJR Region;
- an introduction to operations and maintenance (O&M) of relevant flood management infrastructure;
- an introduction to emergency response in the region and surrounding areas; and
- a brief description of additional relevant planning processes.

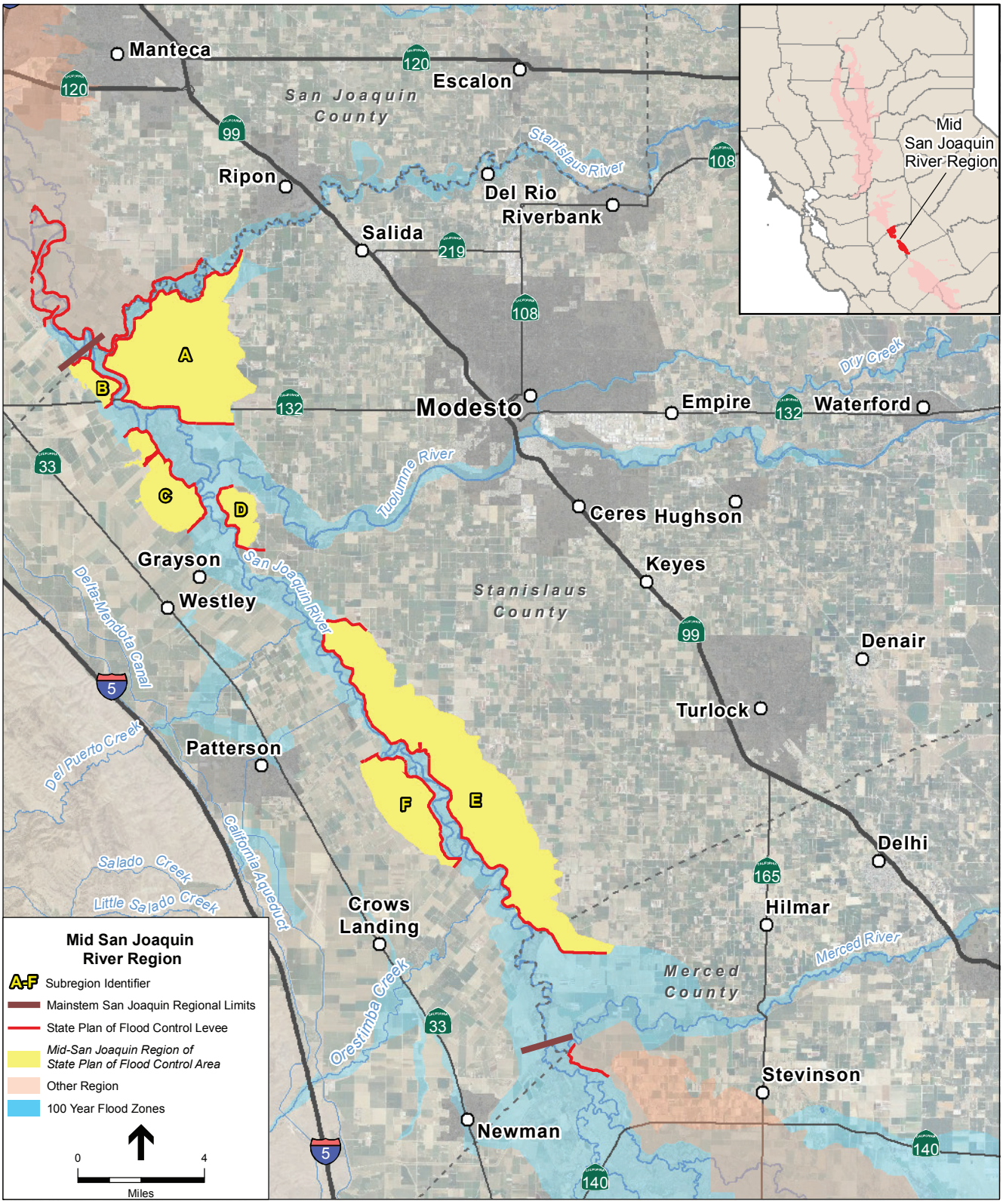
Sources for the information provided in this chapter include reports prepared by USACE, DWR, Federal Emergency Management Agency (FEMA), California Department of Finance (CDF), Stanislaus County, San Joaquin County, City of Modesto, Peterson-Brustad Engineers, Inc. (PBI), City of Modesto, City of Ceres, and Stanislaus County Joint Powers Authority; web content published by the City of Patterson, Stanislaus County, Central Valley Salinity Coalition, United States Environmental Protection Agency (EPA), and the United States Census Bureau (US Census Bureau); and data from DWR and the California Department of Fish and Wildlife (CDFW).

2.2 Regional Overview

The Mid SJR Region is made up of six non-contiguous areas within Stanislaus, Merced, and San Joaquin counties as shown in **Figure 2-1**, **Mid San Joaquin River Region Boundaries** and Map 1, Regional Overview, of the Atlas (Appendix A). These boundaries are consistent with those included in the 2012 CVFPP. The size of each of the non-contiguous areas is labeled on Figure 2-1. Each non-contiguous area is also labeled with the letters A through F, and will be referred to as Subregions A through F in the remainder of this document.

For the purpose of this regional flood management planning process, the Mid SJR Region planning area (planning area) extends along the San Joaquin River from the confluence of the Stanislaus River to the confluence with the Merced River, as shown in Figure 2-1. Because the Mid SJR Region of the SPFC is non-contiguous along the San Joaquin River, and because the flood concerns of the region related to the San Joaquin River and its tributaries extend beyond the specific area of the SPFC, any area that experiences flood issues within the vicinity of the Mid SJR Region of the SPFC and has a nexus with the SPFC facilities is included within the Mid SJR Region and this plan. The planning area includes nine Reclamation Districts: 1602 (Del Puerto), 2031 (Elliot), 2063 (Crows Landing), 2091 (Chase), 2092 (Dos Rios Ranch), 2100 (White Lake Ranch), 2101 (Blewitt), 2099 (El Solyo Ranch), and 2102 (Lara Ranch); Named Area 65 (Gomes Lake); the cities of Modesto, Ceres, Turlock, Patterson, Newman, Oakdale, Riverbank, Waterford, and Hughson; the communities of Grayson, Westley, and Crows Landing; the Patterson, West Stanislaus, El Solyo, Del Puerto, Modesto, Turlock, Twin Oaks, and Oakdale Irrigation Districts; and the Newman Drainage District. Subregion A includes RD 2031; Subregion B includes RD 2101; Subregion C includes RDs 2099, 2100, and 2102; Subregion D includes RD 2092; Subregion E includes RDs 2063 and 2091 and NA 65; Subregion F includes RD 1602.

The majority of the SPFC Area in the Mid SJR Region is located within Stanislaus County (27,980 acres) with approximately 760 and 25 acres within Merced and San Joaquin counties, respectively. The City of Modesto, which is located approximately nine miles east of the San Joaquin River, has jurisdiction over two small areas within Subregion E. The majority of the planning area is rural and agricultural. Approximately 75% of the SPFC Area and 42% of Stanislaus County is in agricultural production, with 50% of the SPFC Area identified as having soils classified as Prime Farmland and Farmland of Statewide Importance.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-1

Mid San Joaquin River Region Boundaries

2.2.1 Geography and Land Use

The planning area is located within the northern San Joaquin Valley. The San Joaquin Valley is bordered on the west by the Diablo Range, part of the California Coast Ranges, on the north by the Sacramento-San Joaquin Delta, and on the east by the Sierra Nevada. Two basins are contained within the San Joaquin Valley—the San Joaquin River Basin in the north and the Tulare Lake Basin in the south. The valley itself is low in elevation and has generally gentle topographic relief. The topography of the San Joaquin River corridor in the Mid SJR Region is typical of the San Joaquin Valley and generally flat, with elevations ranging from approximately 25 to 70 feet above mean sea level.

The land uses within the planning area are predominantly agricultural, including a mix of dairies, livestock pasture and range, livestock feed crops, and orchards. Total agricultural gross income in Stanislaus County totaled $3.07 billion in 2011, an 18% increase over 2010 agricultural values. Relative to other parts of the San Joaquin Valley, the planning area has a high concentration of dairy cows, particularly in the southern end and concentrated around the San Joaquin River corridor (EPA, 2013). According to the 1997 Census of Agriculture, the three counties included in the planning area are among the top 10 dairy-producing counties in the nation. According to the 2012 Census of Agriculture, these three counties continue to place within the top seven milk-producing counties in California, the largest milk-producing state in the nation. Milk is the top agricultural commodity in the region, but almond production has significantly increased in recent years.

2.2.2 Waterways

Four large Central Valley rivers are relevant to the planning area – the San Joaquin, Merced, Tuolumne, and Stanislaus rivers (Figure 2-1). All four rivers originate in the western Sierra Nevada, flowing westward toward the valley floor. The San Joaquin River is 330 miles long from its headwaters to its confluence with the Sacramento River, including 37 miles within the Mid SJR Region. The watershed area of the San Joaquin River upstream of the Mid SJR Region (upstream of the Merced River) is approximately 10,000 square miles. By the time the San Joaquin River flows out of the region, it is draining a total of approximately 14,000 square miles, having received the flow of the Merced, Tuolumne, and Stanislaus rivers, as well as the inflow from the smaller drainages on the west side of the valley. The San Joaquin River originates high in the Sierra Nevada Mountains and is dominated by snowmelt, draining elevations as high as 14,000 feet above mean sea level (msl). The average slope of the San Joaquin River within the Mid SJR Region is very low, falling approximately 1 foot/mile as the valley floor drops from about 65 feet to 25 feet msl at the downstream limit. The length, headwaters elevation, and watershed area of the San Joaquin, Merced, Tuolumne, and Merced rivers along with creeks within the planning area are included in **Table 2-1**, **Rivers and Creeks in Planning Area**. These major tributary watersheds make up approximately 83% of the contributing area augmenting the flow of the San Joaquin River within the region. Dry Creek, tributary to the Tuolumne River, is another significant waterway with respect to flood management within the planning area. The confluence of Dry Creek and the Tuolumne River is near the center of the City of Modesto.

Table 2-1
Rivers and Creeks in Planning Area

River or Stream	Length (miles)	Headwaters Elevation (above mean sea level)	Watershed Area (square miles)
San Joaquin River	330	14,000	14,000[1]
Merced River	145	13,000	1,300
Tuolumne River	149	13,000	1,900
Stanislaus River	96	11,000	1,200
Dry Creek	76	480	196
Orestimba Creek	41	3,600	134
Salado Creek	20	2,600	25
Del Puerto Creek	29	3,600	73

[1] From headwaters to Stanislaus River confluence

SOURCE: USACE, 2012; Atlas geodatabase; USGS, 2012; USGS, 2013

Each of the major rivers tributary to the San Joaquin River is controlled by upstream dams, each of which is operated for multiple purposes that include flood storage. The San Joaquin River is controlled in its headwaters, upstream of the Mid SJR Region, by Friant Dam and is further influenced by multiple control, diversion structures, and parallel flood bypass systems before it reaches the region. Each of the rivers is expected to convey a particular level of flood flow or discharge, by design or circumstance (see Section 3.6, Channel Conveyance Capacity and Flood Forecast Monitoring Network, for more information on conveyance capacity in the region). To help manage the lands needed to convey flood flows, the CVFPB has designated a floodway along each of these rivers below the flood management dams and regulates these lands to limit encroachments that would hamper their function in conveying floods. A description of the flood management infrastructure along each waterway is provided later in the flood management section of this chapter. Three notable tributaries to the San Joaquin River flow from the west out of the Diablo Range, part of the California Coast Range include Orestimba, Salado, and Del Puerto creeks. Orestimba Creek meets the San Joaquin River near the City of Newman. The confluence of Del Puerto Creek and the San Joaquin River is north of Patterson. Salado Creek ends in Patterson near the Southern Pacific Railroad (SPRR) tracks.

Within the planning area, the low-gradient San Joaquin River meanders through a complex topography that is in part the product of a long history of river-driven processes: abandoned slough channels, oxbow lakes, floodplain wetlands. Digitization of historic maps, shown in **Figure 2-2**, **Historic Channels of the San Joaquin River Corridor,** provides a long-term perspective on the dynamics of river processes over a relatively short history since European settlement.

2.2.3 Climate and Hydrology

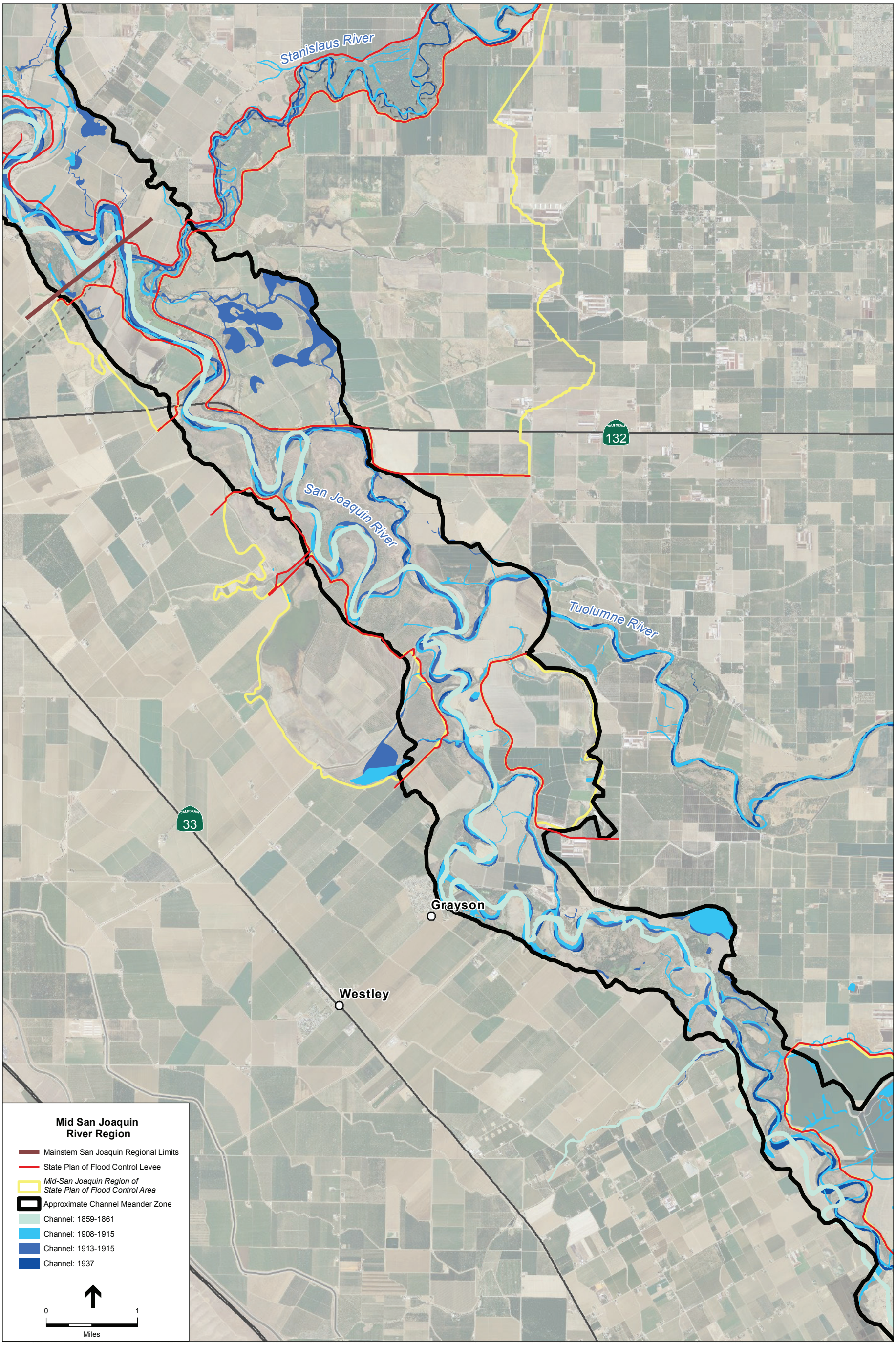
The climate of the San Joaquin Valley is semiarid with hot, dry summers and mild winters. The majority of rainfall occurs from November through April as rain in lower regions and snow at higher elevations. The average annual precipitation in the planning area is between 10 and 11 inches (FEMA, 2008). Flows in the San Joaquin, Merced, Tuolumne, and Stanislaus rivers are dominated by a combination of rain from November through April and snowmelt in the spring. Historically, spring snowmelt would result in localized long-duration flooding for the lower reaches of the major rivers from March through June, and occasional winter storms would result in localized and short duration flooding in December through February. Occasionally, warm winter storms (commonly referred to as “pineapple express”) precipitate

rain on previously accumulated snow in the upper watershed which produces rapid runoff that can overwhelm the flood storage capacity of the region (as was seen in the winter storms of 1997). The runoff pattern of the annual hydrographs of these major rivers has been dramatically altered by flood management and water supply operations of the reservoirs upstream. Large flood flows into the reservoirs are detained in storage, and are either released slowly during and after the flood, or retained toward the end of the specified flood management season to provide water supply. Tributaries entering the system downstream of the reservoirs can contribute significant inflows during flood events.

Several indications of climate change have been observed in California. In the last century, sea levels along the coast has increased by seven inches, the average early spring Sierra Nevada snowpack has decreased by approximately 10 percent, and the temperature has risen 1° F on average with higher increases at higher elevations. Some of the implications of these changes have also been observed. The loss in average early spring snowpack represents a loss of 1.5 million acre-feet of water supply storage. Natural peak flows have increased in many rivers, potentially increasing flood risk. In the last decade, many cities in Southern California have seen the lowest annual precipitation levels on record. A changing climate will continue to increase uncertainty for management of water supply, water quality, flood management, and environmental stewardship (DWR, 2008).

Climate change data for the planning area are available through the Public Interest Energy Research (PIER) Cal-Adapt website. See **Figure 2-3, Cal-Adapt Data for Stanislaus County**, for a graphic representation of the data for Stanislaus County. The historical average temperature in Stanislaus County is 60.6 °F. Future average temperatures under high- and low-emissions scenarios are projected to be 67.2 and 64.6 °F, respectively. Implications of climate change for the Central Valley were identified in the California Adaptation Planning Guide, Understanding Regional Characteristics document (CEMA et al., 2012). The mountainous areas of the state, including the Sierra Nevada, are projected to have less precipitation as snow, more precipitation as rain, and be subject to rapid snowmelt events. This will result in extreme, high-flow events and flooding in the Central Valley. Shorter rainfall events and more rapid snowmelt will reduce water supply because it will be more difficult to capture water in reservoirs or for groundwater recharge. Lower water levels are expected to impact the recreation and tourism industries as well. Agriculture will be impacted by climate change as a result of changes in water availability and stress to livestock and crops under altered temperature regimes. For example, cows may experience heat stress with increases in daily high temperatures, and the projected increase in daily low temperatures will decrease nighttime cooling for nut trees, which is expected to decrease the productivity of the trees. With all of the projected implications, the economically disadvantaged will be disproportionately impacted (CEMA et al., 2012).

A series of regional and statewide adaptation strategies for state and local water managers were recommended by the DWR in Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water (DWR, 2008). The recommendations are also useful in adapting to a growing population, ecosystem rehabilitation, and flood protection. Regional strategies outlined in the plan include 1) Provide sustainable funding for statewide and integrated regional water management; 2) Fully develop the potential of integrated regional water management; and 3) Aggressively increase water use efficiency. Statewide strategies include 1) Practice and promote integrated flood management; 2) Enhance and sustain ecosystems; 3) Expand water storage and conjunctive management of surface and groundwater resources; 4) Fix Delta water supply, quality, and ecosystem conditions; 4) Preserve, upgrade, and increase monitoring, data analysis, and management; 5) Plan for and adapt to sea level rise; and 6) Identify and fund focused climate change impacts and adaptation research and analysis. Specific actions were identified under each of the regional and statewide strategies (DWR, 2008).



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-2

Historic Channels of San Joaquin River Corridor

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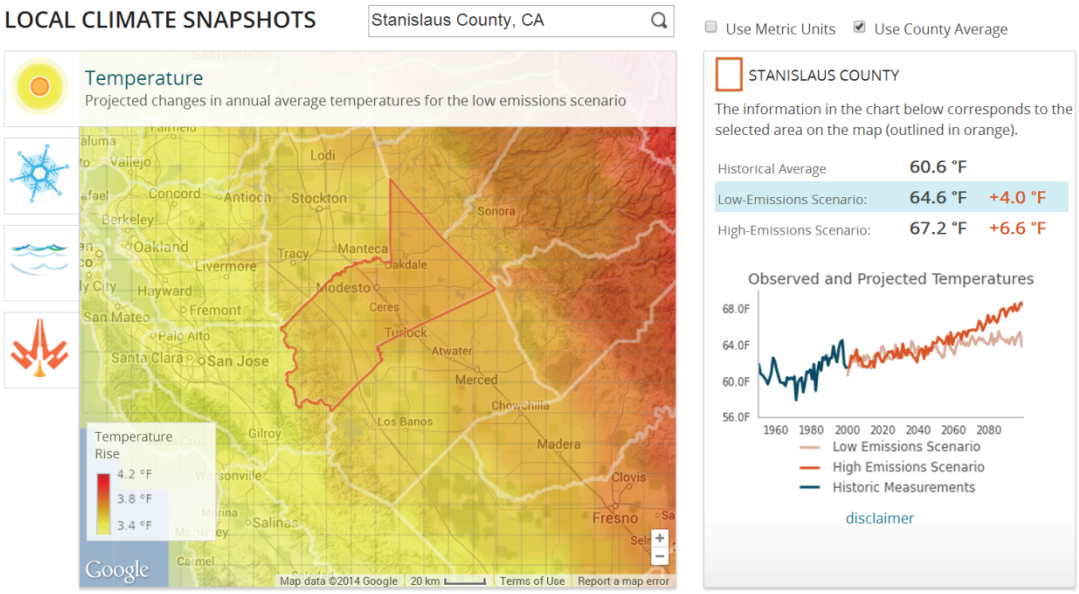


Figure 2-3
Cal-Adapt Data for Stanislaus County

2.2.4 Groundwater

The planning area is located within the San Joaquin River groundwater basin, with two groundwater subbasins identified on the east side of the San Joaquin River between the Merced and the Stanislaus rivers, divided by the Tuolumne River, the Turlock and Modesto subbasins, and one on the west side, the Delta-Mendota Subbasin. The region is heavily groundwater dependent. Marine sediments in the Diablo Range on the west side contribute to high total dissolved solids (TDS) levels in the streamflow recharging the groundwater on the west side, including nitrates, boron, chloride, and organic compounds. West side soils tend to be less permeable, and depth to groundwater is greater than on the east side of the San Joaquin River. The west side includes areas of shallow saline groundwater within about 10 feet of the ground surface over a large portion of the subbasin. There are also localized areas of high iron, fluoride, nitrate, and boron. On the east side, agricultural pesticides and herbicides are more prevalent in the groundwater. There are areas of hard groundwater and localized areas of high chloride, boron, dibromochloropropane, nitrate, iron, and manganese in the east side subbasins. Groundwater generally contributes to flow in the San Joaquin River and the middle to lower reaches of the Stanislaus and Tuolumne rivers (DWR, 2003; IWRIS, 2013). Groundwater overdraft has been identified as a major problem for the agricultural industry in the planning area, and Stanislaus County recently adopted a groundwater mining ordinance to manage the issue (Stanislaus County, 2013). Integrated water management projects that promote groundwater recharge would help to alleviate this regional issue. The Stanislaus County Water Advisory Committee was formed in December 2013 to advise the Stanislaus County Board of Supervisors on groundwater matters and provide a needs assessment, prioritize issues, and develop draft policies/directives (Stanislaus County, 2013). A 5-year action plan prepared by the committee was accepted by the Stanislaus County Board of Supervisors in June 2014 (Modesto Bee, 2014a).

2.2.5 Water Supply and Transportation Corridors

Major linear infrastructure within the planning area includes roadways, a railway, and water transport canals. The Delta-Mendota Canal (part of the federal Central Valley Project) and California Aqueduct (part of the State Water Project) run generally north-south to the east of Patterson and Newman near the base of the Diablo Range and parallel to Interstate 5 and Highway 33 on the west side of the San Joaquin River corridor. Numerous local water supply canals also parallel these generally north-south features on the west side; on the east side, these canals tend to run generally east-west. Two water delivery canals on the west side also run east-west, the West Stanislaus Irrigation District West Stanislaus Canal and the Patterson Irrigation District Main Canal, delivering water supply from the San Joaquin River to local canals. **Figure 2-4**, **Water and Irrigation Districts in Stanislaus County**, shows the jurisdictional boundaries of the water and irrigation districts that cover the majority of the planning area. The California Northern Railroad line runs along Highway 33. The east side of the Mid SJR Region includes another important north-south transportation route in Highway 99, while Highway 132 crosses the San Joaquin River corridor in an east-west alignment near the northern limit of the Mid SJR Region. Additional east-west crossings of the San Joaquin River corridor moving north to south include West Grayson Road, East Las Palmas Avenue/West Main Avenue, Crows Landing Road, and Hills Ferry Road.

2.2.6 Pipelines

At least two major underground pipelines cross the San Joaquin River within the planning area. The Hetch-Hetchy pipeline is a major water supply artery for the City of San Francisco that crosses Reclamation District (RD) 2031 (Elliott) and RD 2099 (El Solyo Ranch), where it reaches its lowest elevation in the entire state as it crosses under the San Joaquin River. Pacific Gas & Electric has a natural gas pipeline that also passes under RD 2031 (PBI, 2013).

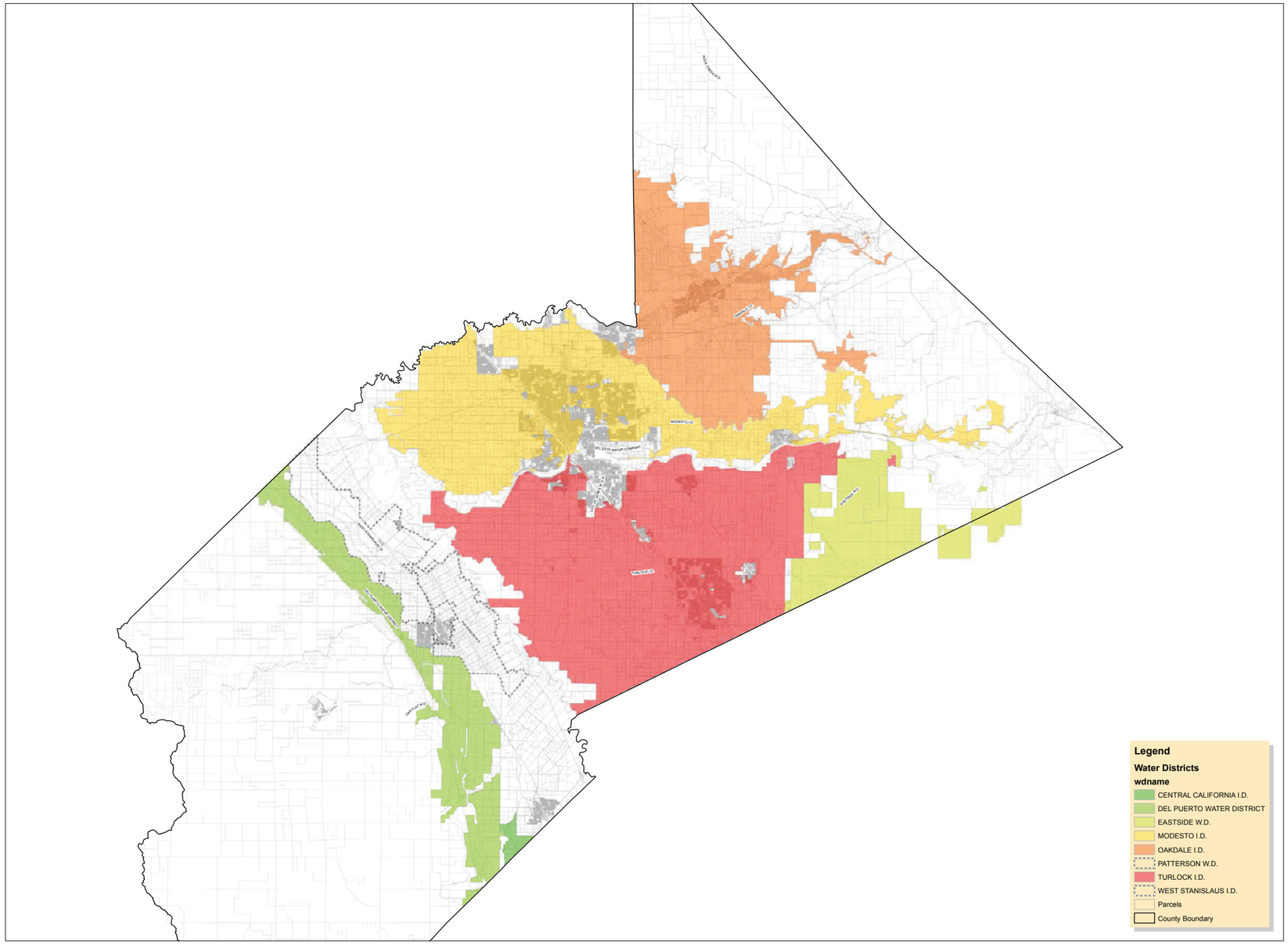
2.3 Flood Management

Flood management includes aspects related to prevention, response, and recovery. The prevention of floods includes flood management infrastructure, O&M of that infrastructure, non-structural approaches including flood-proofing, planning, legislation, regulation, enforcement, and land use decisions that do not place assets in areas with a high probability of flooding. Flood response includes planning, warnings, evacuation, rescue, flood fighting, and monitoring. Recovery involves providing relief centers, temporary housing, counseling, financial assistance, community programs, and rebuilding. This section provides a description of the flood management infrastructure and O&M aspects of flood management in the region. The preparation of this plan is a part of flood prevention planning. Other aspects of flood management are addressed in relevant chapters of this plan, which explore opportunities for flood management enhancement. O&M is discussed in Chapter 5, Operations and Maintenance. Legislation, regulation, and enforcement are discussed in Chapter 7, Proposed Regional Improvements. Land use is addressed in Chapter 6, Land Use and Environmental Enhancements. Response and recovery are discussed in Chapter 4, Emergency Response.

Flood hazards within the planning area are understood at different levels in different locations. More urbanized areas typically have been studied in greater depth. Along the San Joaquin River, for example, detailed floodplain analysis has not been conducted by FEMA, though approximate floodplain mapping has been completed. In the City of Modesto, detailed floodplain analysis has been conducted to map the

35,000 17,500 0 35,000 Feet

WATER DISTRICTS



SOURCE: Stanislaus County, 2009

Figure 2-4
Water and Irrigation Districts in Stanislaus County

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100-year floodplain. The 100-year floodplain is shown in Map 16 of the Atlas (Appendix A). Flood risks in less urban areas are significant in terms of dollars, but the population at risk is relatively small. According to the Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan (2010), approximately 2,400 people live within the 100-year floodplain of the San Joaquin River within Stanislaus County. The same document estimates total property value, including private property, within the 100-year floodplain of the San Joaquin River of $149,520,110, including structures worth $52,849,542 and land worth $87,044,008. This includes 208 miles of canals that provide irrigation to approximately 60,000 acres for the Greater Modesto area by the Modesto Irrigation District (MID, 2014), as well as approximately 250 miles of canals to 150,000 acres of farmland provided by the Turlock Irrigation District (TID, 2014).

The Central Valley Hydrology Study (CVHS) is a current undertaking by the Sacramento District of the USACE in support of an effort by DWR to update hydrologic data and complete floodplain mapping along and behind the federal-state levees in the Central Valley. The CVHS includes development of regulated and unregulated flow frequency curves for more than 200 locations along the Sacramento and San Joaquin rivers for multiple return periods. Unregulated flow is the maximum flow that would be possible at a given point in a river system in the absence of existing reservoirs and other flood management infrastructure. The models used to create the curves will be made available to flood managers.

2.3.1 Flood Management Infrastructure

The flood management system within the San Joaquin Valley includes reservoirs to regulate snowmelt from elevations above 5,000 feet and provide water supply storage, bypasses at lower elevations, and levees that line major rivers. Snowmelt floods are more frequent in the San Joaquin Valley, though rain floods do occur and generally have higher peak flows than snowmelt floods. **Table 2-2, Discharge-Frequency Relationships for Rivers and Creeks Within Planning Area** presents the discharge-frequency relationships for each of the rivers and creeks within the planning area as described by FEMA. (As described above, an updated version of Central Valley flood hydrology is currently under development.)

Table 2-2
Discharge-Frequency Relationships for Rivers and Creeks Within Planning Area

Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second)			
		10 % annual chance (10-year)	2 % annual chance (50-year)	1 % annual chance (100-year)	0.2 % annual chance (500-year)
San Joaquin River at Vernalis	14,010	28,000	52,000	79,000	370,000
Orestimba Creek at Interstate 5	134.0	--	--	15,590	--
Del Puerto Creek at Interstate 5	72.6	--	--	7,960	--
Salado Creek at Interstate 5	25.3	--	--	2,820	--
Salado Creek below Delta-Mendota Canal	25.3	--	710	--	--
Tuolumne River at Modesto	1,884	10,500	32,000	70,000	154,000
Tuolumne River at Waterford	1,640	9,000	10,000	42,000	225,000
Stanislaus River at Oakdale	1,020	7,600	8,000	8,000	41,300
Dry Creek at Modesto	192.3	4,730	9,300	11,800	18,100
Merced River at Crocker-Huffman Dam	1,045	6,640	12,200	14,900	--

SOURCE: FEMA 2008 and 2009;, URS and Stillwater Sciences, 2004

Flood management storage space in San Joaquin Valley reservoirs fills quickly during intense rains (USACE, 1999). Flood management infrastructure upstream of the Mid SJR Region includes large dams and other facilities along the San Joaquin, Merced, Tuolumne, and Stanislaus rivers. **Table 2-3**, **San Joaquin River Basin Dams and Reservoirs**, includes information on each of the dams and reservoirs in the San Joaquin River Basin. Most major reservoirs in the Central Valley have been designed and built to meet multiple purposes, including water supply, recreation, and flood management. These multipurpose reservoirs have defined water conservation space for capturing winter and spring runoff for water supply purposes, and designated flood management space to capture, manage floodflows to reduce flood releases downstream. Water elevation in a reservoir is managed through the release of water according to a rule curve, which is a graph that describes the elevation and associated storage (y-axis) over the year (x-axis) to accommodate defined water uses. There are rule curves that apply to normal, drought, and flood conditions, and all are reservoir-specific.

Table 2-3

San Joaquin River Basin Flood Management Dams and Reservoirs

Project	River/Stream	Storage (TAF)[1]	Maximum Flood Management Space (TAF)	Owner/ Operator	Year
Friant Dam (Millerton Lake)	San Joaquin River	521	170	USBR[2]	1949
Los Banos Detention Dam	Los Banos Creek	35	14	USBR	1965
Hidden Dam (Hensley Lake)	Fresno River	90	65	USACE	1975
Buchanan Dam (Eastman Lake)	Chowchilla River	150	45	USACE	1975
New Exchequer Dam (Lake McClure)	Merced River	1,025	350	Merced ID[3]	1967
McSwain Dam (Lake McSwain)	Merced River	97	0	Merced ID	1967
New Don Pedro Dam (Don Pedro Lake)	Tuolumne River	2,030	340	TID/MID[4]	1970
New Melones Dam (New Melones Lake)	Stanislaus River	2,420	450	USBR	1978

1 TAF = thousand acre-feet, rounded to the nearest 1,000 acre-foot
2 USBR = United States Bureau of Reclamation
3 Merced ID = Merced Irrigation District
4 TID = Turlock Irrigation District; MID = Modesto Irrigation District

SOURCE: USACE, 1999

Consistent with this concept, DWR's Forecast-Coordinated Operations (F-CO) and Forecast-Based Operations (F-BO) programs are a component of the FloodSAFE Flood Emergency Response Program and include a focus on the San Joaquin Watershed. The F-CO Program seeks to coordinate flood releases from the reservoirs located in various tributaries of major rivers to optimize the use of downstream channel capacity, the use of total available flood storage space in the system, and eventually to reduce overall peak floodflows downstream from these reservoirs. The first phase of the program is currently underway and has included a preliminary inventory and assessment of hydrologic gaging networks, evaluation of historical data used to support real-time flood forecasting and emergency operations, use of a decision support system for real-time analysis of data and reservoir scheduling, evaluation of hydrologic constraints and opportunities for improved gaging, forecasting, and operations of major reservoirs and

flood facilities. DWR's F-BO Program anticipates the use of improved long-term runoff forecasting and operating within the parameters of an existing flood management diagram.

Flood management infrastructure within the Mid SJR Region consists of SPFC levees or "project levees," non-project levees, the RD 2091/Named Area 65 Gomes Lake Pumping Plant, and the RD 2063 Pumping Plant and Nelson Drain. **Figure 2-5** and Map 9, **SPFC and Local Flood Management Facilities**, of this plan and the Atlas (Appendix A), respectively, include the locations of this infrastructure.

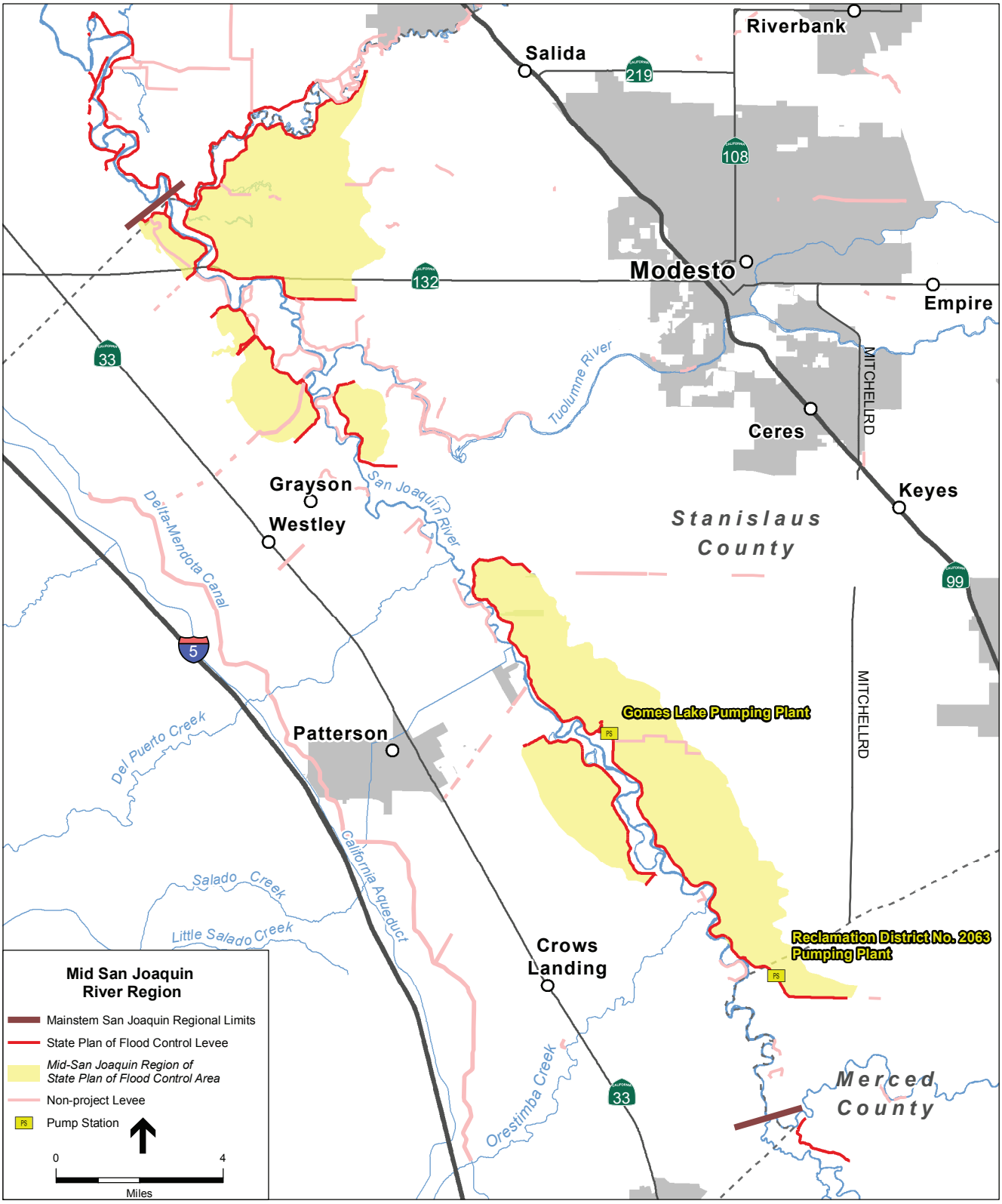
The Gomes Lake Pumping Plant (GLPP) is located approximately just east of the San Joaquin River and just west of Carpenter Road, north of Crows Landing Road. Levees that were constructed in the 1950s and 1960s along the San Joaquin River were preventing stormwater, irrigation tailwater, and water from other sources from draining into the San Joaquin River. The GLPP was constructed so that backed up water could be pumped over the levees and discharged into the San Joaquin River (Stanislaus County, 2011). The Nelson Drain directs runoff from below Mitchell Road during the flood and irrigation seasons, and the RD 2063 Pumping Plant pumps it over the levee and into the San Joaquin River.

2.3.2 Operations and Maintenance Practices

Levees operated and maintained by Reclamation District Nos. 1602 (Del Puerto), 2031 (Elliot), 2063 (Crows Landing), 2091 (Chase), 2092 (Dos Rios Ranch), 2100 (White Lake Ranch), 2101 (Blewitt), 2099 (El Solyo Ranch), and 2102 (Lara Ranch) are a part of the SPFC facilities, as is Gomes Lake, Named Area (NA) 65. Federal flood protection facilities must be inspected at least four times per year according to the Federal Flood Control Regulations (Title 33, Code of Federal Regulations, Section 208.10). Inspections occur immediately before the flood season, immediately following every major high water period, and at intervals not exceeding 90 days. The primary objective of the inspections is to confirm that project facilities maintenance is being carried out effectively, rather than to identify problems with project facilities (DWR, 2013a).

LMAs are responsible for operating and maintaining levees and associated drainage systems and structures, participating in inspections, flood fighting, and filing annual reports. Maintenance typically includes such items as management of vegetation, rodent burrows, seepage, and erosion.

Few of the SPFC levees in the Mid SJR Region are both inspected by DWR and in a condition that DWR deems "Acceptable." Of the nine RDs in the planning area, only five have submitted complete documentation in 2012 as required of LMA's by California Water Code Section 9141 since 2008: RD 1602 (Del Puerto), RD 2063 (Crows Landing), RD 2091 (Chase), RD 2092 (Dos Rios), and RD 2101 (Blewitt). The balance of the LMA's is inactive, with the exception of NA 65, Gomes Lake. NA 65, Gomes Lake is also an LMA required to file annual reports; however, no report was filed in 2012 and the DWR Levee Inspection Report noted that levees in NA 65 are not inspected by DWR. DWR did inspect the pumping plant at Gomes Lake and found it "Acceptable." Of the four non-reporting RDs (RD 2099, El Solyo; RD 2100, White Lake Ranch; RD 2102, Lara Ranch; and RD 2031, Elliott), three are made up of lands owned by the United States Fish and Wildlife Service (USFWS) and are part of the San Joaquin River National Wildlife Refuge (SJRNWR): RD 2099, RD 2100, and RD 2102. In the wake of levee breaches caused by the floods of 1997, the USACE initiated an effort to remove the levees from the project as part of a "Non-Structural Alternative" or NSA under PL 84-99. While the lands were purchased for this purpose and several required acquisitions and improvements have been made, the process to remove the project levees bounding Subregion C from the SPFC is still underway. Based on communication submitted by the Refuge Manager to DWR (for example, the letter dated September 1, 2010



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-5

SPFC and Local Flood Control Facilities

included in the 2012 LMA Annual Report), the SJRNWR expressed intent to both not maintain the levees of these three RDs and to breach them in the future to restore river-floodplain connectivity, consistent with the NSA. RD 2031, the remaining non-reporting RD, appears to be inactive, though the two property owners within the District (Faith Ranch and Mapes Ranch) continue to perform levee maintenance and engage in flood fights at the levees adjacent to their lands (PBI, 2013). In 2012, the levees in RD 2031 were rated "Minimally Acceptable" by DWR and two river erosion sites were identified. Currently, RD 2031 is working to reorganize.

Of the five reporting RDs, RD 2063 reports challenges in recruiting leadership and generating sufficient revenue to meet District obligations (PBI, 2013). The 2012 DWR Levee Inspection Report indicates that of these five RDs, only RD 2091 and RD 2092 had levees with an overall "Acceptable" rating. The remainder had levees with an overall rating of "Unacceptable." Only one of these Districts had a structure that was inspected, RD 2063: the pumping plant serving the Nelson Drain, which was rated "Unacceptable."

In 2012, DWR found erosion sites at RD 2031 and RD 2101 (two and one, respectively).

2.4 Ecologically Sensitive Areas, Existing Habitat, and Recreation

As the Central Valley was transformed from a natural landscape to a vast agricultural region with areas of urban and rural development, the majority of the aquatic and terrestrial habitat in the planning area was lost. Wetlands and riparian habitat were converted to farms and urban areas. Flood management projects introduced levees that constrict natural channel morphology and migration and prevent the seasonal inundation of floodplains, a key requirement of anadromous fish at the juvenile life stage. Dams restrict anadromous fish migration and natural sediment transport, which is critical to the formation of spawning habitat in river channels, and result in hydrology that is significantly different than that to which aquatic species are highly adapted. Habitat that remains in the planning area is stressed further by the presence of revetment; unscreened diversions; pollutants; and invasive plant, aquatic, and terrestrial species.

While much diminished from its pre-European settlement condition, the planning area contains a rich array of river-related ecologically sensitive areas. These include lands specifically acquired and managed for habitat values, public lands such as parks, private lands with conservation easements, and private lands without easements, but containing valuable natural habitat.

Worldwide, river corridors and floodplain lands are some of the most ecologically valuable areas in the landscape. In an arid region like California, they are also areas with the greatest diversity of wildlife. The combination of complex topography, hydrologically-driven disturbance, gradient of habitat conditions, and flood-driven generation of habitat and food sources for aquatic species make them a tremendous resource for native species, which have adapted to thrive in these conditions. Because these lands have also been tremendously desirable for other uses, such as agriculture and urban development, and few "living" floodplains remain, conservation and restoration of floodplain lands have become a major focus for many resource management agencies. Rivers and floodplains are vitally important to native fish species, including anadromous species like salmon and steelhead, a central focus of the San Joaquin River Restoration Program being implemented upstream of the Mid SJR Region. The San Joaquin Valley and its

wetlands and river corridors also provide vitally important wintering areas for migratory birds on the Pacific Flyway. In addition, vegetated expanses within view of a waterway, and perhaps with access for fishing, swimming, or boating, are natural attractants for people – highly appealing for public access and recreation.

2.4.1 Public Access and Recreation

As population grows in the Mid SJR Region, the need for recreational opportunities on or near waterways also increases. Compared to other California regions, the Central Valley lacks parks for residents and visitors. Major trends that include significant population growth and increasingly sedentary lifestyles contribute to the need for more parks and recreational facilities. With additional recreational opportunities, an economic benefit to the local economy could occur with supporting uses such as marinas, boat rentals, and restaurants.

An array of parks currently occupies lands along the major waterways of the Mid SJR Region with additional improvements and recreational areas proposed. The Stanislaus River Parks ("string of pearls") managed by the USACE include 11 riverside parks between Knights Ferry and the confluence with the San Joaquin River. These parks provide camping, fishing and boating access to the Stanislaus River. The Ripon River Crossing Park is one of these parks. Some of these sites have been fully developed, while others are awaiting further investment.

The Stanislaus River at Highway 99 and downstream includes Caswell Memorial State Park (camping and river access) as well as smaller parks, such as Oak Grove Park in Modesto and the Mohler Tract of the San Joaquin River National Wildlife Refuge (hiking and river access). The USFWS manages a 4-mile walking trail including river access for passive recreation at the terminus of Dairy Road just south of Hwy 132 (Pelican Nature Trail). Most bridge crossings are heavily used by fishermen, although access is largely uncontrolled.

Near Highway 99 and the cities of Modesto and Ceres is the Tuolumne River Regional Park (TRRP), a park being developed jointly by the two Cities and Stanislaus County. This park is being developed on 500 acres of public land along seven miles of the Tuolumne River in a series of separate parks. When completed, it will include 150 acres of developed park lands, pedestrian/biking trails, and over 350 acres of land designated for riparian habitat conservation and restoration. Five of its component parks have been fully or partially developed so far, and one more remains to be initiated. One of the partially-developed parks, Gateway Park, is located at the confluence of Dry Creek and the Tuolumne River in Modesto (EDAW, 2001). Additional river-oriented County parks are also located along the Tuolumne River, such as Riverdale Park and the Shiloh Road river access (closed). Near the town of Grayson, Stanislaus County maintains Laird Park and, near the town of Patterson, the Las Palmas Boat Launch (closed), both located on the San Joaquin River. The George J. Hatfield State Recreation Area is located along the lower Merced River; further upstream is a county facility, Hagaman Park. There is also a County Park at Orestimba Creek near the City of Newman.

In addition to the existing parks and park plans, riverside land in the planning area figures large in the recreational vision of many. The Stanislaus County General Plan (1987) indicates a host of additional county and state parks, both existing and proposed, along the waterways of the planning area, some with direct river access. The Tuolumne River Trust has an active Lower Tuolumne River Parkway initiative, working with a larger coalition of interests to accomplish an array of goals. The Parkway is described as a

series of non-continuous habitat restoration and public access projects in the river and river corridor from La Grange Dam to the San Joaquin River. A river-oriented public access point has been proposed by City of Turlock for lands they own on the San Joaquin River at the outlet of the Harding Drain.

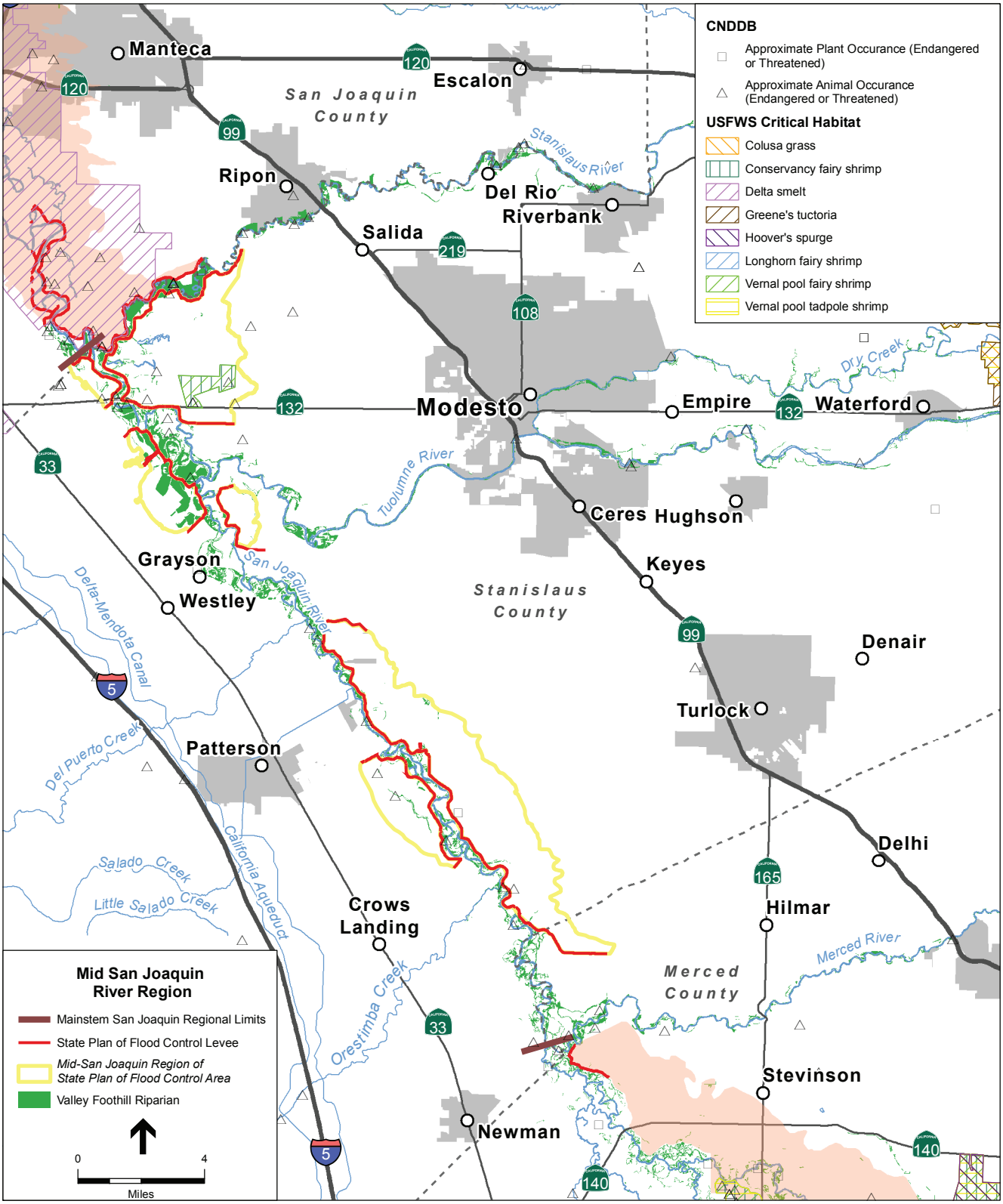
A large scale recreational plan applicable to the Mid SJR Region is the Central Valley Vision Implementation Plan, a strategic plan for State Parks expansion in the Central Valley, developed by the California State Parks in 2009. The Implementation Plan is a catalog of proposed initiatives, to be implemented over the next twenty years, to improve recreation and resource protection in the Central Valley. Many of these initiatives are located within the Mid SJR Region, and include improving the Caswell Memorial State Park, Turlock Lake State Recreational Area (SRA), McConnell SRA (along the Merced River), George J. and Hatfield SRA, and developing Dos Rios Ranch as a public use area.

Other recreational plans for the region include the San Joaquin River Blueway sponsored by the San Joaquin River Partnership, which outlines a vision for the future by proposing a variety of parks, wildlife refuges, and other publicly accessible places that provide the public an opportunity to explore and enjoy the San Joaquin River. If realized, this vision is anticipated to not only improve recreational opportunities in the region, but the air quality, water quality, and health of its users, while providing additional economic benefits in, and flood protection to, the region. The San Joaquin River was one of two rivers in California nominated to become a National Blueway under the Department of Interior "America's Great Outdoors Initiative" in 2010. Recently, however, the United States Department of the Interior (DOI) has reduced its funding of the San Joaquin River Blueway effort and is no longer pursuing implementation of this project.

2.4.2 Ecologically Sensitive Areas and Habitat

There are two wildlife areas, two wildlife refuges, and several large areas of conservation land within and near the Mid SJR Region of the SPFC. Atlas Map 18, Managed Environmental Lands (Appendix A), includes the locations of land managed by the USFWS, CDFW, The Nature Conservancy (TNC), River Partners, Tuolumne River Trust, and others. **Figure 2-6, Managed Environmental Lands and Riparian Vegetation**, shows these areas along with privately-held lands with conservation easements, including those held by the Natural Resources Conservation Service (NRCS). Many of these riverside lands were specifically acquired to restore or preserve floodplain habitat.

The SJRNWR covers nearly 8,000 acres and is part of the San Luis National Wildlife Refuge Complex (Refuge Complex). The refuge includes a contiguous 3,356-acre area that covers nearly all of Subregion C and part of the area between Subregions A and C as shown in Figure 2-1. Six non-contiguous areas cover 1,635 acres of land between Subregion A and C and another small 35-acre parcel is located approximately one mile northeast of the northeast boundary of Subregion A. Three non-contiguous areas within Subregion A and an area with a portion extending outside its northwest boundary total 2,046 acres. The total area of SJRNWR land that is included within the Mid SJR Region is 4,090 acres. Approximately three-quarters of these lands were specifically acquired to allow floodwater to temporarily move out onto the floodplain, now in flood-compatible land use, thereby lowering flood risks and stages in the river. The SJRNWR includes woodland, wetland, and grassland habitats that are important for wintering Aleutian cackling geese as well as songbirds, water birds, and multiple special-status species including riparian brush rabbit (State and federal endangered), riparian woodrat (federal endangered) and Swainson's hawk (State threatened). In 2005, it also became the site of the first known nesting pair of endangered least Bell's vireos in the Central Valley in more than 50 years.



Note: This analysis includes lands within a 1 mile distance of the centerline of the San Joaquin River and its tributaries.

SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-6

Managed Environmental Lands and Riparian Vegetation

Dos Rios Ranch is a 1,600-acre area managed by the Tuolumne River Trust and River Partners located at the confluence of the Tuolumne and the San Joaquin rivers, between the SJRNWR and TRRP. This parcel includes six miles of river frontage and will be managed for habitat and attenuation of flood flows.

In 2013, River Partners acquired the 497-acre Hidden Valley Ranch, adjacent to Dos Rios Ranch, using funding from the DWR and the Wildlife Conservation Board. In addition to expanding the flood attenuation and wildlife habitat objectives of the Dos Rios Ranch project, Hidden Valley Ranch will also host 191 acres of mitigation for future impacts associated with the SPFC.

In addition to the SJRNWR, the USFWS manages the San Luis National Wildlife Refuge (San Luis NWR), located outside of the Mid SJR Region along the San Joaquin River upstream of the confluence with the Merced River and adjacent to California State Route 140. The San Luis NWR and SJRNWR are both part of the Refuge Complex, which also includes the Merced National Wildlife Refuge (Merced NWR), and the Grasslands Wildlife Management Area (Grasslands WMA), and is managed out of the Refuge Complex headquarters in Los Banos. Two wildlife areas managed by CDFW are located near the Mid SJR Region of the SPFC: the West Hilmar Wildlife Area and North Grasslands Wildlife Area. The West Hilmar Wildlife Area is adjacent to Subregion E within Merced and Stanislaus counties and includes 340 acres of woodland, riparian, and grassland habitat. The North Grasslands Wildlife Area covers just over 7,000 acres adjacent to the San Luis NWR to the north and is located in both Merced and Stanislaus counties. The North Grasslands Wildlife Area includes wetland, riparian, and upland habitats. Romero Ranch and Simon Newman Ranch were purchased by TNC in 1998 and provide 61,000 acres of habitat along and in between Orestimba and Garzas creeks.

Map 19, Riparian Vegetation, Critical Habitat, and Endangered and Threatened Species, of the Atlas (Appendix A) identifies areas within the Mid SJR Region and vicinity that are dominated by riparian vegetation; the channels that are critical habitat for steelhead trout (*Oncorhynchus mykiss*); and the approximate locations of occurrences of plant and animal species that are listed as endangered and/or threatened under the California or United States Endangered Species Acts. Extensive riparian vegetation is present within the SJRNWR and there are small swaths of riparian vegetation along the San Joaquin River from the confluence with the Merced River to the confluence with the Stanislaus River. Riparian vegetation that lines the Merced, Tuolumne, and Stanislaus rivers is shown in **Figure 2-6**. As shown in Atlas Map 19 (Appendix A), the San Joaquin, Merced, Tuolumne, and Stanislaus are characterized as Critical Habitat for steelhead trout. Critical Habitats are those that are designated by the USFWS as areas essential to the survival of listed species. Other Critical Habitats located within the Mid SJR Region include those for the vernal pool tadpole shrimp (*Lepidurus packardi*) and vernal pool fairy shrimp (*Branchinecta lynchi*) within Subregion A. The California Natural Diversity Database (CNDDB) is the source of occurrences of endangered plant and animal species shown in Atlas Map 19.

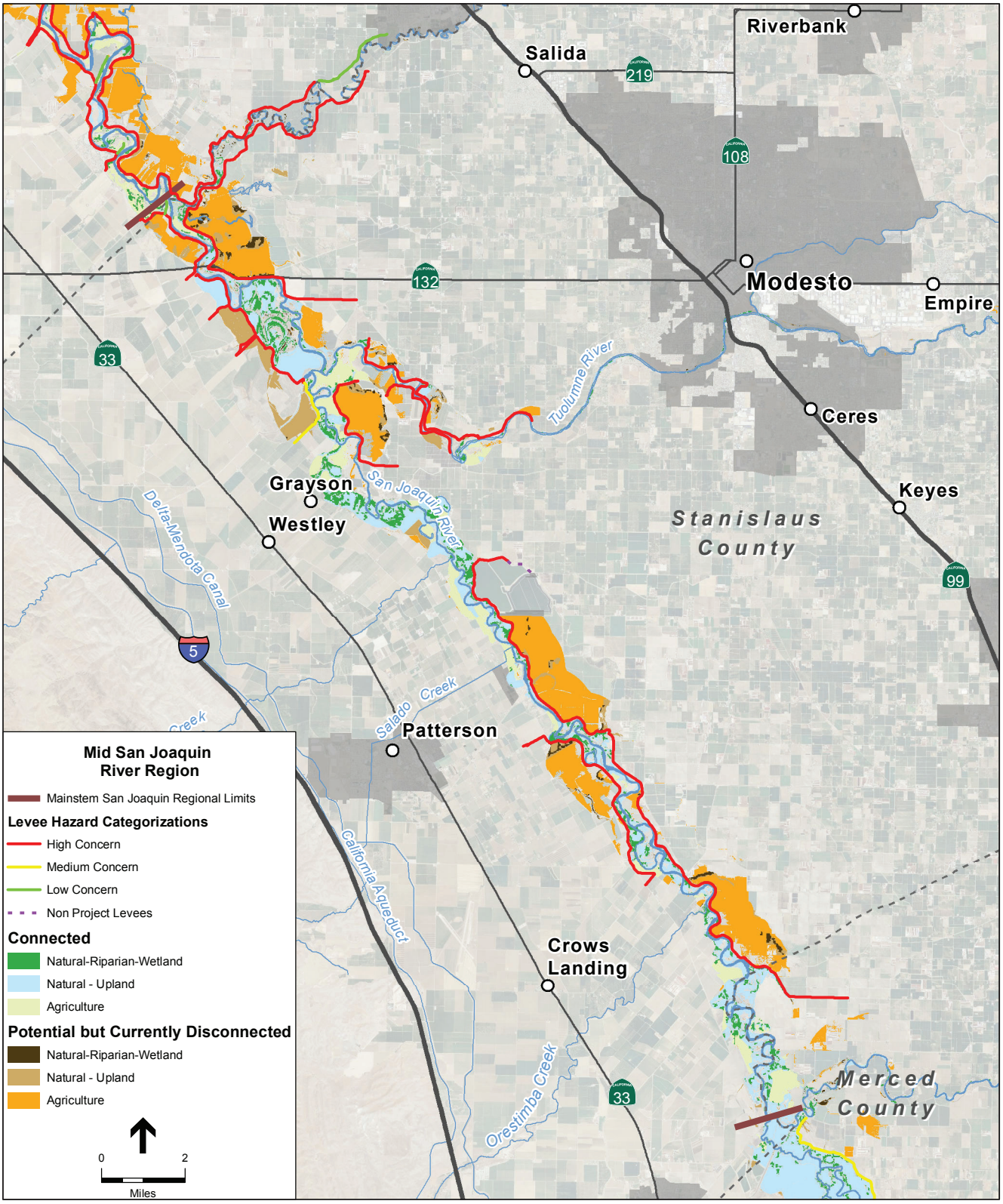
Within Subregion A of the Mid SJR Region of the SPFC, there is an area that is designated as Critical Habitat for the Conservancy fairy shrimp (*Branchinecta conservation*). In east Stanislaus County, there are large areas of Critical Habitat for Colusa grass (*Neostapfia colusana*), California tiger salamander (*Ambystoma californiense*), and vernal pool fairy shrimp (*Lepidurus packardi*). The entire length of the Merced, Tuolumne, Stanislaus, and San Joaquin Rivers in the planning area are designated as Critical Habitat for steelhead trout (*Oncorhynchus mykiss*). The San Joaquin River just downstream of the planning area is designated as Critical Habitat for green sturgeon (*Acipenser medirostris*).

Riparian and wetland-associated sensitive species documented within the San Joaquin River corridor and the lower reaches of the Merced, Tuolumne, and Stanislaus rivers include Delta button-celery, valley elderberry longhorn beetle, riparian woodrat (*Neotoma fuscipes riparia*), riparian brush rabbit (*Sylvilagus bachmani riparius*), least Bell's vireo (*Vireo belli pusillus*), colonies of tricolored blackbirds, Swainson's hawk, pallid bat, and western red bat. This area also provides wading bird rookeries; habitat for Sacramento splittail; and migrating, holding, and rearing habitat for steelhead and fall-run Chinook salmon (DWR, 2012). Since 1998, a captive breeding and reintroduction program has been underway to recover the riparian brush rabbit from the brink of extinction. A viable population of this flood-threatened mammal has been re-established in restored forests at the SJRNWR, and may be delisted with the establishment of two additional viable populations. This species resides wholly within the Mid San Joaquin River and Lower San Joaquin River/Delta-South planning regions, and its preferred habitat is brushy vegetation along levee slopes and riverbanks. Past efforts to clear levee vegetation within this species range have resulted in regulatory conflict.

The banks of the major rivers in the planning area are inconsistently reinforced with rock rip-rap, waste concrete and other rock debris. No engineered rock revetment was included as part of the original SPFC in the region; nonetheless, rock revetment is present and is currently being mapped in the region by DWR. Past efforts to use revetment to stabilize river banks and levees from erosion in this region have resulted in regulatory conflict.

Analyses conducted for the CVFPP (DWR, 2012a) identified 7,760 acres of floodplain lands along river corridors within the planning area that could potentially be hydrologically reconnected to the San Joaquin, Merced, Tuolumne, and Stanislaus rivers for frequent inundation so as to benefit ecological processes. These areas are identified in **Figure 2-7 Potential Floodplain Restoration Areas**.

The CVFPP identified conservation plans that were relevant to the CVFPP planning area in Table 1-1 of Attachment 9E to the CVFPP. The subset of the information in that table that applies to the Mid SJR RFMP planning area is provided below in **Table 2-4**, **Conservation Plans Relevant to the Planning Area**.



Note: This analysis includes lands within a 1 mile distance of the centerline of the San Joaquin River and its tributaries

SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013

Mid San Joaquin River Regional Flood Management Plan . 120802

Figure 2-7

Potential Floodplain Restoration Area

Table 2-4
Conservation Plans Relevant to Planning Area

	Selected Habitat Targets from Relevant Conservation Plans				Selected Species Targets from Relevant Conservation Plans									
Plan Name	Riparian/SRA	Wetland	Seasonal Floodplain	Riverine Aquatic	Delta Button Celery	Salmonids	Giant Garter Snake	VELB	Yellow-Billed Cuckoo	Bank Swallow	Swainson's Hawk	Least Bell's Vireo	Riparian Brush Rabbit	Riparian Woodrat
San Joaquin County Multi-Species HCP and Open Space Plan	+	+			+		+	+	+	+	+		+	+
PG&E O&M HCP	+	+	+	+	+		+	+		+	+		+	+
San Joaquin River Restoration Program	+		+	++		++								
Central Valley Project-State Water Project OCAP and Associated BOs	+		+	++		++								
CALFED Multi-Species Conservation Strategy	++	++	++	++	++	++	++	++	++	++	++	++	++	++
Central Valley Improvement Act Programs	++		+	++		++	+	+	+	+	+	+	+	+
Central Valley Joint Venture	++	++							++	++	++	++		
Bay-Delta Conservation Plan	++	++	++	++	++	++	++	+	++	+	++	+	+	+
Draft Recovery Plan for the Giant Garter Snake		++					+							
California Red-legged Frog Recovery Plan	+	+	+	+										
Recovery Plan for Upland Species of the San Joaquin Valley, California	+												++	++
California Water Plan	+	+	+	+										
State Water Resources Control Board Plans				+										

\+ A probable or potential relationship exists. The Conservation Strategy is not likely to significantly contribute to the other conservation plan's conservation objectives, or the conservation target is a secondary focus of the conservation plan. For geographic overlap, there is a minor spatial overlap between the conservation plan area and one of the CVFPP planning boundaries.

++ A significant relationship exists. The Conservation Strategy could significantly contribute to the other conservation plan's conservation objectives. For geographic overlap, there is a large spatial overlap between the conservation plan and one of the CVFPP planning boundaries.

SOURCE: Table 1-1, Summary of CVFPP Relationships to Conservation Objectives from Other Conservation Plans, of Attachment 9E the 2012 CVFPP.

2.5 Protected Populations and Assets

Because the vast majority of the lands within the planning area are within Stanislaus County, some of the data presented in this section references Stanislaus County alone.

2.5.1 Protected Populations

Based on data collected during the United States 2010 Census of Population and Housing (US Census Bureau, 2010), the population within the Mid SJR Region boundary is 2,129 (**Table 2-5, Mid San Joaquin River Region Population**). According to the 2010 Census, the total population of Stanislaus County is 514,453. The population of each major city and community is included in **Table 2-6**, **Population of Cities and Communities in Planning Area**. **Table 2-7**, **Population and Assets within 100- and 500-year floodplains in Stanislaus County**, includes the population within the 100- and 500-year floodplains associated with each major river and creek in the planning area. Population and asset data are presented in **Figure 2-8**, **Mid SJR Region Population**, of this plan as well as Maps 2 and 16 of the Atlas (Appendix A). The majority of land within the region is agricultural and as a result, population density is low relative to urban and suburban areas with an average density of less than 1 person per 10 acres. Private residences and other property are included within the assets of the Mid SJR Region at risk from flooding.

Table 2-8, **Mid San Joaquin River Region Land Use**, includes a summary of land use within the Mid SJR Region of the SPFC by acres and percent of region. Land use within the Mid SJR Region of the SPFC and surrounding areas is also shown on Map 6 of the Atlas (Appendix A). Farmland makes up 75 percent of the Mid SJR Region of the SPFC, with urban areas accounting for only four percent. Modesto is the closest large urban area to the Mid SJR Region of the SPFC, approximately 10 miles east, and according to the 2010 Census, has a population of approximately 201,165 (US Census Bureau, 2013a). The small areas within the Mid SJR Region of the SPFC that are under the jurisdiction of the City of Modesto are entirely urban and developed land. The City of Patterson is located approximately 1.2 miles west of Subregion E and has a population of 20,413. Newman is located approximately six miles southwest of Subregion F and has a population of 10,224. The communities of Grayson and Westley have populations of 952 and 603, respectively, and are located approximately 1.8 and 3.8 miles southwest of Subregion D, respectively. Ceres is a city within Stanislaus County, adjacent to Modesto to the south, with a population of 45,417 (US Census Bureau, 2013b). Salida is located northwest of Modesto and has a population of 13,722. Crows Landing is a small community of 355 located between Patterson and Newman along Highway 33. Other cities in Stanislaus County include Oakdale and Riverbank along the Stanislaus River, Hughson and Waterford along the Tuolumne River, and Turlock, which is located many miles from the rivers in the planning area.

Table 2-5
Mid San Joaquin River Region Population

Subregion	Population
A	849
B	77
C	20
D	101
E	1,037
F	45
Total	2,129

SOURCE: 2010 Census

Table 2-6
Population of Cities and Communities in Planning Area

City/Community	Population
Ceres	45,417
Crows Landing	355
Grayson	952
Hughson	6,640
Modesto	201,165
Newman	10,224
Oakdale	20,675
Patterson	20,413
Riverbank	22,678
Salida	13,722
Turlock	68,549
Waterford	8,456
Westley	603

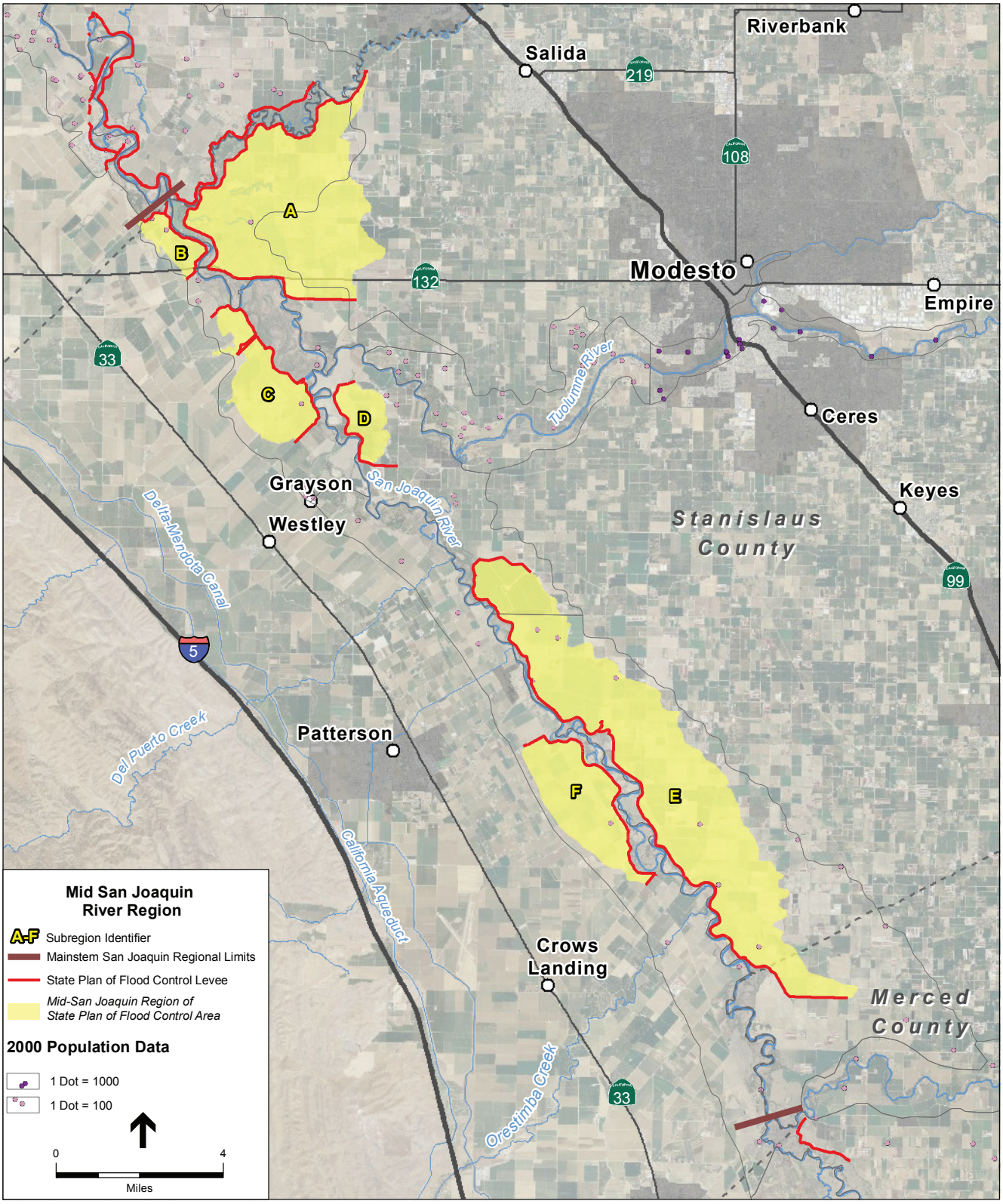
SOURCE: 2010 Census

Table 2-7
Population and Assets within 100- and 500-year Floodplains in Stanislaus County

River	Population	Households	Number of Parcels	Total Value
100-year Floodplain				
Del Puerto Creek	248	71	139	$49,686,842
Dry Creek	747	273	146	$143,550,227
Orestimba Creek	588	223	189	$48,685,552
Salado Creek	38	10	31	$8,795,382
San Joaquin River	2,354	676	630	$149,520,110
Stanislaus River	2,322	892	268	$117,176,939
Tuolumne River	4,766	1,566	974	$187,806,940
500-year Floodplain				
Del Puerto Creek	375	112	194	$62,664,305
Dry Creek	747	273	149	$149,644,108
Orestimba Creek	927	338	300	$77,913,338
Salado Creek	221	70	67	$16,659,356
San Joaquin River	2,408	694	668	$166,250,814
Stanislaus River	2,460	943	465	$200,322,760
Tuolumne River	11,177	3,555	2,162	$578,719,622

SOURCE: Stanislaus County, 2010

Floodplains in the planning area that are in Merced County are not covered above. According to Attachment 8F of the 2012 CVFPP, the general floodplain area along the San Joaquin River at the confluence with the Merced River includes 522 residential units with a total value of $26,196.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-8
Mid SJR Region Population

Table 2-8
Mid San Joaquin River Region Land Use

Land Use Category	Acres of Land Type	% of SPFC Area
Urban and Developed Land	1,260	4%
Native Vegetation and Grazing Land	5,160	18%
Local and Unique Farmland	7,260	25%
Prime and Statewide Importance Farmland	14,290	50%
Confined Animal Agricultural Land	620	2%
Rural and Semi-Agricultural Land	160	1%
Total	**28,750**	**100%**

SOURCE: Mid San Joaquin River Region Flood Atlas (Appendix A)

Urban and Developed Land. Urban and developed land is occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10-acre parcel. Common examples include residential, industrial, commercial, institutional facilities, cemeteries, airports, golf courses, sanitary landfills, sewage treatment, and water control structures.

Native Vegetation and Grazing Land. Land on which the existing vegetation is suited to the grazing of livestock. This category is used only in California and was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities. Land which consists of open field areas that do not qualify for an agricultural category, mineral and oil extraction areas, and rural freeway interchanges.

Local and Unique Farmland. Farmland of Local Importance - All farmable lands that do not meet the definitions of Prime, Statewide, or Unique. This includes land that is or has been used for irrigated pasture, dryland farming, confined livestock and dairy, poultry facilities, aquaculture and grazing land. Unique Farmland - Lesser quality soils used for the production of the leading agricultural crops in the state. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

Prime and Statewide Importance Farmland. Prime Farmland - Irrigated land with the best combination of physical and chemical features able to sustain long term production of agricultural crops. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date. Farmland of Statewide Importance - Irrigated land similar to Prime Farmland that has a good combination of physical and chemical characteristics for the production of agricultural crops. This land has minor shortcomings, such as greater slopes or less ability to store soil moisture than Prime Farmland. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date.

Confined Animal Agricultural Land. This includes aquaculture, dairies, feedlots, and poultry facilities. Confined Animal Agriculture qualifies for Farmland of Local Importance in some counties.

Rural and Semi-Agricultural Land. This includes residential areas of one to five structures per ten acres. This includes semi-agricultural lands such as farmsteads, agricultural storage and packing sheds, unpaved parking areas, composting facilities, equine facilities, firewood lots, and campgrounds.

It is estimated that a population of approximately 2,400 is located in unincorporated areas within the 100-year (1% annual chance of occurrence) floodplain of the San Joaquin River alone. (See Chapter 3, Flooding and Flood Hazards, of this plan for a map of the 100-year floodplain boundary.) Stanislaus County is estimated to have a population of 14,544 that is exposed to flood hazards during a 100-year event. Additionally, a population of approximately 3,300 is located within all 100-year floodplains in the City of Modesto, 1,600 within all 100-year floodplains in the City of Newman, and 1,500 within all 100-year floodplains in the City of Patterson (Stanislaus County, 2010). The CVFPP estimated potential loss of 50 lives in the Mid SJR Region because of flooding over the next 100 years. The Expected Annual Damages from flooding within the Mid SJR Region is more than $3 million to crops; structures and contents; and business losses (Figure 2-8) (DWR, 2012a). The probability of flood damages shown in **Figure 2-9**, **Expected Annual Damages from Flooding**, takes into account several sources of uncertainty related to levee performance, including the anticipated probability of levee failure based on geotechnical considerations.

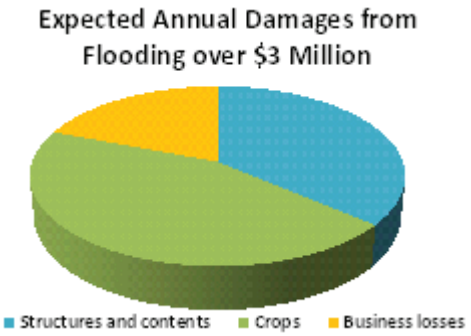
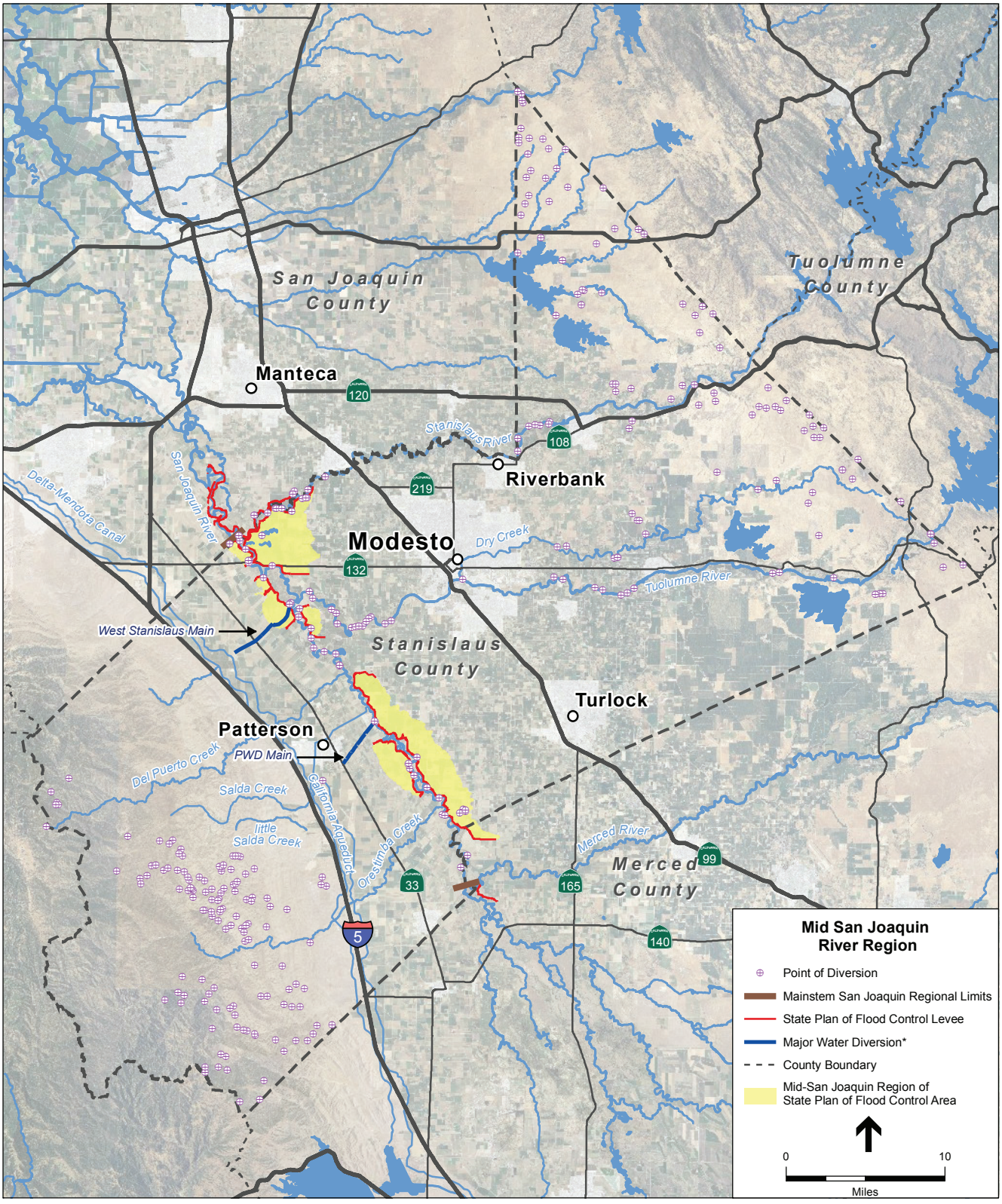


Figure 2-9
Expected Annual Damages from Flooding in the Mid SJR Region

2.5.2 Protected Assets – Critical Public Infrastructure

Types of assets that are protected by the SPFC facilities include state, federal, local, and county facilities; health and public safety facilities; public schools; and other critical public infrastructure. Protected federal, state, and local facilities include canals and pipelines. Local and county facilities include roadways, bridges, water and wastewater facilities and local, non-SPFC levees. Hospitals and emergency operations centers would be considered health and public safety facilities, respectively. Power facilities and substations as well as potential hazardous material (hazmat) storage areas are examples of other critical public infrastructure.

Map 8 of the Atlas, Existing Critical Facilities and Economic Assets, includes the locations of protected assets within the Mid SJR Region and surrounding areas (Appendix A). Assets within the Mid SJR Region of the SPFC shown in Map 8 of the Atlas include SPFC levees along the San Joaquin River, State Highway 132, and the Crows Landing Bridge. **Figure 2-10**, **Major Water Diversion Facilities**, shows the locations of major water diversion facilities within the Mid SJR Region and surrounding areas. Assets within the SPFC Area surrounding communities include police stations in Modesto, Salida, Ripon, Crows Landing, and near the San Joaquin River approximately four miles east of Westley; fire stations in Modesto, Salida, Ripon, Patterson, approximately eight miles east of Patterson and approximately nine miles east of Westley; hospitals in Modesto and Patterson; the Modesto City-County Airport, Patterson Airport, and the Crows Landing Naval



*Likely incomplete data

SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013; CSWRCB, 2014

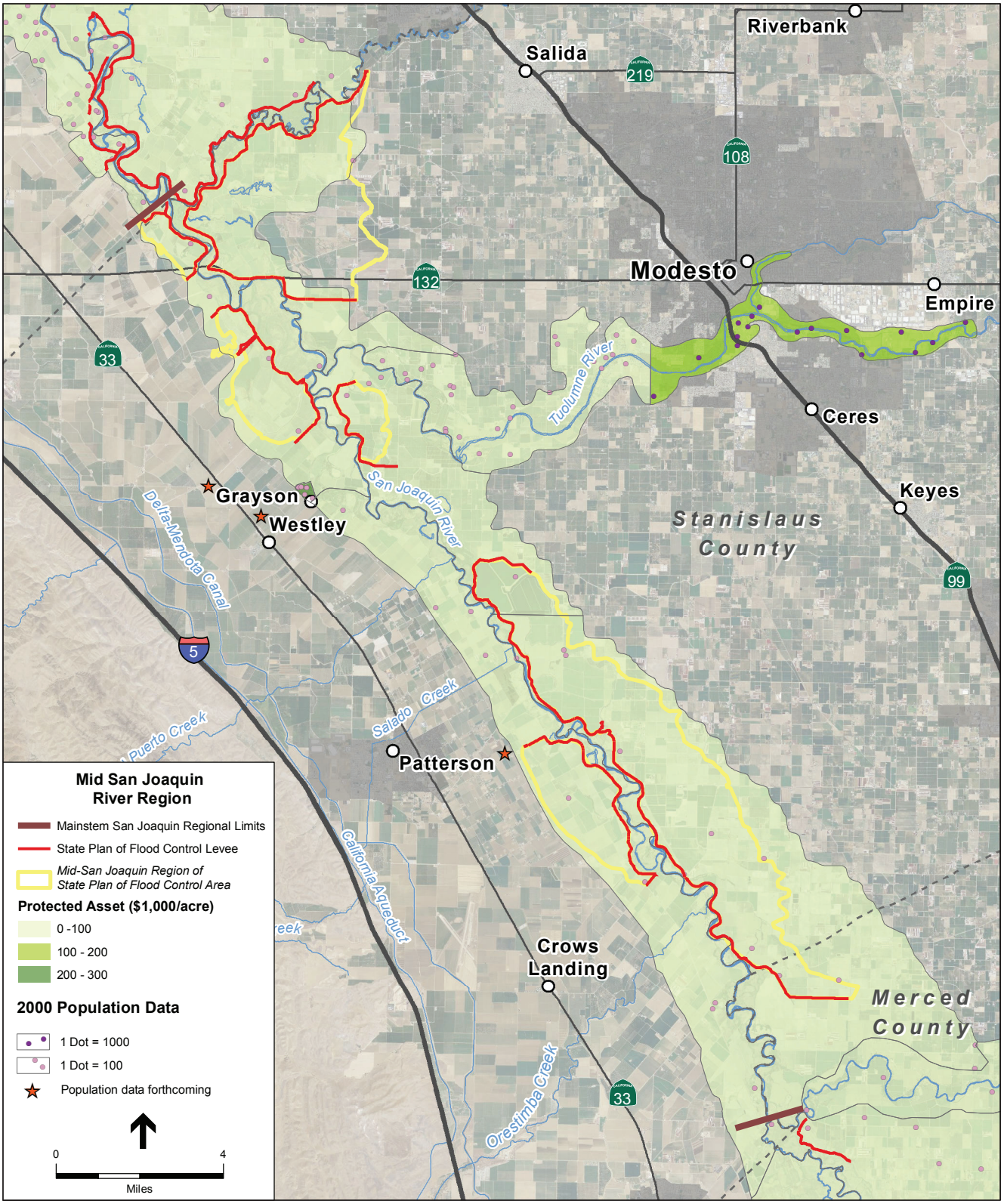
Figure 2-10
Water Diversion Facilities

Air Station (not operational but being redeveloped as a general aviation airport); public schools in Modesto, Ripon, Salida, Westley, Patterson, Crows Landing, and three east of the San Joaquin River outside of these communities; a boat launch in Modesto; the Shiloh Bridge over the Tuolumne River in Stanislaus County; Union Pacific and California Northern railroads; State Highways 33, 99, 108, 219, and Interstate 5 (I-5); and the Modesto, Patterson, and Newman Wastewater Treatment Plants (WWTPs). **Figure 2-11**, **Mid SJR Region Protected Assets**, of this plan and Map 2 of the Atlas (Appendix A) depict assets within the region based on ranges of value. As shown, assets within the Mid SJR Region of the SPFC are valued within the range of $0 to $100,000/acre. The Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan included the value of several assets within the 100- and 500-year flood zones, including Honor Farm, a prison facility in Grayson ($2.36 million), Fox Grove Regional Park along the Tuolumne River near Hughson ($60,000), the Newman Library ($1.03 million), Patterson Library ($1.99 million), and animal services facilities in Modesto near the Tuolumne River upstream of the confluence with Dry Creek ($1.36 million) (Stanislaus County, 2010).

Damage to bridge facilities in the event of a flood could cost tens of millions of dollars to repair. The Highway 132 (Maze Blvd.) bridge, which is a major commuter route between the Modesto vicinity to the Bay Area, would have severe economic impacts on commerce if damages were incurred as a result of flood damage. Highway 99 and the main route of the Union Pacific Railroad (UP) cross the Tuolumne River at Modesto. In a major flood event in which Don Pedro Reservoir overtops the dam, both of these facilities could be at risk. The repair or replacement cost for a mainline railroad bridge capable of carrying heavy freight traffic such as that found on the UP line would be expected to cost tens of millions of dollars. Additional costs would be incurred by the necessity to reroute rail traffic around the damaged bridge and secure alternative transportation measures. Lastly, major public assets located within the Mid SJR region include the Hetch-Hetchy electrical transmission lines and domestic water lines, which service millions of San Francisco Bay Area residents; these are adjacent to the Highway 132 bridge, and are in jeopardy during flood events. The Crows Landing and Las Palmas Avenue bridges that cross the San Joaquin River are a vital transportation link from areas west of the San Joaquin River to east of the river (PBI, 2013). The Crows Landing Bridge is valued at $6.86 million, and the value of the Las Palmas Avenue Bridge is $7.45 million (Stanislaus County, 2010). Both roadways are within the 100-year floodplain.

The cities of Patterson and Newman have WWTPs that are located along the San Joaquin River, but outside of the SPFC Area boundaries. The City of Modesto WWTP includes two facilities located along the Tuolumne and San Joaquin rivers, one within and one outside of the SPFC Area. These facilities are included in the scope of this plan because they are susceptible to flood hazards, which are described in more detail in Chapter 3. The City of Patterson WWTP is located on the left bank of the San Joaquin River just north of the East Las Palmas Avenue/West Main Street river crossing. The City of Newman WWTP is located near the left bank of the San Joaquin River on Hills Ferry Road near the City of Newman. The Modesto WWTPs include the Sutter Avenue Primary Treatment Plant along the right bank of the Tuolumne River adjacent to Bellenita Park and the Jennings Road Secondary Treatment Plant on the right bank of the San Joaquin River within the SPFC Area.

Thus, the critical infrastructure and property either within or adjacent to areas protected by SPFC on the San Joaquin River include roads, important underground pipelines, and the WWTPs described above.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 2-11
Mid SJR Region Protected Assets

Assets within the 500-year floodplain (0.2% annual chance of occurrence) floodplain of Orestimba Creek were evaluated in the Orestimba Creek Draft Interim Feasibility Study (USACE, 2012). **Table 2-9**, **Orestimba Creek 500-year Floodplain Structure Inventory and Property Values**, includes the results of that evaluation as reported in the feasibility study. Assets within the 500-year floodplain include residential, commercial, industrial, and public property valued at a total of just over $300 million. The Eastin Road, Bell Road, and Jorgensen Road low water crossings are also assets within the 500-year floodplain. Over two thirds of those assets, or approximately $211 million, are residential properties. See Chapter 3, Flooding and Flood Hazards, of this plan for a map of the 500-year floodplain boundary.

Table 2-9
Orestimba Creek 500-year Floodplain Structure Inventory and Property Values

	Number of Structures		Structural Value ($1,000)		Content Value ($1,000)		Total Value by Land Use Type ($1,000)
Land Use	Rural	Urban	Rural	Urban	Rural	Urban	
Residential	158	1,122	17,706	123,204	8,853	61,602	$211,365
Commercial	0	62	0	23,732	0	25,030	$48,763
Industrial	0	16	0	13,593	0	20,014	$33,607
Public	0	7	0	4,541	0	2,123	$6,664
Total	158	1,207	$17,706	$165,070	$8,853	$108,769	$300,398

SOURCE: USACE 2012

2.5.3 Protected Assets – Agriculture and Associated Infrastructure

Other assets protected by SPFC facilities include agricultural lands and associated infrastructure, which may be privately owned or owned by irrigation districts, such as the Modesto or Turlock Irrigation Districts. Agricultural land and the crops that it contains, along with supporting water delivery and storm drainage infrastructure, are important assets protected by SPFC facilities.

According to the 2011 Stanislaus County Crop Report, milk is the top agricultural commodity in the planning area (Stanislaus County, 2011). In total, dairy products in Stanislaus County comprised $766 million of gross farm income, approximately one quarter of all agricultural income in the County. Not all dairy production occurs in the floodplains, however; recent spikes in conversion to almond orchards (60% increase in gross income in Stanislaus County from 2010 to 2011) has relegated much annual agriculture to flood-prone or other lands less suited to conversion to permanent crops. The major drought in much of the Mid-western United States in 2012 drove dairy feed prices very high, which negatively impacted many dairies in the San Joaquin Valley. According to a recent news story, over 100 dairies across the San Joaquin Valley closed in 2012 and more were expected to close in 2013 (CVBJ, 2013). Continued conversion of row crops and silage production land uses to nut production is anticipated in coming years, and this trend may have an impact on flood management across the region. Flood damages to orchard crops may result in higher dollar costs than flood damages to annual forage crops, depending on the timing and duration of flooding.

Spring floods pose particular hazards for some crops, most notably orchards. For example, almond trees, which are common in the region, bloom from late February through the end of March. This coincides with

the flooding period for the San Joaquin River. An almond orchard that has saturated soils cannot be sprayed effectively for brown rot, a common fungus that attacks the flower. Orchard trees that have their roots in standing water for prolonged periods during the growing season undergo significant physiological stress. Therefore, with a combination of these factors, if an extended duration flood occurs during bloom time or the early growing season, devastating effects on yields and agricultural income would occur. In general, orchards are generally not considered flood-compatible.

The dairy sector is also highly susceptible to income loss because of flooding – particularly in the early spring. In the spring and early summer, milk production peaks. Dairy cows are extremely stress-sensitive, and milk yields can be expected to fall precipitously when cows are subjected to environmental stresses such as flood events, moving herds out of the floodway, or other activities that disrupt daily routines. According to recent data from the EPA, approximately 21 dairies are located within the 100-year floodplain in the Mid San Joaquin River Region (EPA, 2013).

2.6 Emergency Response/ Public Safety

Two key components of emergency response during flood events include flood fight operations and general public safety operations. Flood fight operations include emergency activities aimed at preventing failure of a levee during a flood or in the event of a levee breach, as well as a maintenance activities provided by the reclamation districts with possible assistance from DWR and USACE. Another component of flood response includes public warning, evacuation rescue, care and shelter, and recovery functions provided by local counties, cities, and special purpose “fire districts.”

Local fire and law enforcement agencies have jurisdiction within the floodplain for protecting people and property, while reclamation districts have jurisdiction for flood fight. In large flood events, the geographic scale at which these different groups of agencies establish command and control or organize their response varies because of differences in agency jurisdictional boundaries and internal protocols (PBI, 2013). See Chapter 4, Emergency Response, for a more detailed discussion on this topic.

2.7 Agricultural Land Management and Water Quality

Water quality is an important component of agricultural land management in the Central Valley. Runoff from agricultural lands must be managed for a variety of pollutants including pesticides, herbicides, salts,

fertilizers, sediment, and pathogens. Commercial growers and confined animal facility operators must comply with the Central Valley Regional Water Quality Control Board (CVRWQCB) Irrigated Lands Regulatory Program and Confined Animal Facility Program requirements, respectively. Water Quality Coalitions have been formed among growers to address regulatory requirements collectively. The various coalitions benefit the growers and regulatory agencies because compliance is handled by a group, rather than on a grower-by-grower basis. The Westside San Joaquin River Watershed Coalition and East San Joaquin Water Quality Coalition are active within the planning area. These coalitions are focused on addressing water quality issues related agricultural operations, including the potential to use managed wetlands to accomplish pollutant removal from drainage. Under the Irrigated Lands Regulatory Program, specific Waste Discharge Requirements are currently being developed for several types of agricultural lands. Elevated salinity and nitrate levels in surface water and groundwater are a problem within the planning area and Central Valley. In 2006, a joint effort began among the Central Valley Regional Water Quality Control Board, State Water Resources Control Board, and local stakeholders to address salinity and nitrate issues within the Central Valley and to adopt long-term solutions. The collaborative effort is called Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS). The Lower San Joaquin River Committee is a subcommittee of the CV-SALTS Executive Committee, was established in 2010, and includes a variety of stakeholders including municipalities, irrigated agriculture, food processors, irrigation districts, and state and federal agencies. The primary goal of the Lower San Joaquin River Committee is to develop water quality objectives that support the beneficial uses on the Lower San Joaquin River, including the Mid SJR Region (CV-SALTS, 2013). The committee is currently working with the CVRWQCB, United States Bureau of Reclamation (USBR), and others to implement a real-time management system to manage salt in the Lower San Joaquin River watershed. One water quality and wildlife management strategy that could be used to reduce salts is exemplified by the wetlands created by Mickey Saso along the San Joaquin River in which agricultural drainage is used to provide wildlife habitat and remove sediment, pesticides, herbicides, and other contaminants. The wetlands could be used to store irrigation water that is higher in salts, and the water could be discharged into the San Joaquin River during higher river flows when salt concentrations are lower. Funding is available for projects aimed at improving water quality in agricultural areas. For example, the NRCS, which is part of the United States Department of Agriculture, provides funding through its Bay-Delta initiative for small, high-impact projects that protect water quality in the tributaries to the Sacramento-San Joaquin Delta.

2.8 Integrated Regional Water Management Planning

The Integrated Regional Water Management (IRWM) planning process, fostered by recent legislation and bond measures and administered by DWR, adopts a strategy for regional water management solutions that incorporates physical, environmental, societal, economic, legal, and jurisdictional aspects and use of an extensive stakeholder engagement process. The IRWM planning process is intended to be more effective than traditional methods by incorporating all of the relevant aspects of water management planning rather than addressing each aspect through a separate process. Flood management strategies identified in this plan should be incorporated into the IRWM Plans that have overlapping planning area boundaries. Map 5, DWR Integrated Regional Water Management Planning Areas, of the Atlas, includes the boundaries of the two IRWM planning areas with boundaries that overlap with the Mid SJR Region, which include the East Stanislaus and Westside San Joaquin IRWM Regions.

The East Stanislaus IRWM Plan identifies projects and measures to be implemented to meet the goals set for the region, one of which is flood protection. This regional flood management plan and the East Stanislaus IRWM Plan are being developed cooperatively to ensure consistency and integration between the two plans. The East Stanislaus IRWM Plan identifies 28 potential projects, some of which are related to flood management. Flood management-related projects include the La Grange Floodplain Restoration and Spawning Gravel Augmentation, Dos Rios Floodplain and Riparian Habitat Restoration, and the Integrated Stormwater Resource Management and Groundwater Augmentation Plan. Because of economic challenges in the East Stanislaus IRWM Region, funding to implement these projects has not yet been secured. Remaining IRWMP funding is limited and additional funds may or may not be forthcoming. One more round of Proposition 84 implementation funding is expected, with submittals due in December 2014/January 2015 timeframe to potentially fund identified projects in 2015. The East Stanislaus Region expects to pursue grant funding through Round 3. Prior to release of the DWR Proposal Solicitation Package (PSP), the East Stanislaus Regional Water Management Partnership, the Regional Water Management Group for the region, and the Steering Committee will meet to determine next steps. No future funding for the Proposition 1E Stormwater and Flood Management grant program has yet been authorized.

The Westside Integrated Water Resources Plan (WIWRP) was adopted in 2006 to address the integrated regional water management needs and opportunities of the Trans-San Joaquin-Tulare/Kern area. Part of the Mid San Joaquin Region is located within this area, but the WIWRP was not specific with respect to that region. Therefore, a process is now underway to update the WIWRP in accordance with the latest DWR IRWP guidelines and requirements and to provide a Westside-San Joaquin region specific IRWMP by Summer 2014.

The Governor and Legislature have directed DWR to expedite the solicitation and award of $200 million in IRWM funding to support projects and programs that provide immediate regional drought preparedness, increase local water supply reliability and the delivery of safe drinking water, assist water suppliers and regions to implement conservation programs and measures that are not locally cost-effective, and/or reduce water quality conflicts or ecosystem conflicts created by the drought. DWR received 39 grant applications requesting a total of $339 million in IRWM grant funds for projects totaling in excess of $970 million for the 2014 IRWM Drought Grant Solicitation. Grants have been awarded, and a table summarizing the grant applicants, IRWM region, requested grant amounts, and total project costs is available online (DWR, 2014a).

3. Flooding and Flood Hazards

3.1 Introduction

The purpose of this chapter is to describe flood conditions and known flood hazards within the planning area for the Mid San Joaquin River Region (planning area). Topics covered are those that are relevant to flood management within the planning area. The content of this chapter includes information on the following:

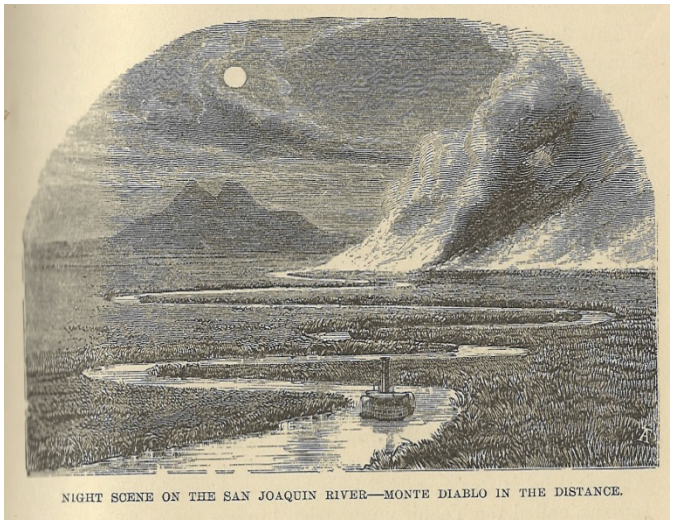
- flood history within the San Joaquin River Basin, including flood system performance during the 1983, 1986, 1995, and 1997, 2006, and 2011 flood events;
- flood management infrastructure within the San Joaquin River Basin and Mid SJR Region;
- roles of agencies with flood management responsibilities within the Mid SJR Region;
- organizations in the region with a flood management focus;
- the 100-, 200-, and 500-year floodplain boundaries;
- calculated design channel capacities;
- information on the Flood Forecast Monitoring Network;
- condition of levees throughout the Mid SJR Region;
- detail on known flood hazards;
- a synopsis of system deficiencies within the Mid SJR Region; and
- an introduction to opportunities for flood management improvements and opportunities for integration with additional purposes.

Sources for the information provided in this chapter include reports prepared by the California Department of Water Resources (DWR), the Federal Emergency Management Agency (FEMA), the United States Army Corps of Engineers (USACE), City of Modesto, Stanislaus County, California Department of Finance (CDF), United States Fish and Wildlife Service (USFWS), and McBain and Trush; web content published by the National Weather Service (NWS), Stanislaus, Merced, and San Joaquin Counties, and the Cities of Modesto, Patterson, and Newman; and the United States Code.

Flood hazards within the planning area occur as a result of the combination of the naturally flood-prone character of the San Joaquin Valley, levees that are in poor condition, assets that are located along major rivers, and a range of flood preparedness levels among communities and the LMAs. Within the Mid SJR Region planning area, the cities of Modesto, Newman, Patterson and communities of Westley and Grayson are exposed to flood risk during large runoff events as are large agricultural areas along the San Joaquin, Merced, Tuolumne, and Stanislaus rivers. In Modesto, flooding occurs at the confluence of the Tuolumne River and Dry Creek during intense rains, especially when releases from Don Pedro Reservoir are high. Within the Westside tributary watersheds to the San Joaquin River, intense rainfall results in extensive, low-depth flooding. Each of these hazards is described in this chapter along with brief introductions to identified opportunities to improve flood management in the planning area, which are presented in detail in Chapter 7, Proposed Regional Improvements, of this plan.

3.2 Flood History of the San Joaquin River Basin

There is a long history of catastrophic flooding within the Central Valley that dates back to the early 1800s (USACE, 1999). In the 30 years since 1983, a federal disaster has been declared four times in the Mid SJR Region (DWR, 2012a). A brief history of flooding within the Central Valley was provided in Section 1.2 of the 2012 Central Valley Flood Protection Plan (CVFPP) (DWR, 2012a). The Sacramento and San Joaquin River Basins, California Post-Flood Assessment (Post-Flood Assessment) prepared by the United States Army Corps of Engineers (USACE) provides a detailed history of flooding and flood management within the Central Valley (USACE, 1999). Prior to European settlement and reclamation of lands within the Central Valley, the vast floodplains of the Sacramento and San Joaquin rivers would become inundated during seasonal flood events, often for long periods. Within the San Joaquin Valley alone, snowmelt floods peaking in May or June each year would create several hundred thousand acres of perennial tule marshes and seasonally-flooded wetlands (USACE, 1999).



NIGHT SCENE ON THE SAN JOAQUIN RIVER—MONTE DIABLO IN THE DISTANCE.

These extensive floods have prompted response from those who settled in the Central Valley that continues to the present day. Reclamation districts (RDs) in the Central Valley were formed as early as 1868 to reclaim frequently inundated lands for agriculture. Levees,

small dams, and other diversion infrastructure were constructed by federal, state, and local agencies and turned over to RDs for operation and maintenance (CDF, 1997). Larger flood management projects began to be constructed in the San Joaquin Valley by the Federal Government and local agencies in the mid-1900s. Because of their influence on river flows and river stage, facilities both upstream and downstream of the planning area interact with flood hazards and flood management facilities and activities within the planning area. **Table 3-1**, **San Joaquin River Basin Flood Control Infrastructure**, includes the chronology of large-scale flood management projects within the San Joaquin River Basin. **Figure 3-1**, **Major Flood Control Infrastructure within the San Joaquin River Basin**, includes the locations of these projects and an overview of the flood management infrastructure within the San Joaquin River Basin. As shown in Figure 3-1, levees within the planning area include State Plan of Flood Control (SPFC), or "project," levees and non-project levees. Project levees line the San Joaquin and Stanislaus rivers covering a distance of 72.0 miles. Non-project levees within the planning area are largely non-engineered agricultural levees or material that has been piled along ditches that have been cleared and consist of 0.9 miles along the Merced, 12.0 miles along the Tuolumne, 27.9 miles along the Stanislaus, and 18.9 miles along the San Joaquin River, and 28.0 miles of other levees within the 100-year floodplain. Documented levee failure in the system includes 29 breeches, 3 overtoppings, and seepage in many locations (DWR, 2011c).

Table 3-1
San Joaquin River Basin Flood Control Infrastructure

Project	River/Stream	Storage (TAF)[1]	Maximum Flood Control Space (TAF)	Owner/ Operator	Year
Lower San Joaquin River and Tributaries Project levees	San Joaquin River[2]	n/a	n/a	Multiple entities	1944
Friant Dam (Millerton Lake)	San Joaquin River	521	170	USBR	1949
Los Banos Detention Dam	Los Banos Creek	35	14	USBR	1965
Hidden Dam (Hensley Lake)	Fresno River	90	65	USACE	1975
Buchanan Dam (Eastman Lake)	Chowchilla River	150	45	USACE	1975
New Exchequer Dam (Lake McClure)	Merced River	1,025	350	Merced ID	1967
Don Pedro Dam (Don Pedro Lake)	Tuolumne River	2,030	340	TID/MID	1970
New Melones Dam (New Melones Lake)	Stanislaus River	2,420	450	USBR	1978

USBR = United States Bureau of Reclamation; Merced ID = Merced Irrigation District; TID = Turlock Irrigation District; MID = Modesto Irrigation District

1 TAF = thousand acre-feet, rounded to the nearest 1,000 acre-foot

2 Levees were constructed downstream of the Merced River, Stanislaus River, Old River, Paradise Cut, and Camp Slough.

SOURCE: USACE, 1999

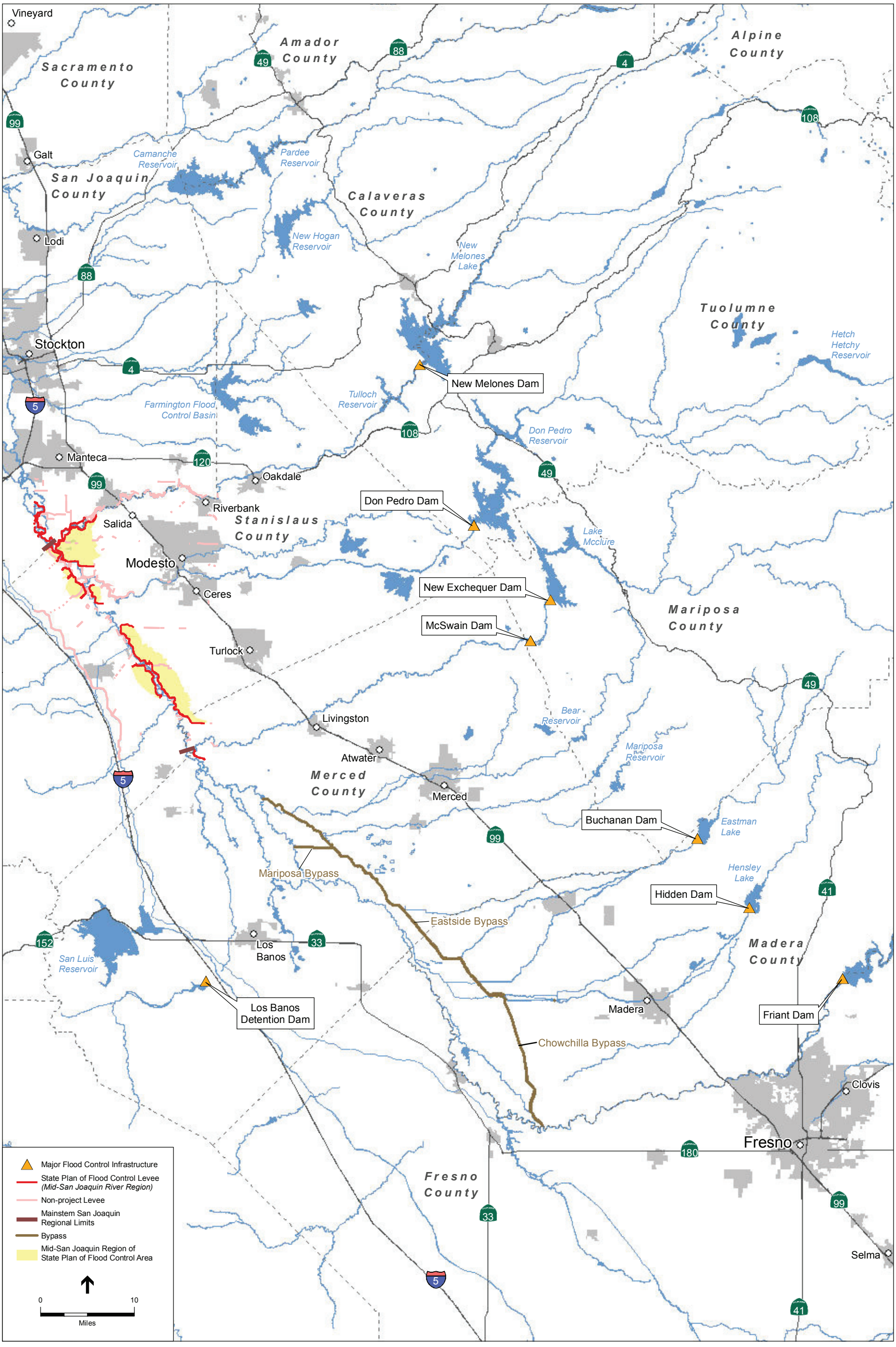
New Melones Dam and Reservoir, completed in 1978, was the last major flood management facilities construction project within the Central Valley (USACE, 1999). Six major floods have occurred since—in 1983, 1986, 1995, 1997, 2006, and 2010. The most significant of the six major floods occurred in January 1997. Flooded area maps were developed to delineate the extent of the 1983, 1986, 1995, and 1997 floods. The maps were developed using aerial photographs, primarily from the DWR Photogrammetry Department. The initial flood boundary delineations only included the flood extent shown in aerial photographs, and any flooded areas not captured in the photographs were excluded from the initial delineated boundary. Areas of known inundation not captured in the photographs, those that were inundated during other flood events, and/or areas included within FEMA GIS data were then added to the

delineation maps by inference. Finally, levee failure locations, including breaks and overtopping, were added to the flooded area maps (USACE, 1999). A description of the flooding extent and levee breaks shown on each map as well as information on reservoir levels and damages sustained and prevented are provided in the discussions below. [Note: the historic flooding maps included below exclude depictions of flooding from the Westside tributaries, though reporting of floods in these areas, when it occurred, is included in the text.]

3.2.1 Flood Control System Performance – 1983 Flood

Numerous storms from November 1982 to March 1983 caused flooding in Northern and Central California. These storms were a result of the El Niño Southern Oscillation, which is characterized by unusually warm ocean temperatures in the Equatorial Pacific and results in increased rainfall in Peru and the southern tier of the United States, including California. Statewide, precipitation in California was 190 percent of normal on average, and in some areas rainfall was more than 220 percent of normal. Snow water content in the Sierra Nevada in 1983 exceeded 230 percent of normal. Snowmelt runoff moving through Central Valley rivers in 1983 was approximately four times the average volume. The combination of storms in the first half of the 1983 water year and one of the wettest Septembers on record in 1982 resulted in all major reservoirs operating within their flood management reservation pools by the end of March. During peak snowmelt runoff in June and July, all reservoirs reached or nearly reached design capacity (USACE, 1999). The estimated exceedance interval for the 1983 event at the San Joaquin River at Newman and the Tuolumne River at Don Pedro Dam is 25-50 and 15-25 years, respectively (USACE, 1999).

The extent of flooding within the Mid SJR Region in 1983 as delineated in the Post-Flood Assessment is shown in **Figure 3-2**, **1983 Detailed View of Flooding Extent**. Refer to the Post-Flood Assessment for maps of the 1983 flooding extent for other portions of the Central Valley (USACE, 1999). One of the four levee breaks that occurred within the San Joaquin River Basin was located in the Mid SJR Region and another was in the vicinity, just downstream of the confluence of the San Joaquin and Stanislaus rivers. The levee break within the Mid SJR Region occurred on March 5th on a SPFC levee along the left bank (looking downstream) of the San Joaquin River just downstream of the confluence with the Tuolumne River and along the San Joaquin River National Wildlife Refuge (SJRNWR), or the former RD 2100. This break resulted in the inundation of 500 acres. The specific cause of this levee break is undocumented (DWR, 2011a; USACE, 1968a). The levee break just downstream of the Mid SJR Region and the San Joaquin River and Stanislaus River confluence also occurred along a SPFC levee, but was along the right bank of the San Joaquin River. The break occurred on March 29th and resulted in the flooding of 6,000 acres within and just outside of the boundaries of RD 2064. The specific cause of this levee break is also unknown (DWR, 2011a; USACE, 1968b). Note that the flooding extent associated with the levee break downstream of the San Joaquin River and Stanislaus River confluence was inferred rather than based on aerial photography.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 3-1

Major Flood Control Infrastructure within the San Joaquin River Basin

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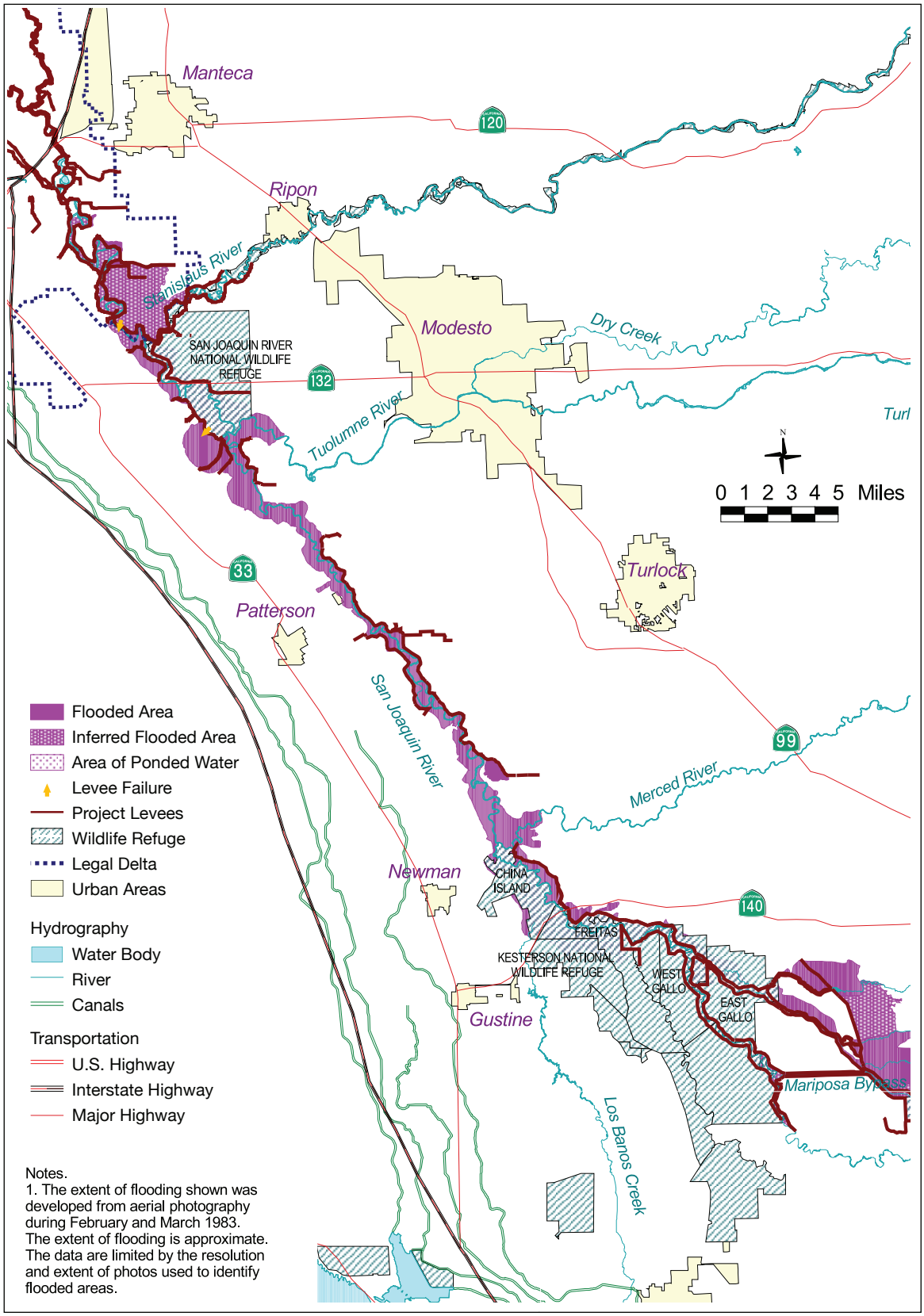


SOURCE: U.S. Army Corps of Engineers, Sacramento District, 1999

Figure 3-2
Detailed View of Flooding Extent
1983

Flooding in 1983 within Stanislaus, Merced, and San Joaquin counties resulted in more than $136 million in damages. **Table 3-2**, **1983 Flood Damages Sustained and Prevented**, includes damages sustained to private, public, and agricultural assets as well as roads, and estimates of damages prevented by flood management projects within the San Joaquin River Basin. The majority of the damage in Stanislaus County was to agricultural lands, with $12 million in losses. Merced and San Joaquin counties sustained damages valued at $614,000 and approximately $123 million, respectively. Total damages prevented by the flood management infrastructure within the San Joaquin River Basin were estimated at nearly $86.6 million. Prevented damages were calculated by USACE by subtracting residual damage, or the damage that did occur even with existing flood management infrastructure in place, from estimated damages that would have occurred without the existing flood management infrastructure in place. No lives were lost as a result of flooding in the Central Valley in 1983.

Table 3-2
1983 Flood Damages Sustained and Prevented

Damages Sustained ($1,000)[1]

County	Private	Public	Agricultural	Road	Total
Stanislaus	$111	$541	$12,200	$35	$12,887
Merced	$200	$414	$0	$0	$614
San Joaquin	no data	$25,204	$97,533	$35	$122,722
Total Damages Sustained					$136,223

Damages Prevented

Project	Damages Prevented ($1,000)[1]
Lower San Joaquin River Levees	$6,600
Friant Dam	$23,690
Hidden Dam	$2,900
Buchanan Dam	$3,400
Merced County Streams	$10,200
New Exchequer Dam	$14,400
Don Pedro Dam	$12,700
New Melones Dam	$12,700
Total Damages Prevented	$86,590

1 Damages are in 1983 dollars. Prevented damages were calculated by USACE by subtracting residual damage, or the damage that did occur even with existing flood management infrastructure in place, from estimated damages that would have occurred without the existing flood management infrastructure in place.

SOURCE: USACE, 1999

3.2.2 Flood Control System Performance – 1986 Flood

The floods of 1986 were caused by a series of four storms from February 11th through 19th. A 300-mile-wide band of heavy precipitation was positioned along San Francisco to Sacramento to Lake Tahoe. Precipitation within this area in the nine day period of February 11th through 19th ranged from 100 to 200 percent of normal for the entire month of February. Several precipitation records were set during these storms, including the greatest precipitation in February in the State at the Four Trees station in the Feather River

Basin. The estimated exceedance interval for the 1986 event at the San Joaquin River at Newman and the Tuolumne River at Don Pedro Dam is 10-20 and 30-40 years, respectively (USACE, 1999).

The San Joaquin River Basin was relatively unaffected when compared to the Sacramento River Basin in the 1986 floods. The extent of flooding within the Mid SJR Region in 1986 as delineated in the Post-Flood Assessment is shown in **Figure 3-3**, **1986 Detailed View of Flooding Extent**. As shown, portions of floodplains where levees do not line the San Joaquin River were inundated, but not to a great extent. With the exception of Millerton Lake, all major San Joaquin River Basin reservoirs remained with more than 90 percent of flood management reservation capacity available. Millerton Lake was operating with only 16 percent of flood management capacity available. The San Joaquin River at Vernalis reached a peak of 29.86 feet (gage datum), which is 0.86 feet above flood stage.

No damages were sustained in Stanislaus County during the 1986 event. San Joaquin County and Merced County sustained damages totaling over $13.7 million and $70,000, respectively. **Table 3-3**, **1986 Flood Damages Sustained and Prevented**, includes damages sustained to private and public assets, and estimates of damages prevented by flood management projects within the San Joaquin River Basin. Flood management infrastructure within the San Joaquin Valley was estimated to have prevented almost $218 million in potential damages. One life was lost during the 1986 floods in Placer County in the Sacramento River Basin (USACE, 1999).

Table 3-3
1986 Flood Damages Sustained and Prevented

Damages Sustained ($1,000)[1]

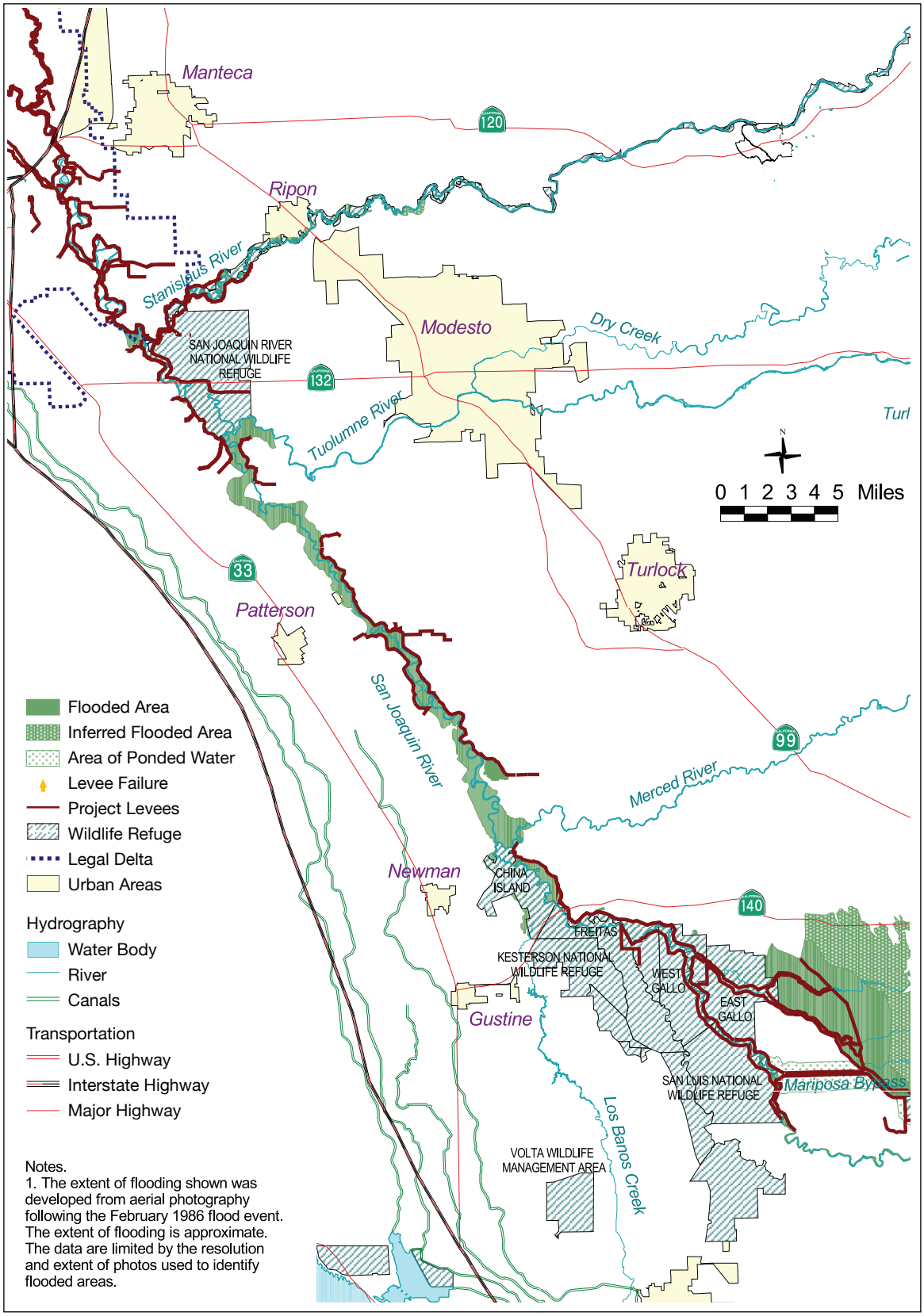
County	Private	Public	Total
Stanislaus	$0	$0	$0
Merced	$70	$0	$70
San Joaquin	$6,500	$7,238	$13,738
Total Damages Sustained			$13,808

Damages Prevented

Project	Damages Prevented ($1,000)[1]
Lower San Joaquin River Levees	$17,300
Friant Dam	$33,190
Hidden Dam	$1,900
Buchanan Dam	$6,000
Merced County Streams	$8,000
New Exchequer Dam	$23,300
Don Pedro Dam	$25,600
New Melones Dam	$102,500
Total Damages Prevented	$217,790

1 Damages are in 1986 dollars. Prevented damages were calculated by USACE by subtracting residual damage, or the damage that did occur even with existing flood management infrastructure in place, from estimated damages that would have occurred without the existing flood management infrastructure in place.

SOURCE: USACE, 1999



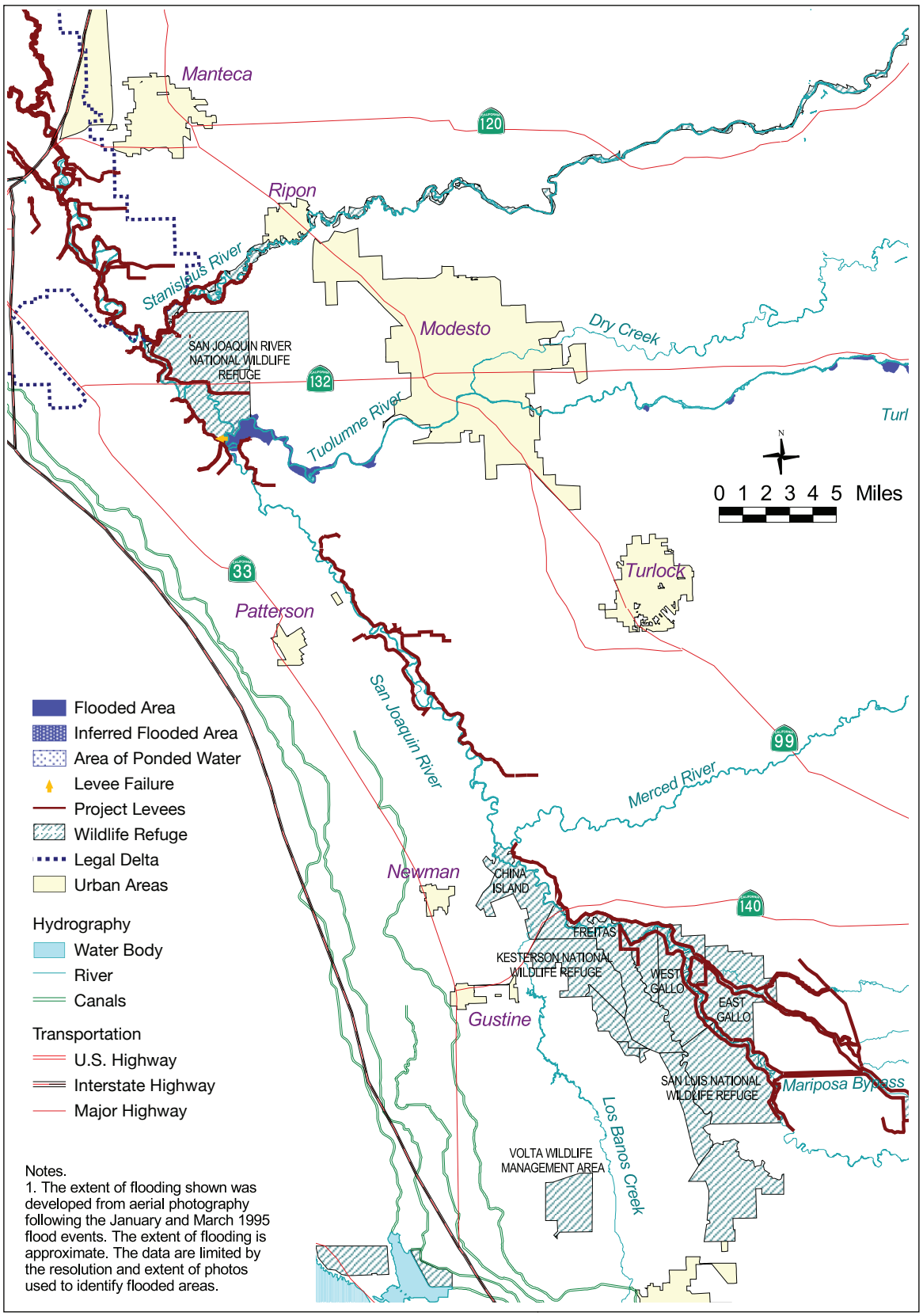
SOURCE: U.S. Army Corps of Engineers, Sacramento District, 1999

Figure 3-3
Detailed View of Flooding Extent
1986

3.2.3 Flood Control System Performance – 1995 Flood

In January and March of 1995, the El Niño Southern Oscillation caused large rain storms in northern and southern California. The Sacramento River Basin was most affected by the storms in January, and the March rain storms primarily affected the coast and southern California. Snowpack water content was more than 150 percent of normal in the Sierra Nevada and a significant portion of the Sacramento River Basin. At the beginning of January, all of the major Sacramento and San Joaquin River reservoirs had more than 100 percent of the flood management reservation pool available. After the January storm, flood management reservation pool capacity varied greatly between reservoirs within both the Sacramento and San Joaquin River Basins. This was also the case during the March storm, with Millerton Lake operating with four percent of flood management storage remaining and New Melones Lake, a very large reservoir, having 315 percent of flood storage available. All of the major reservoirs in the Sacramento or San Joaquin River Basins operated during the January 1995 floods with the majority of their flood management pools available. Flooding that occurred in January was a result of the failure of storm drainage systems and local flooding along small streams (USACE, 1999). The estimated exceedance interval for the 1995 event at the San Joaquin River at Newman and the Tuolumne River at Don Pedro Dam is 5-10 and 5-15 years, respectively (USACE, 1999).

Similar to the 1986 floods, the San Joaquin River Basin was affected to a much lesser extent than the Sacramento River Basin in the 1995 floods (USACE, 1999). However, in March 1995, flooding from Orestimba Creek caused an estimated $5.6 million in damages in and around the City of Newman. The March 1995 storm was the largest on record (1932 – 2010) at Orestimba Creek. Flows in Orestimba Creek reached 12,000 cubic feet per second (cfs). Overland flow from Orestimba Creek flooded agricultural fields and inundated the City of Newman (USACE, 2012). The extent of flooding within the Mid SJR Region in 1995 as delineated in the Post-Flood Assessment is shown in **Figure 3-4**, **1995 Detailed View of Flooding Extent** (USACE, 1999). As shown, small areas along the Tuolumne River just upstream of and at the confluence with the San Joaquin River were inundated. Otherwise, flow remained in the river channels within and near the Mid SJR Region with the exception of flooding that occurred in the Orestimba Creek floodplain (USACE, 2012). [Note that flooding from Orestimba Creek is not shown on Figure 3-4.] There was a levee breach along the left bank of the San Joaquin River near the southern boundary of the SJRNWR. The cause of the breach is undocumented (DWR, 2011a; USACE, 1968a). It does not appear that flooding resulted from this levee breach (USACE, 1999).



SOURCE: U.S. Army Corps of Engineers, Sacramento District, 1999

Figure 3-4
Detailed View of Flooding Extent
1995

Damages in Stanislaus, Merced, and San Joaquin counties totaled $95.8 million and all losses were agricultural assets. **Table 3-4**, **1995 Flood Damages Sustained and Prevented**, includes damages sustained to private, public, and agricultural assets, and estimates of damages prevented by flood management projects within the San Joaquin River Basin. Over $108.5 million in damages were estimated to have been prevented by the flood management system within the San Joaquin River Basin (USACE, 1999). No lives were lost as a result of flooding in the Central Valley in 1995.

Table 3-4
1995 Flood Damages Sustained and Prevented

Damages Sustained ($1,000)[1]

County	Private	Public	Agricultural	Total
Stanislaus	$0	$0	$52,447	$52,447
Merced	$0	$0	$38,854	$38,854
San Joaquin	$0	$0	$4,499	$4,499
Total Damages Sustained				$95,800

Damages Prevented

Project	Damages Prevented ($1,000)[1]
Lower San Joaquin River Levees[2]	$583
Friant Dam	$54,310
Hidden Dam	$2,200
Buchanan Dam	$1,800
Merced County Streams[2]	$2,400
New Exchequer Dam	$25,700
Don Pedro Dam	$19,500
New Melones Dam	$2,100
Total Damages Prevented	$108,593

1 Damages are in 1995 dollars. Prevented damages were calculated by USACE by subtracting residual damage, or the damage that did occur even with existing flood management infrastructure in place, from estimated damages that would have occurred without the existing flood management infrastructure in place.

SOURCE: USACE, 1999

3.2.4 Flood Control System Performance – 1997 Flood

Severe flooding was caused in 1997 by the combination of the second wettest December on record in the Sierra Nevada and three tropical storms that hit northern California on December 29, 30, and 31, 1996. Within three days, more than 30 inches of rain fell in the upper watersheds of the Sierra Nevada. Record flows were a result in both the Sacramento and San Joaquin River Basins. In mid-December, a cold storm brought snow to the Sierra Nevada foothills, which was then melted by the three warm storms at the end of December. Snowmelt was estimated to account for approximately 15 percent of the total runoff volume (USACE, 1999).

During the month of December 1996, the flood management reservation space in most of the major reservoirs in the Sacramento and San Joaquin River Basins was needed to accommodate heavy rainfall prior to the three tropical storms at the end of the month. During the series of three storms at the end of

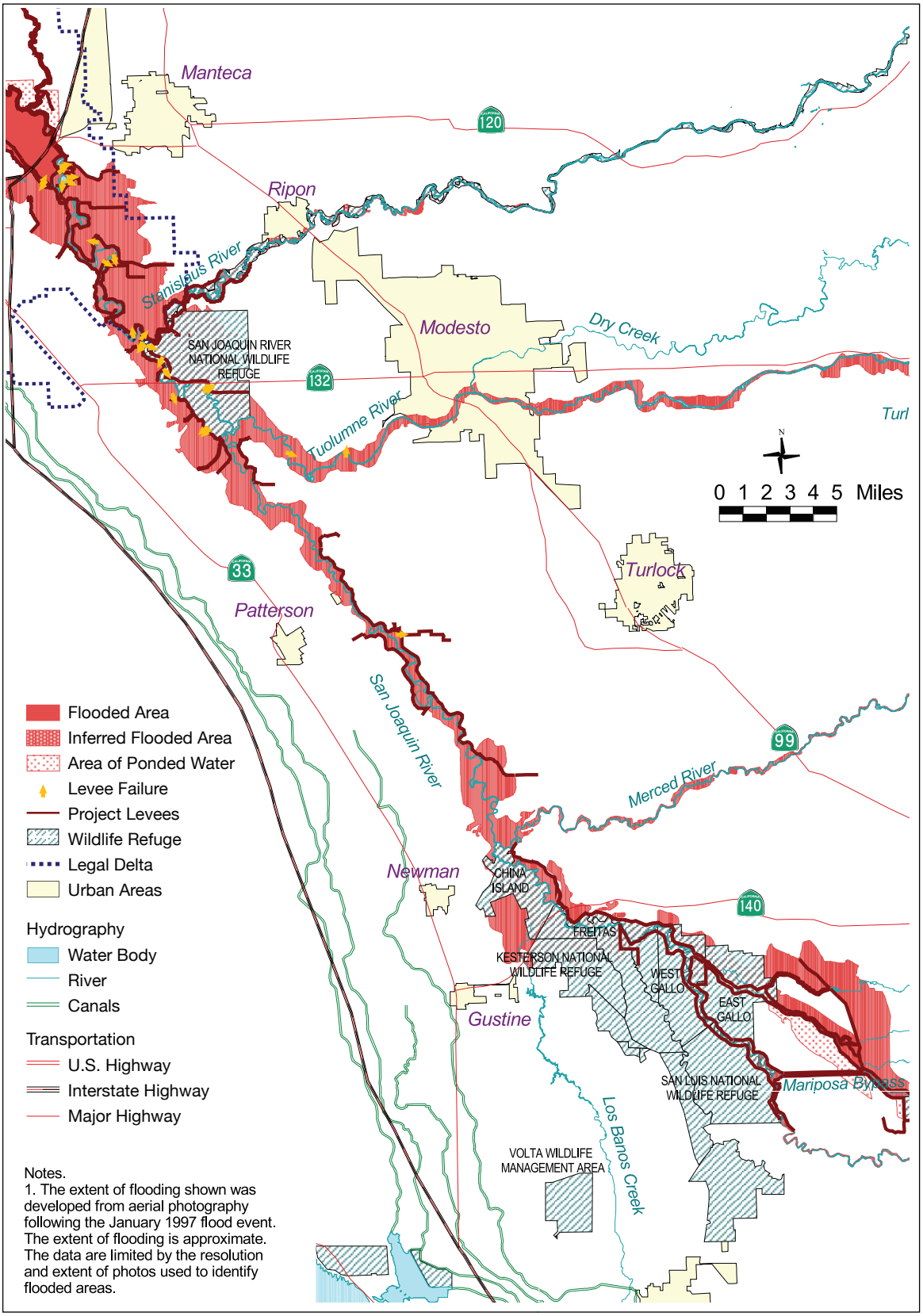
December, the flood management system in the San Joaquin River Basin was unable to contain the volume of runoff coming from the Sierra Nevada. Millerton Lake and Don Pedro Reservoir both exceeded their design capacity. Peak hourly inflow and outflow at Millerton Lake was 95,000 cfs and 63,000 cfs, respectively. At Don Pedro Reservoir, peak hourly inflow and outflow was 121,000 cfs and 59,000 cfs, respectively (USACE, 1999). The banks of the Tuolumne River overtopped in Modesto, Waterford, La Grange, and Roberts Ferry because of high flows from Don Pedro Reservoir. The estimated exceedance interval for the December 1996-1997 flood event at the San Joaquin River at Newman and the Tuolumne River at Don Pedro Dam is 90-110 and 80-110 years, respectively (USACE, 1999).

Numerous levee breaks occurred in the San Joaquin River Basin during the 1997 floods. The extent of flooding within the Mid SJR Region and the locations of levee breaks in 1997 as documented in the Post-Flood Assessment are shown in **Figure 3-5**, **1997 Detailed View of Flooding Extent**. As shown in Figure 3-5, levee breaks occurred along the Tuolumne and San Joaquin rivers within and near the Mid SJR Region. A total of 13 levee breaks occurred within Stanislaus County during the 1997 event. As stated in **Table 3-5**, the cause of each levee breach is unknown. Flooding occurred along the Merced River, Tuolumne River, and San Joaquin River, particularly within and near the SJRNWR. Areas within Modesto, Ripon, Waterford, La Grange, and Roberts Ferry were inundated.

Table 3-5
1997 Levee Breaches, Seepage, Boils, and Erosion in Mid SJR Region

Reclamation District	Channel Capacity (cfs)	Description of Levee Damage
2031 (Elliot)	46,000	5 breaches, including one 350 feet long. Breach causes are unknown, but squirrel activity was noted in the vicinity of 3 of the breaches and seepage was noted along 2 breach repair sites during the 1998 high water event. It is suspected by property owners that one of the breaks occurred because of prolonged saturation and pressure from flood waters. Wavewash damage at each of the 5 breach locations along the landside toe and mid-slope. Unknown if repairs have been made for wavewash damage.
2091 (Chase)	45,000	Severe seepage, sloughing of landside berm because of seepage, and extensive boils
n/a	15,000	2 levee breaks, cause unknown
2099 (El Solyo Ranch)	46,000	One 200-foot-wide breach, cause unknown; major wavewash damage along both slopes and landside wavewash damage, evidence that erosion damage may not have been repaired - 2009 Kleinfelder reconnaissance noted 3- to 4-foot vertical face along waterside slope about 2 to 3 feet below the crest, linear extent may be greater, but was obscured by dense vegetation.
2100 (White Lake Ranch)	46,000	3 breaches, cause unknown, seepage noted at 2 of the 3 repair sites after the event; massive wavewash damage along the landside slope and shoulder with vertical faces of 6 to 7 feet, sometimes extending into the crown. It's unknown if the wavewash damage was repaired
2101 (Blewitt)	46,000	Cause of breach unknown, but heavy seepage and multiple boils were noted at the breach repair site during the 1998 high water event; 1- to 2-inch-wide longitudinal cracking noted along landside toe during 1997 event and was attributed to a pump pit. During the 1997 event, the levee sustained wavewash damage along the landside slope. A 3- to 4-foot vertical face in the landside slope was repaired after the event.

SOURCE: DWR, 2011a; PBI, 2013; USACE, 1961; USACE, 1968a, 1968b, 1968c, and 1968d.



SOURCE: U.S. Army Corps of Engineers, Sacramento District, 1999

Figure 3-5
Detailed View of Flooding Extent
1997

A levee failure at Finnegan Cut and two levee breaches on the San Joaquin River resulted in flooding within RD 2031 boundaries (USACE, 1999). The RD 2031 levee was breached approximately 1/8 mile north of Highway 132. Anecdotal information suggests that the levee probably breached after prolonged saturation and pressure from flood waters. The ground to the south of the District levee system is lower and only a portion is protected by a private levee. Additionally, in 1997, river flood flows inundated an area south of the District levee system, and reached the top of the District's southern levee section maintained by Mapes Ranch. This levee section also subsequently breached.

Water rose to within one foot of the crown of the RD 2091 project levee, and numerous boils north of Gomes Lake at an extreme bend in the levee and additional boils in other locations were noted. While the project levee did not fail, the Gomes Lake Dike did subsequently fail. A section of the levee back slope adjacent to the Gomes Lake Bypass Channel failed as well (PBI, 2013).

Four levee failures on the west levee along the San Joaquin River and levee failures in two locations along the east levee flooded the RDs 2099, 2100, 2101, and 2102 (USACE, 1999). RD 2101 has ongoing erosion problems on the riverbank in front of levee during high flow events. In one area this riverbank erosion has reached the toe of the levee. The USACE repair of the 1997 breach was not effective, and extensive seepage occurs at that location in high water events. An attempt by the USACE to address this problem was made by building up the river bank in front of levee, but was not completely successful (PBI, 2013). Another major issue in the 1997 flood was entry of flood waters into RD 2101 from the south over Highway 132. Private levees along the river south of RD 2101 were breached by the heavy flows flooding the area to the south of Highway 132. Flood waters up to 2-3 feet deep subsequently flowed over Highway 132 into RD 2101 (PBI, 2013). Downstream of the Mid SJR Region, water from the four breaches along the RD 2094 levee along the San Joaquin River flooded RD 2096. At the confluence of the San Joaquin and Stanislaus rivers, the levee along the right bank of the San Joaquin River along the RD 2064 boundary failed in two places. The levee along the right bank of the San Joaquin River failed in three places near the boundaries of RD 2075 (USACE, 1999).

In the 1997 flood, RD 1602 did not suffer a levee break. There was a significant boil and seepage on the levee section next to Westside Properties, a small group of residences within the district boundary. At the request of RD 1602, the USACE had previously placed a seepage berm behind the levee to prevent levee failure because of seepage. However, seepage continued beyond the berm and standing water did impact the Westside Properties structures. Flood waters impacted Las Palmas Avenue and nearby residences about one-half mile to the north of RD 1602, but did not approach its northern levee extension. Flood waters over Crows Landing Road entered RD 1602. When overbank flow from Salado Creek flooded portions of Patterson and surrounding areas, water was routed to RD 1602 through the local drainage network and resulted in flooding within RD 1602 lands.

Flood waters nearly reached the crown of the levee that runs along the south end of RD 2063, but the levees held. However extensive seepage and high flows in the slough that leads to the Victoria Pumping Station necessitated a pump installation while flooding was in progress.

A rural area of approximately 1,500 acres is located between the north boundary of RD 2092 and the south bank of the Tuolumne River. Several farms and structures and a mobile home park are located within this area. Privately constructed levees are present along the south bank of the Tuolumne River. The entire area is unincorporated without a reclamation district. In the 1997 flood, this area flooded when private levees failed on its upstream end. Structures were damaged and evacuation operations were necessary. At least one death was associated with this flooding (PBI, 2013).

The Newman and Patterson wastewater treatment plants (WWTPs) were affected by the 1997 flood. In the 1997 flood, water elevations to the east of the Newman WWTP plant reached within two feet of the crown of the City levee protecting the oxidation pond. Wave wash was a serious problem in that event, and the City has been slowly placing rip rap on the oxidation pond levee since, a project that is not yet complete. The Patterson WWTP did not flood in 1997, but after the event the City of Patterson placed fill to restore a significant erosion site on the bank of the San Joaquin River (Ignacio Lopez, personal communication, July 11, 2013; PBI, 2013).

Significant damages were sustained in Stanislaus, Merced, and San Joaquin Counties during the 1997 floods, totaling almost $166 million. **Table 3-6**, **1995 Flood Damages Sustained and Prevented**, includes damages to individual, public, business, road and bridge, and agricultural assets. Significant damages were also prevented in the San Joaquin River Basin. More than an estimated $331 million in damages were avoided because of the flood management infrastructure that is in place. New Melones Dam alone is estimated to have prevented nearly $176 million. The USACE reported that no lives were lost as a result of flooding in the Central Valley in 1997 (USACE, 1999), though local sources reported one death (PBI, 2013). Highway 132, a vital transportation link, was closed as a result of flooding in 1997, flooding that occurred because of a levee breach in RD 2031. After the 1997 event, it was also recognized by Stanislaus County that the Crows Landing and Las Palmas Avenue Bridges that cross the San Joaquin River are also vital transportation links from areas west of the San Joaquin River to hospitals and other services east of the river (PBI, 2013).

Table 3-6
1997 Flood Damages Sustained and Prevented

Damages Sustained ($1,000)[1]

County	Individual	Public	Business	Road	Agricultural	Total
Stanislaus	$20,680	$23,200	$3,650	$0	$30,832	$78,362
Merced	$0	$570	$0	n/a	$7,610	$8,180
San Joaquin	$46,500	$9,500	$10,000	n/a	$13,455	$79,455
Total Damages Sustained						$165,997

Damages Prevented

Project	Damages Prevented ($1,000)[1]
Lower San Joaquin River Levees	--
Friant Dam	$3,320
Hidden Dam	$5,670
Buchanan Dam	$2,180
Merced County Streams	$27,500
New Exchequer Dam	$86,210
Don Pedro Dam	$30,690
New Melones Dam	$175,770
Total Damages Prevented	$331,340

[1] Damages are in 1997 dollars. Prevented damages were calculated by USACE by subtracting residual damage, or the damage that did occur even with existing flood management infrastructure in place, from estimated damages that would have occurred without the existing flood management infrastructure in place.

SOURCE: USACE, 1999

3.2.5 Levee Repair Investments

The USACE has emergency management authority under PL 84-99, Flood Control and Coastal Emergencies (33 U.S.C. 701n) (69 Stat. 186). Under PL 84-99, the USACE may undertake disaster preparedness, emergency response, and rehabilitation, activities. **Table 3-7** includes a description of the rehabilitation assistance that the USACE provided after the 1997 flood. Rehabilitation assistance may have been provided after other flood events in the region or to other entities after the 1997 flood, but no records were obtained that described such assistance.

Table 3-7
Rehabilitation Assistance under PL 84-99 After 1997 Flood

Reclamation District	Year	Description of Repair	Cost
1602	1997	Restored west levee along SJR with compacted fill in 2 locations – Levee Mile 0.89 at Lake Ramona and Levee Mile 5.47 to Levee Mile 5.71.	$449,200
2063	1997	Restored east levee from Levee Mile 1.81 to Levee Mile 2.27 by filling wavewash-damaged areas with fill and resloping to 3:1. Sand boils were also remediated from Levee Mile 5.52 to Levee Mile 5.64 by constructing a gravel berm on the landside of the levee.	$1,060,000
2091	1997	Restored east levee along SJR after a breach from Levee Mile 0.00 to Levee Mile 0.05. Clay fill topped with aggregate course was used to repair the breach and the waterside and landslide slopes were reset at 3:1 and 2:1, respectively.	unknown
2092	1997	Repaired damage from Levee Mile 0.09 to Levee Mile 1.25 with fill material over filter fabric on the waterside and 1-foot of aggregate base course on the road shoulder.	$151,200
2100 and 2102	1997	Repair of 3 levee breaches	Phase I – unknown Phase II – $1,200,000 Phase III - $968,450

Note: Rehabilitation assistance may have been provided after other flood events in the region or to other entities after the 1997 flood, but no records were obtained that described such assistance.

SOURCE: USACE, 1997a-b, 2001 a-d, 2006, 2007, and undated

3.3 Entities with a Role in Flood Management

In the Mid SJR Region, most flood management activities occur at the local level with an overlay of broader planning and oversight occurring at the state and federal levels. At the local level, there are many agencies with discrete responsibilities and limited investment has been made to date in coordinating these for effectiveness and efficiency.

3.3.1 State and Federal Agencies

The oversight agency for flood management in the Central Valley is the Central Valley Flood Protection Board (CVFPB). The CVFPB mission is threefold, including to control flooding along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the USACE; cooperate with various federal, state, and local agencies in establishing, planning, constructing, operating, and maintaining flood management works; and maintain the integrity of the existing flood management system and designated floodways through regulatory authority by issuing permits for encroachments. The USACE, United States Bureau of Reclamation (USBR), Merced Irrigation District (Merced ID), Turlock Irrigation District (TID), and Modesto Irrigation District (MID) own and operate reservoirs within the San Joaquin River Basin (Table 3-1). These agencies, particularly the USACE, have been involved in the study, design, and construction of flood management projects, which are often part of multiple purpose facilities (e.g., reservoirs also used for water supply).

The role of DWR is described in Chapter 1 of the CVFPP. Per California Water Code (CWC) Sections 8532 - 8533, the State has a responsibility to build and maintain flood management facilities along the Sacramento and San Joaquin rivers and tributaries to preserve the welfare of the residents and landowners within the reclaimed overflow basins in the Central Valley. Additionally, the State is responsible for responding to emergencies and public threats, and, therefore, has an interest in avoiding and mitigating known flood risks.

3.3.2 Local Maintaining Agencies

LMAs are any city, county, district, or other political subdivision of the State that is authorized to operate and maintain levees. Map 7, Local Maintaining Agencies, of the Atlas (Appendix A) includes the jurisdictional boundaries of all of the LMAs associated with the Mid SJR Region. Mid SJR Region LMAs include RDs 1602 (Del Puerto), 2031 (Elliot), 2063 (Crows Landing), 2091 (Chase), 2092 (Dos Rios Ranch), 2099 (El Solyo Ranch), 2100 (White Lake Ranch), 2101 (Blewitt), 2102 (Lara Ranch), and the TID. TID provides water for the irrigation of land within Merced and Stanislaus counties between the Tuolumne and Merced rivers and east of the San Joaquin River; it is one of the responsible entities for the levee and drainage facilities at Gomes Lake. Lands within Reclamation District Nos. 2099, 2100, and 2102 were purchased by the federal government and are now owned by the USFWS and managed as a part of the SJRNWR. Under the requirements of CWC Section 9140, DWR prepares the LMA Annual Report for submittal to the CVFPB each year by December 31. Per CWC Section 9140, each LMA must provide DWR with information regarding the levees that they operate and maintain by September 30 of each year. Refer to Appendix A for a description of the information that LMAs must submit annually to DWR. **Table 3-8**, **Facilities Maintained by Mid SJR Region LMAs**, includes a list of the levees that are maintained by LMAs with jurisdictional boundaries that overlap with the Mid SJR Region of the SPFC.

In addition to the LMAs described above, Stanislaus, Merced, and San Joaquin Counties and the Cities of Patterson, Newman, and Modesto have flood management responsibilities within the Mid SJR Region planning area. The General Plan for each of these cities and counties complies with Section 65300 of the California Government Code and identifies areas that are subject to flooding within the land use element; each addresses flooding in the safety and conservation elements. Each jurisdiction's regulations and flood management activities are briefly described below.

Table 3-8
Facilities Maintained by Mid SJR Region LMAs

Sub region	Area (acres)	LMA	Facilities Maintained				
			Levees	Total levees (miles)	2012 levee rating	Structures	2012 structure rating
A	8,851	**RD 2031** (Elliot)	7.15 miles of levee, left bank of the Stanislaus River; 6.04 miles of levee, right bank of the San Joaquin River	13.19	Minimally Acceptable	N/A	N/A
B	685	**RD 2101** (Blewitt)	3.20 miles of levee, left bank of the San Joaquin River; 0.31 miles of levee, right bank of the San Joaquin River	3.51	Unacceptable	N/A	N/A
C		**RD 2099** (El Solyo Ranch)	2.40 miles of levee, left bank of the San Joaquin River	2.4	N/A	N/A	N/A
	2,410	**RD 2100** (White Lake Ranch)	2.70 miles of levee, left bank of the San Joaquin River	2.7	N/A	N/A	N/A
		RD 2102 (Lara Ranch)	1.80 miles of levee, left bank of the San Joaquin River	1.8	N/A	N/A	N/A
D	1,003	**RD 2092** (Dos Rios Ranch)	3.76 miles of levee, right bank of the San Joaquin River	3.76	Acceptable	N/A	N/A
E		**RD 2063** (Crows Landing)	10.63 mile of levee, right bank of the San Joaquin River	10.63	Unacceptable	PP (Nelson Drain)	Unacceptable
	12,850	**RD 2091** (Chase)	7.59 miles of levee, right bank of the San Joaquin River; 0.33 miles of levee, San Joaquin River, bank n/a[1]	7.92	Acceptable	N/A	N/A
		NA 65 Turlock Irrigation District (TID)	0.30-mile Gomes Lake Spur Levee[1]	0 (counted as RD 2091)	N/A	PP (Gomes Lake)	Acceptable
F	2,968	**RD 1602** (Del Puerto)	6.29 miles of levee, left bank of the San Joaquin River	6.29	Unacceptable	N/A	N/A
			TOTAL	52.2			

1 DWR, 2012c indicates that this levee is associated with RD, 2091, not NA 65.

SOURCE: Mid San Joaquin River Regional Flood Atlas (Appendix A); DWR, 2012c (LMA Annual Monitoring Report).

3.3.3 Counties, Cities, and Flood Control Districts

Stanislaus County manages flooding through land use planning and regulations; provision of emergency response services and data used in flood risk analysis; and coordination with other agencies. Supervisorial Districts 2, 3, and 5 are relevant to the Mid SJR Region planning area (Stanislaus County, 2013a). Chapter 16.50, Flood Damage Prevention, of the Stanislaus County Code includes standards for construction, utilities, subdivisions, manufactured homes, recreational vehicles, and activities within floodways to minimize public and private losses because of flooding within special flood hazard areas within the unincorporated areas of the county. The Stanislaus County Office of Emergency Services; Chief Executive Office; Department of Public Works, Departments of Planning and Community Development and Public Works; and the Assessor's Office each play a role in managing flood risk and flood hazards within Stanislaus County. **Table 3-9, Stanislaus County Flood Management** includes a description of the responsibilities of each of the relevant parts of the Stanislaus County government.

Table 3-9
Stanislaus County Flood Management

Role	Department
Authority on mitigation planning, hazard response, and community issues; maintains historical data of past events; understands Emergency Operations Plans for the County and nine cities; coordinates and provides emergency services	Office of Emergency Services
Prepares and updates the Multi-Jurisdictional Hazard Mitigation Plan; provides inventory of current and future County facilities for hazard mapping, including insured value of each County-owned facility; provides information to the public regarding flood hazards	Chief Executive Office
Prepares and updates Safety and Housing Elements of the General Plan and Multi-Jurisdictional Hazard Mitigation Plan; establishes land use policy and regulation; develops mitigation goals and strategy	Planning and Community Development
Maintains inventory and valuation of public infrastructure including roads, traffic signals, drainage facilities, lighting facilities, bridges, and airports; GIS map creation, research, data collection, data verification, and hazard analysis	Public Works
Determines property values; shares database and resources for risk assessment analyses	Assessor's Office
Authority over land use decisions and land use planning	Board of Supervisors
Authority over land use decisions and land use planning	Planning Commission

SOURCE: Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan, Updated 2010.

Merced County manages flooding through land use planning and regulations; emergency response planning and preparation; provision of information regarding flood risk, including Base Flood Elevation Certificates for specific parcels; and coordination with other agencies. Chapter 18.34, Special Flood Hazard Areas, of the Merced County Code includes floodplain management regulations. Provisions for flood hazard reduction are outlined in Section 18.34.050 and include standards for construction, utilities, subdivisions, manufactured homes, recreational vehicles, and activities within floodways. The Department of Code Enforcement, Development Services, Economic Development, Engineering, Planning, and Public Works are responsible for various aspects of flood management within Merced County. The County employs an emergency preparedness coordinator and convenes meetings of the Emergency Preparedness Committee each quarter. The Merced Streams Group and Merced Irrigation District collaborate with the

Merced County Public Works Department in operating and maintaining the flood management systems in Merced County (Merced County, 2013). The San Joaquin County Flood Control and Water Conservation District offers flood management services including providing floodplain map determination services to residents, realtors, lenders, and insurance agents; copies of FEMA elevation certificates; site visits to review flood and drainage issues and the Flood Zone Viewer, which is an online tool accessible from the County website that provides the designated flood zone for any address or Assessor's Parcel Number in San Joaquin County. The San Joaquin County website also includes flood emergency information, an informational video, FEMA contact information, historical flood area map, general flood protection information, and guidance on building within a floodplain.

The City of Patterson Public Works Department's flood management responsibilities include providing restrictions and regulations that govern use of floodplains; providing information on how property owners can protect themselves from flood damage; and providing information on the National Flood Insurance Program (NFIP) (Patterson, 2013). The City of Patterson Water Operations Division does not maintain levees and, therefore, does not report to DWR as part of the annual LMA report process. The Patterson Municipal Code includes regulations on flooding in Title 17, Flood Hazard Areas. Chapter 4.11, Floodplain Management, of the Patterson City Code includes regulations intended to reduce flood losses. The City Manager is the designated Floodplain Administrator and is responsible for development permit review; review, use, and development of base flood data; notification of other agencies regarding alteration or relocation of a watercourse; documentation of floodplain development; map determinations if conflicts in mapped boundaries arise; and remedial action for any violations of the regulations in Chapter 4.11. Departments that support the Floodplain Administrator in these duties include Building, Community Development, and Public Works.

The Orestimba Creek Flood Control District (OCFCD) has jurisdiction over a 17,652-acre area north of the City of Newman that includes a portion of the right bank of the San Joaquin River at the confluence with Orestimba Creek. The OCFCD was established in 1984 and has the responsibility for maintaining existing flood management facilities within its sphere of influence. Five directors are elected by local landowners to run the OCFCD and must hold title to land within the district boundaries (Stanislaus County, 2013b).

The City of Newman manages floods through land use planning, including serving as local sponsor in the Orestimba Creek Draft Interim Feasibility Study; land use regulations; a partnership with the Stanislaus County Office of Emergency Services; and coordination with local agencies such as the OCFCD. Chapter 4.11, Floodplain Management, of the Newman City Code includes local regulations on land uses within flood hazard areas as delineated by the Federal Insurance Administration or FEMA. Standards for construction, utilities, residential developments, recreational vehicles, building permits, and activities within designated floodways are outlined in Chapter 4.11 of the Newman City Code.

The City of Modesto manages flooding through land use planning and regulations; provision of emergency response services, data used in flood risk analysis, and annual flood fight training; and coordination with other agencies. The City of Modesto Municipal Code addresses the management of floods within Modesto jurisdictional boundaries in Chapter 4, Floodplain Management of Title 9, Building Regulations. Article 5, Provisions for Flood Hazard Reduction, outlines standards for construction, utilities, land development, placement of manufactured homes, recreational vehicles, and activities within floodways. Methods of reducing flood losses are listed in Section 9-4.104 and include restricting or prohibiting land uses which are dangerous to health, safety, and property because of water or erosion hazards, or which result in damaging increases in erosion or flood heights or velocities; requiring that land uses vulnerable to floods, including facilities which serve those uses, are protected against flood damage at the time of initial

construction; controlling the alteration of natural floodplains, stream channels, and natural protective barriers, which help accommodate or channel floodwaters; control of filling, grading, dredging, and other development which may increase flood damage; and prevention or regulation of the construction of flood barriers that unnaturally divert floodwaters or increase flood hazards in other areas. A representative from the City of Modesto sits as one of three individuals on the RD 2091 Board of Trustees. Modesto is contracted with RD 2091 to provide levee maintenance and limited emergency response (PBI, 2013). Departments involved in floodplain management include Community and Economic Development, Public Works, and Utility Planning & Projects.

3.3.4 Flood Management NGOs

Within the Mid SJR Region, there are several informal organizations with a flood management focus. The San Joaquin River Flood Control Association has the following stated purpose: "to improve the hydraulic capacity of the channels of the San Joaquin River in order to minimize the risk of damage to adjacent lands." At present, this ad hoc organization meets twice annually and includes participants from the entire length of the San Joaquin River. The Lower Tuolumne Farmers are another informal organization of approximately 30 families and landowners who are working with the Modesto and Turlock IDs to make sure that their needs are considered in Don Pedro's operational decision-making, including flood operations. Additionally, public-private partnerships have developed among the USFWS, Tuolumne River Trust, River Partners, and DWR to develop floodplain expansion and floodwater attenuation concepts in the region.

3.4 Emergency Response/ Public Safety

In an event of a flood, there are several layers of emergency response that are employed, as shown below in **Table 3-10 Flood Emergency Responders**, which depends on the location and type of flood emergency. There are two key separate components of flood response; levee flood fight operations and general public safety operations. Levee flood fight operations include emergency activities aimed at preventing failure of a levee during a flood or containing flood waters in the event of a levee does fail. Reclamation districts, where they exist, have jurisdiction for performing levee flood fight operations. Among local jurisdictions in the Mid San Joaquin River planning area, only the City of Modesto and some fire agencies are known to have participated in some way in levee flood fight operations. In regard to the other response component, public safety operations, fire agencies provide fire suppression and rescue and law agencies provide traffic control and security functions. Public warning and evacuation activities may be shared by multiple agencies depending on a jurisdiction's response plans. Overall, public safety operations within an area protected by a levee are performed by the local county or city agency, special purpose district (e.g., fire district), or community-based organization that has jurisdiction within that area. Other entities, as shown below in Table 3-8, also provide assistance during a flood emergency when requested. These various entities can help respond to a flood emergency by providing coordination between agencies, as well as personnel and equipment for flood fighting.

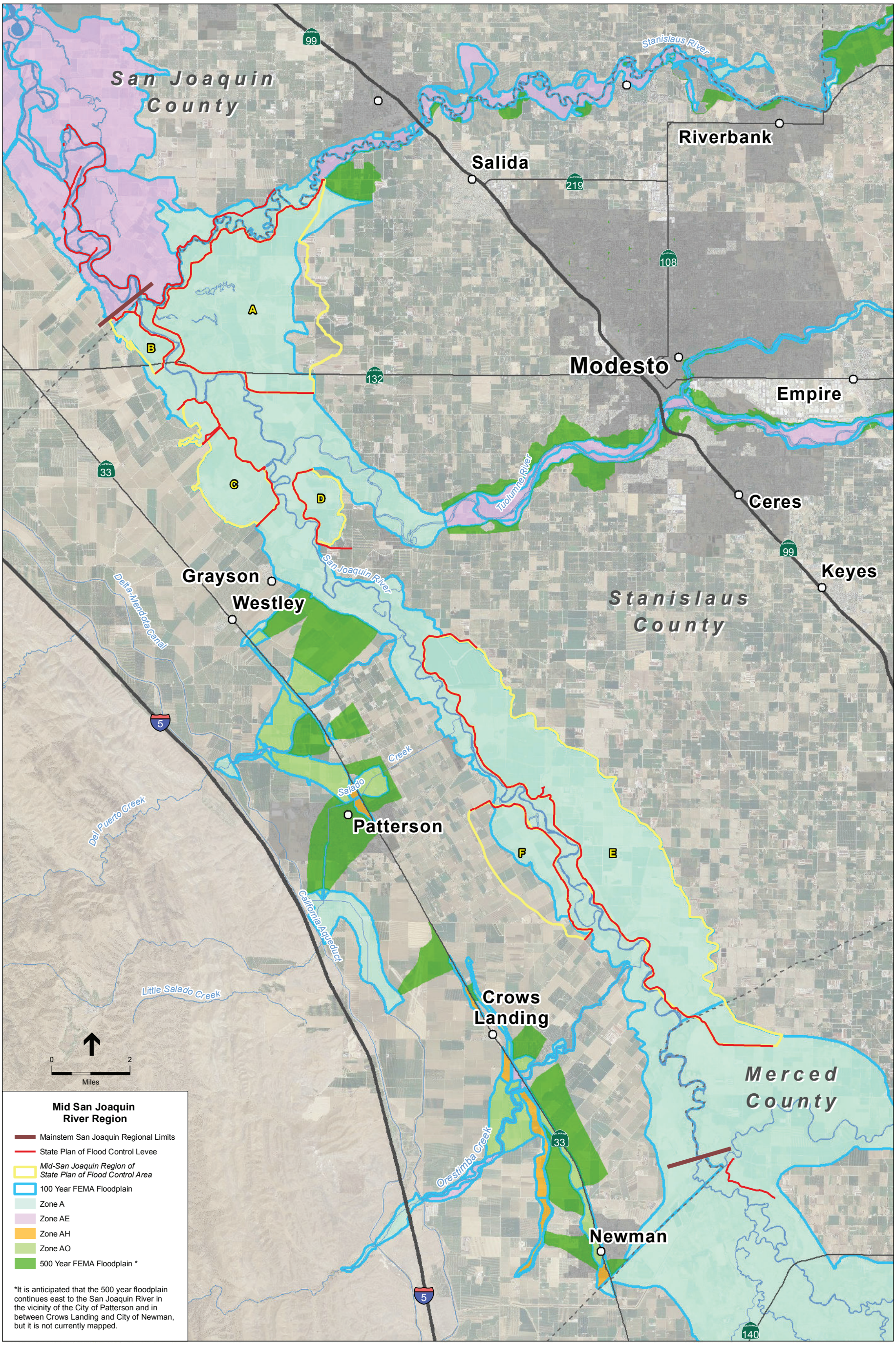
Table 3-10
Flood Emergency Responders, Mid SJR Region

Responder	Level	Comment
Person(s) or organization(s) on the site	0	Any emergency
Emergency services units of the cities in the region	1	Any emergency
Reclamation Districts 1602, 2099, 2100, 2101, 2102	1	Levees on the west bank of the San Joaquin River
Reclamation Districts 2031, 2063, 2091, 2092	1	Levees on the east bank of the San Joaquin River
Emergency services units of the counties in the region	1 or 2	Any emergency, and by request from Level 1 responders
Department of Water Resources	2	Flood Operations Center, flood fight and Corps liaison
California Emergency Management Agency, Inland Region	3	Any emergency, by request of county (operational area)
US Army Corps of Engineers	3	Specified water-related emergencies, by request of DWR
California Conservation Corps	3	Personnel and equipment for flood fight
Department of Forestry and Fire Protection	3	Personnel and equipment for flood fight
California Emergency Management Agency Headquarters	4	All emergencies, entire planning area, by request of Cal EMA Region

SOURCE: DWR, 2009.

3.5 Delineated Floodplain Boundaries

The 100-year floodplain is defined by FEMA as the area with a one percent annual chance of flooding, equal to a 26 percent chance of flooding at least once over the life of a 30-year mortgage. The FEMA 100-year floodplain within and surrounding the Mid SJR Region is shown in **Figure 3-6**, **100- and 500-year FEMA Floodplain within the Planning Area** and Map 16, FEMA 100-Year Floodplain, of the Atlas (Appendix A). The primary areas that have a one percent annual chance of flooding are identified by FEMA as Zone A or AE. As shown in Figure 3-6, the majority of the area along the San Joaquin River is designated Zone A. The Zone A designation is applied to areas where detailed analyses were not performed in delineating the 100-year floodplain boundary and, therefore, base flood elevations (BFEs) are not available for those areas. Zone A flood extents are typically estimated using observed flood extents or other simple methods. The 100-year floodplains along the Merced, Tuolumne, and Stanislaus rivers are classified as Zone AE, and this designation applies to the 100-year floodplain where detailed analyses were completed and BFEs are available. Some parts of the AE Zone may be identified as "Floodway," used to indicate the primary flow zone, where more stringent regulatory constraints apply. The identifier Zone AH is applied to ponded areas within the 100-year floodplain where average flood depths are between one and three feet and velocities are low. Zone AO applies to shallow flow areas within the 100-year floodplain where average flood depths are between one and three feet, but are subject to higher flow velocities. As shown in Figure 3-6, Subregions B, C, D, and E are located entirely within the 100-year floodplain boundary. Portions of sub regions A and F, or 7,524 and 1,475 acres, respectively, are within the 100-year floodplain boundary. Portions of the Cities of Modesto, Patterson, Newman, and a 1,550-acre area along the Delta-Mendota Canal between Patterson and Newman are located within the 100-year floodplain boundary. Subregions A through D are within a portion of the 100-year floodplain boundary that ranges from approximately 8.5 miles wide at the confluence of the San Joaquin and Stanislaus rivers along the northern extent of Subregion A, to about 0.9 miles wide near Grayson, downstream of Subregion D. Along Orestimba Creek, the 100-year floodplain extends approximately one mile to the north and south. The 100-year floodplains of the Stanislaus and Tuolumne rivers and Dry Creek extend into the City of Modesto by up to 0.5 miles in places.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013.

Figure 3-6

100- and 500-year FEMA Floodplain within the Planning Area

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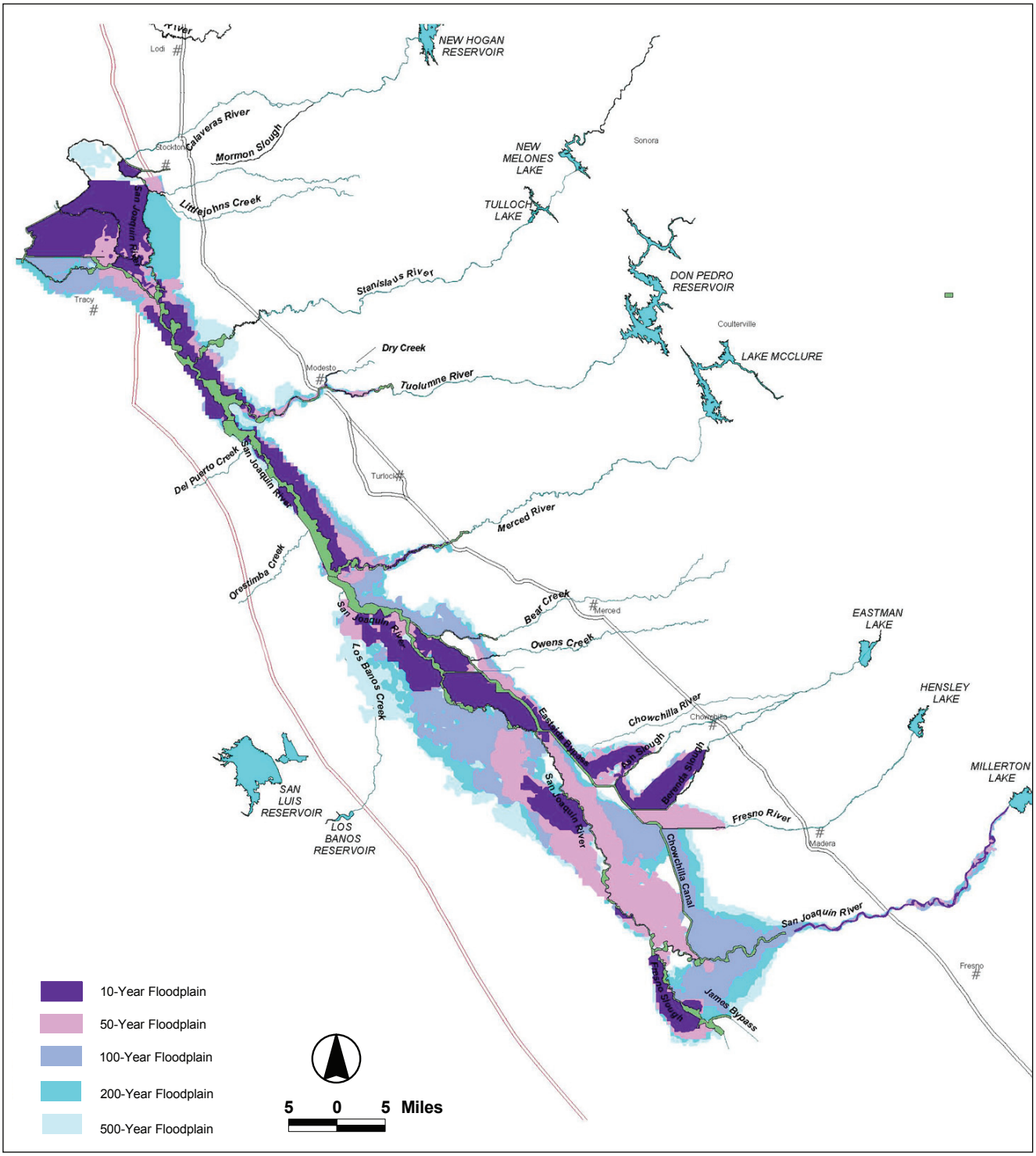
The City of Patterson is located within the 100-year floodplain of Del Puerto Creek, which flows north of the City of Patterson but breaks out to the south during very large flood events, as well as being influenced by breakout flows from the Hirschfield lateral entering the City from the south, which also generates flooding in Patterson during 100-year flood events. The community of Grayson is located along the left bank of the San Joaquin River and is not located within the 100-year floodplain. The City of Newman is within the 100-year floodplain of an irrigation canal that meets Orestimba Creek approximately 3.5 miles north of the City of Newman. The 100-year floodplain of the San Joaquin River also extends to the southwest edge of the City Newman. Portions of Modesto lie within the 100-year floodplain of the Stanislaus and Tuolumne rivers. Westley, Crows Landing, Turlock, Hilmar, Delhi, and Ripon are outside of any 100-year floodplain.

The 200- and 500-year (0.5% and 0.2% annual chance of occurrence, respectively) floodplains were delineated as a part of the Sacramento and San Joaquin River Basins Comprehensive Study (Comprehensive Study) prepared by the USACE (USACE, 2002). The 200- and 500-year floodplain boundaries as delineated in the Comprehensive Study are shown in **Figure 3-7**. The 500-year floodplain boundary is also delineated by FEMA and is provided in **Figure 3-6**. As shown in both figures, the 500-year boundary extends beyond the 100-year floodplain to many noncontiguous areas along the San Joaquin, Merced, Tuolumne, and Stanislaus rivers. Updated delineations of the 200-year floodplain boundaries within four defined regions of Central Valley have been completed as part of the DWR Central Valley Floodplain Evaluation and Delineation Program, as shown in **Figure 3-8**.

An updated Flood Insurance Study (FIS) that reexamines the extent of the 100-, 200-, and 500-year floodplains of the Tuolumne River and Dry Creek within, upstream of, and downstream of, the City of Modesto was recently completed. The floodplain boundaries delineated in the FIS will be used by FEMA to develop Preliminary Flood Insurance Rate Maps (FIRMs), which will undergo a 90-day public review. The Preliminary FIRMs will become Effective FIRMs after the FEMA mapping process is complete.

3.5.1 Designated Floodways (CVFPB)

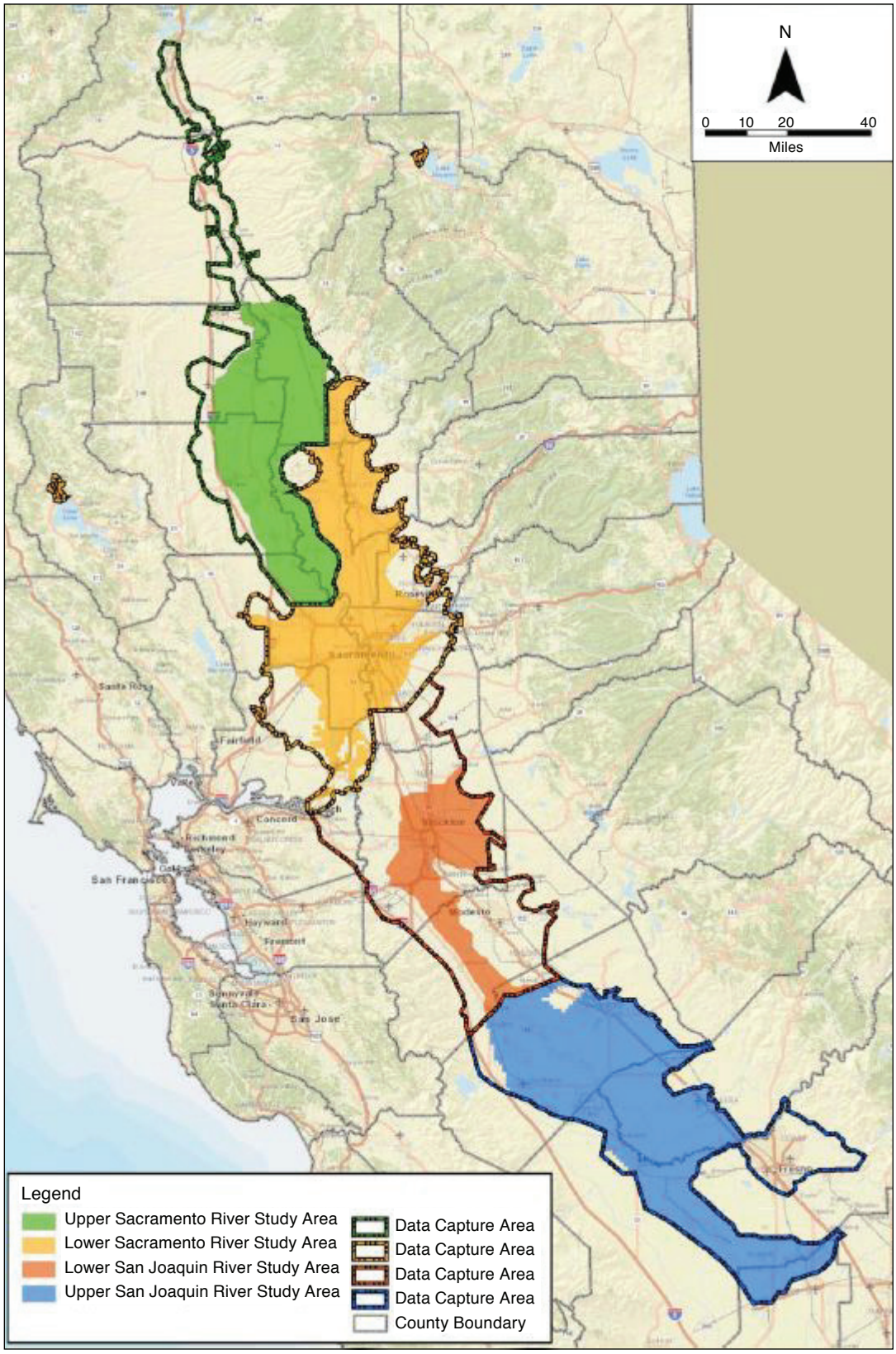
In addition to the regulatory floodplains and floodways designated by FEMA, California has its own system of Designated Floodways in the Central Valley. In this system, a Designated Floodway is the channel and the portion of the adjoining floodplain that is required for the passage of a design flood, which is the flood that the system is designed to adequately convey. It is also the floodway between existing levees as adopted by the CVFPB or the California Legislature. Projects within a Designated Floodway require an encroachment permit from the CVFPB. **Figure 3-9, Designated Floodways**, includes Designated Floodways within the planning area. As shown, in many areas, especially along the San Joaquin River, the extent of the Designated Floodways within the floodplains of the planning area is less than the effective 100-year floodplain as delineated by FEMA. This is the case because the levees in these areas provide varying levels of protection below that which would be required to convey 100-year flood flows. Maintenance of channel capacity in a Designated Floodway is the responsibility of the applicable RD.



Note: Composite floodplains shown do not include operational effects of headwaters reservoirs (storage facilities upstream of the major flood control reservoirs).

SOURCE: U.S. Army Corps of Engineers, 2001

Figure 3-7
San Joaquin River Basin
Floodplain Delineations



SOURCE: DWR, 2013

Figure 3-8
Central Valley Floodplain Evaluation and Delineation Program Boundaries

SOURCE: DWR, 2013

Figure 3-9
Designated Floodways

3.6 Channel Conveyance Capacity and Flood Forecast Monitoring Network

The conveyance capacity of a channel is the maximum rate of flowing water that can be conveyed by a river, canal, or bypass without exceeding a threshold value. As part of the Central Valley Flood Management Planning (CVFMP) Program, channel capacities were calculated along portions of the San Joaquin and Stanislaus rivers within the Mid SJR Region using a very limited hydrologic record from actual flood events without the consideration of temporal and spatial flow and depth variations. These capacities are shown on Map 17, Channel Capacities and Flood Forecast Monitoring Network, of the Atlas (Appendix A). It is important to note that the calculated capacities do not reflect vegetation changes, channel sedimentation/erosion, or flood system degradation (e.g., because of encroachments, settlement, subsidence) or improvements implemented after the occurrence of the historical floods used in the design capacity calculations (DWR, 2013a).

This analysis found that within the Mid SJR Region, 43 of 45 miles of river channel potentially cannot pass design flows, predominantly on the San Joaquin River (DWR, 2011c). The San Joaquin River upstream of the Tuolumne River to the Merced River confluence has a design capacity of 45,000 cfs, but an estimated current capacity of only 22,000 – 35,000 cfs. Downstream of the Tuolumne River to the Stanislaus River, the design capacity is 46,000 cfs, while the estimated current capacity is only 25,000 cfs. The lowest reaches of the Stanislaus River (11.9 miles) have a design capacity of 12,000 cfs, though the estimated conveyance capacity is far greater: 23,000 cfs. The lowest 0.6 miles of the Tuolumne River has a design capacity of 15,000 cfs. (Current conveyance capacity for the Tuolumne was not estimated; however, riverside landowners along the lower Tuolumne River report flood damages when flows exceed 8,200 cfs.) Where levees contain these flows, capacities are based on an overall engineering estimate of levee effectiveness, not levee overtopping alone (DWR, 2011b).

The levee and diversion systems along the San Joaquin River are not designed to contain the objective release from each of the upstream reservoirs simultaneously (USACE, 1999). An objective release is the maximum dam outflow allowed as specified in the USACE Water Control Plan. Objective flows are defined for a specific river reach based on local conditions, collaboratively with local entities, and intended to result in no damage to the system. Considerations in establishing objective flows may include levee stability, levee seepage, riparian habitat, and adjacent land uses (USACE, 1999).

Flood flow travel time is a key factor in flood management and unique in each system. Over time, sediment has accumulated within the northern portion of the San Joaquin River, which has decreased channel capacity and increased travel time. Water released from Friant Dam on the San Joaquin River takes more than five days to reach the confluence of the San Joaquin and Merced rivers and another two days to reach Vernalis. The travel time for water released from New Exchequer Dam on the Merced River is 42 hours to the confluence with the San Joaquin River. Releases from Don Pedro Dam on the Tuolumne River to Vernalis take approximately two days to travel to Vernalis. Discharges from New Melones Dam on the Stanislaus River take a little more than one day to pass through Vernalis (USACE, 1999). Rainstorms centered over the Merced, Tuolumne, and/or Stanislaus rivers take between one and two days to arrive at the San Joaquin River.

The DWR River Forecasting Section collaborates with the NWS California-Nevada River Forecast Center (CNRFC) in providing daily reservoir inflow, river flow, and water level forecasts throughout California and portions of Nevada. The DWR Flood Operations Branch and the NWS use these forecasts in determining the appropriate level of Federal-State flood response activation and operations. **Table 3-11** includes the flood stage categories at key river gages along the San Joaquin, Merced, Tuolumne, and Stanislaus rivers. At the San Joaquin River at Vernalis gage, which is downstream of the Mid SJR Region, seepage begins to occur when flows reach a stage of 21 feet[1]; seepage becomes severe at 26 feet; and at 37.3 feet, the levees overtop (NWS, 2013a). At the Newman gage of the San Joaquin River, seepage begins near the Newman WWTP at a stage of 62 feet; at 63 feet levee patrols are required; Sand Slough begins to flow when stage reaches 63.6 feet; the Fisherman's Bend Trailer Park north of Hills Ferry Road begins to flood at 65 feet; project flood stage is reached at 69.4 feet; the top of the levee that surrounds the Newman WWTP is reached at 70 feet; and at 71.7 feet, water reaches the top of the right bank levee (NWS, 2013b). Flood stage is reached at 71 feet on the Merced River at Stevinson (NWS, 2013c). On the Tuolumne River at Modesto, extensive flooding occurs when the river reaches a stage of 67 feet. Extensive damage could be caused to residential, industrial, and commercial properties within the City of Modesto at flows greater than 40,000 cfs (NWS, 2013d). At the Orange Blossom Road gage along the Stanislaus River, inundation of camp sites at Caswell State Park occurs when the river reaches a height of 10.5 feet; at 11 feet, the Orange Blossom Park begins to flood; and at 11.5 feet, access roads and park areas at Caswell State Park are flooded along with the lower areas within Orange Blossom Park (NWS, 2013e).

Table 3-11
Flood Stage Categories along the San Joaquin, Merced, Tuolumne, and Stanislaus Rivers

River Gage	Major Flood Stage (feet)[1]	Discharge (cfs)	Moderate Flood Stage (feet)[1]	Discharge (cfs)	Flood Stage (feet)[1]	Discharge (cfs)	Action Stage (feet)[1]	Discharge (cfs)
San Joaquin River at Vernalis	37.3	80,800	32	50,000	29	34,000	24.5	22,400
San Joaquin River at Newman	71.7	>25,800[2]	70.7	>25800[2]	69.4	>25,800[2]	63	13,200
Merced River at Stevinson	75	10,029	73.8	9,080	71	6,865	67	3,090
Tuolumne River at Modesto	67	39,400	66	35,300	55	11,200	50.5	7,340
Stanislaus River at Orange Blossom Bridge	22	>7,238[3]	21	>7,238[3]	16	>7,238[3]	13	>7,238[3]

1 Gage datum
2 Stage-Discharge records for San Joaquin River at Newman do not extend above 66.5 feet.
3 Stage-Discharge records for Stanislaus River at Orange Blossom Bridge do not extend above 12.4 feet.

SOURCE: NWS, 2013a-e; CDEC, 2014a-e

1 In this and each subsequent instance in this paragraph, river stage is presented relative to the gage datum.

3.7 Levee Conditions

Project levees, which are part of the State-Federal Flood Protection System, and non-project (local) levees are both key flood management features within the planning area.

Protection provided by SPFC levees is defined by levee flood protection zones (LFPZ) per the requirements of Assembly Bill 156 (AB156). An LFPZ is defined as the area that receives protection from a levee that is part of the SPFC facilities. There are generally three groups of LFPZs – areas that are subject to flooding from ponding of less than three feet deep, areas that are subject to flooding from ponding greater than three feet deep, and areas subject to flooding from channels or overland flow where the depth is unknown. Maps that define the boundaries of each type LFPZ were required under AB156. Map 3, Levee Flood Protection Zones, of the Atlas shows the LFPZ boundaries within the Mid SJR Region (Appendix A). The LFPZs associated with depths of more or less than three feet generally apply to areas surrounded by levees where the lateral extent of flooding can be easily identified. The boundary of the unknown depth LFPZ should not be considered precise because these areas are not surrounded completely by levees or other hydraulic controls, and, therefore, require more information to delineate. The Estimated Depth Less Than 3' LFPZ designation applies to 514,895 acres within the Mid SJR Region. The Estimated Depth Greater Than 3' LFPZ designation covers 788,158 acres. A large portion of the subarea of Mid SJR Region that extends into Merced County, or 343,636 acres, is characterized by the Depth Unknown LFPZ designation.

San Joaquin River flows that are less than the design flow may still result in levee damage and may seep through the levees and damage adjacent areas (USACE, 1999). The DWR Non-Urban Levee Evaluations (NULE) project included the evaluation of over 560 miles of project and non-project, non-urban levees within the San Joaquin River Basin, including those within the Mid SJR Region. The evaluation was the first phase of a project to characterize the condition of the levees generally within the Sacramento and San Joaquin River Basins, referred to as the North and South NULE study areas, respectively. The primary purpose of the NULE project was to evaluate SPFC levees and appurtenant non-SPFC levees to determine whether they met geotechnical criteria and identify measures to meet those criteria, if necessary. The first phase included non-intrusive studies followed by field explorations, testing, and more detailed geotechnical analyses on selected levees. The studies in Phase 1 of the South NULE project included comprehensive data collection efforts; the development of a database that included extensive records describing levee construction and performance during high flow events; field reconnaissance surveys along 560 miles of non-urban levee; geomorphic studies involving aerial photographs, vintage topographic maps, regional geologic maps, soil survey maps, and existing topographic data; development of the Levee Assessment Tool (LAT), which was used to assign hazard indicator scores that could be compared to past performance; coordination with local agencies, including interviews with over 40 LMAs; and development of conceptual remediation costs. The following four hazard categories were defined during LAT development:

- **Hazard Level A** – When water reaches the assessment water surface elevation (WSE), there is a low likelihood of either levee failure or the need to flood-fight to prevent levee failure.
- **Hazard Level B** – When water reaches the assessment WSE, there is a moderate likelihood of either levee failure or the need to flood-fight to prevent levee failure.
- **Hazard Level C** – When water reaches the assessment WSE, there is a high likelihood of either levee failure or the need to flood-fight to prevent levee failure.

- **Lacking Sufficient Data (Category LD)** – The segment is currently lacking sufficient data about past performance or hazard indicators to assign a hazard level, or there is poor correlation between past performance and hazard indicator scores.

Levees within the South NULE study area were divided into 114 segments, and each segment was evaluated according to four potential geotechnical failure modes – underseepage, slope stability, through seepage, and erosion. Hazard scores for each of the four failure modes were used to generate an overall hazard category designation for each levee segment. Each segment was also reviewed in terms of levee geometry, freeboard, and the history of overtopping (DWR, 2011a).

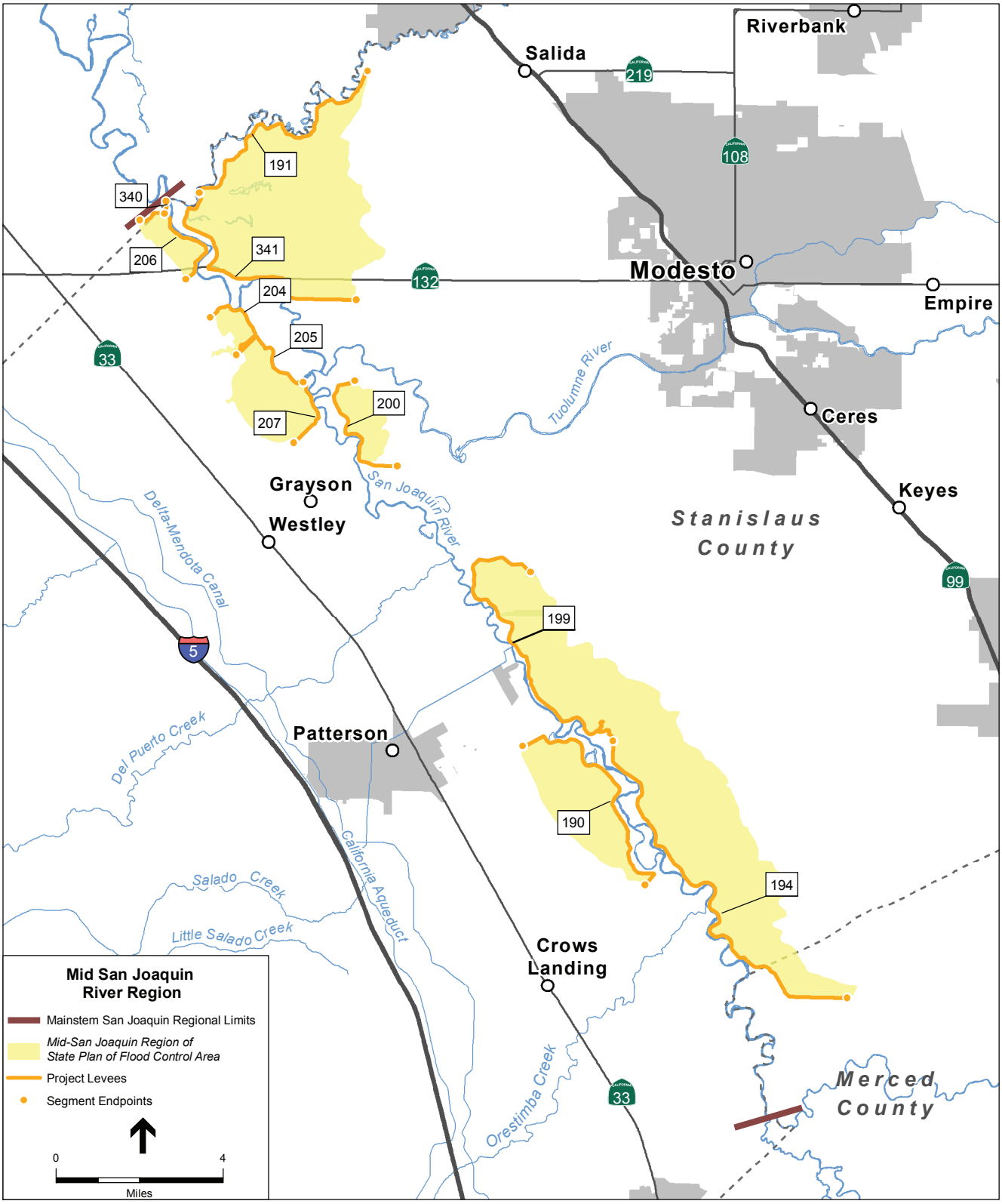
The hazard categories that were assigned to each of the 14 levee segments within the Mid SJR Region are provided in **Table 3-12**. **Figure 3-10** includes the location of each levee segment on a map. Most levees in the Mid SJR Region were identified as having a high likelihood of failure, or the need for flood fighting to prevent failure. Underseepage and through seepage are the dominant issue; the Hazard Category C is assigned to 11 and 10 of the 14 segments for each of these issues, respectively. Additionally, five segments were given the Hazard Category C for documented erosion. Levee Segment 5002 was given a hazard category of LD because while erosion sites were not observed during site reconnaissance, over-steepened waterside slopes are shown in Light Detection and Ranging (LiDAR) data. However, crest widths in the over-steepened areas are 20 to 90 feet generally, and review of topographic maps do not suggest a Hazard Level C for erosion hazard is appropriate along this levee segment. Detail is provided on the basis for each of the assigned hazard categories in Volume 3, Appendix C of the Geotechnical Assessment Report, South NULE Study Area (DWR, 2011a).

Table 3-12
NULE Hazard Categories Assigned to Levees within Mid SJR Region

	Potential Failure Mode			
	Underseepage	Stability[1]	Through Seepage	Erosion
Levee Segment	Hazard Category			
190	C	A	C	A
191	C	A	B	A
194	C	A	C	A
199	C	A	C	A
200	B	A	B	C
204	C	B	C	A
205	C	B	C	A
206	C	A	C	C
207	B	B	B	A
340	Not Assessed	Not Assessed	Not Assessed	A
341	C	A	C	C
5001 (non-project)	C	A	C	C
5002 (non-project)	C	A	C	LD (A/B)
5003 (non-project)	C	A	C	C

[1] Stability was assessed independently of through seepage and underseepage. Seepage might cause instability not accounted for in the stability assessment.

SOURCE: DWR, 2011a



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 3-10

NULE Levee Segments within the Mid SJR Region

Map 11, Overall Levee Conditions, of the Atlas (Appendix A) includes a simplified representation of the condition of project levees within the Mid SJR Region as evaluated under the South NULE effort and supplemented with DWR annual inspection data and data from other sources, as presented in the December 2011 Flood Control System Status Report (FCSSR) (DWR, 2011c). The FCSSR included the following Levee Status Factors in the evaluation of the status of SPFC levees: inadequate levee geometry; seepage; structural instability; erosion; settlement; penetrations; levee vegetation; rodent damage; and encroachments. Four categories are included in Map 11: levees with lower, medium, or higher concern and those lacking sufficient data for a designation.

With few exceptions, the project levees within the Mid SJR Region shown in Map 11 are designated as being of higher concern. Levees along the entire river side of Subregions A, B, D, E, and F are designated as being of higher concern. Along the river side of Subregion C, 9,476-feet of levee are designated of medium concern and the remaining length of the levee (26,583 feet) is considered of higher concern. In addition to levees that form portions of the subregion boundaries, levees along the Tuolumne River upstream of Subregion D are labeled as being of higher concern. A spur levee (1,580 ft) at the northeastern corner of Subregion B and a 1,556-foot length of levee along the right bank of the Stanislaus River across from and just upstream of Subregion A are characterized as being of lower concern. Levees directly across the majority of Subregion A, along with those downstream of the Mid SJR Region, are shown in Map 11 and characterized as being of higher concern, with the exception of two short levees in that area that are labeled as being of lower concern.

The locations of project levees having known issues with seepage, slope instability, and erosion are shown in Maps 12, 13, and 14, of the Atlas, respectively (Appendix A). As shown in Map 12, seepage issues occur along levees within Subregions A, B, E, and F. Levee seepage is not currently an issue within Subregions C and D. Problems with slope instability are noted at one location within Subregion A, four locations within Subregion D, three locations, one of which is a 7,000-foot levee segment, within Subregion E, and two locations along Subregion F. Erosion is an issue within Subregions A (5 instances), B (3 instances), E (2 instances), and F (6 instances).

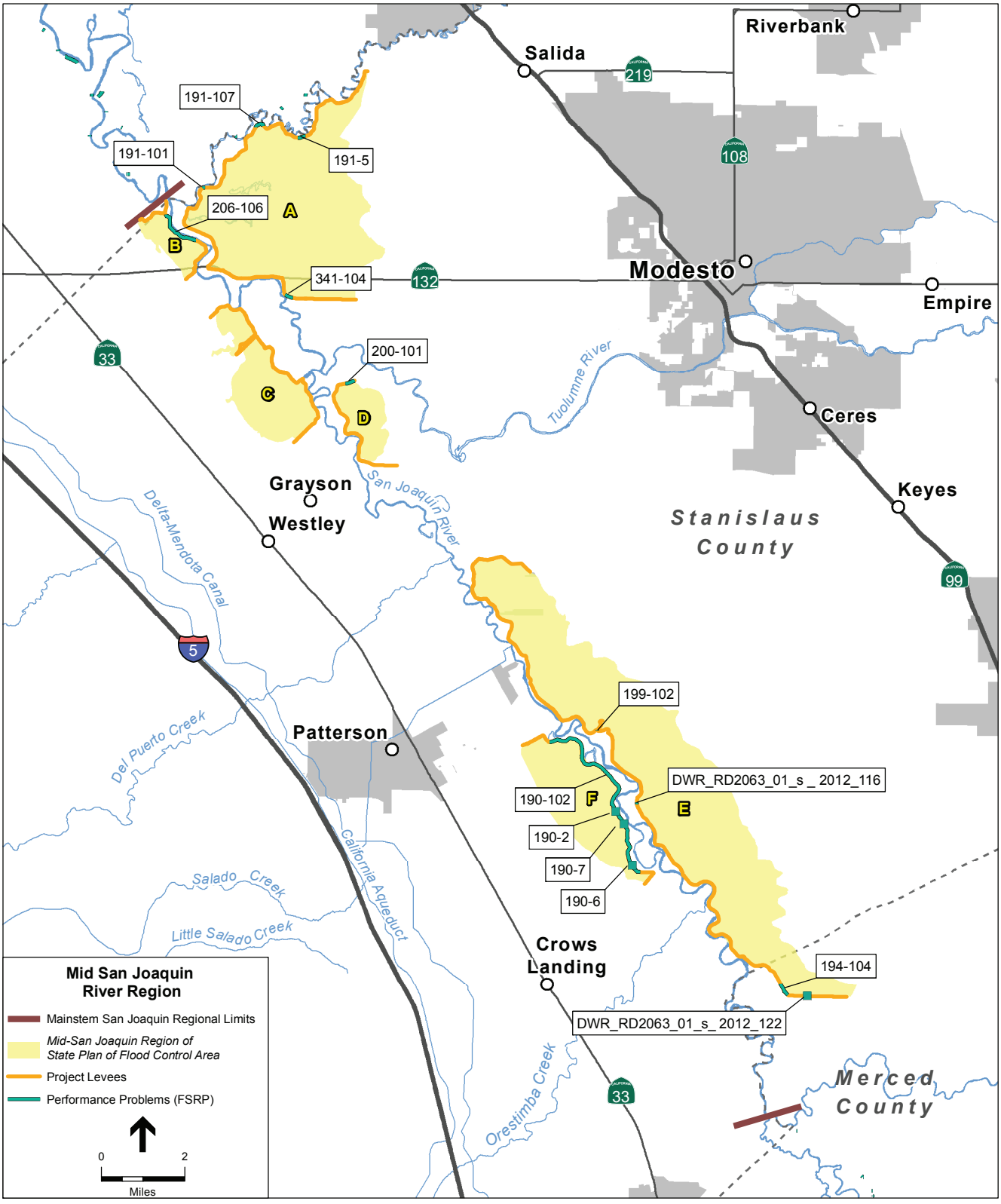
Map 15, Other Past Performance Problems, of the Atlas (Appendix A) includes the locations of documented performance problems with project levees that are not associated with seepage, slope instability, and erosion. **Table 3-13** includes brief descriptions of the performance problems shown in Map 15 and **Figure 3-11**, the latter of which includes labels to identify the location of each performance problem. As described in Table 3-11, these past levee performance problems relate to animal burrows, historic breaches, installed berms, pipe penetration, damage because of farming activities, and available freeboard.

Table 3-13
Other[1] Past Levee Performance Problems

Subregion	Flood System Repair Project (FSRP) Point of Interest (POI) No.	Performance Problem
	191-5	1969 observation of squirrel burrows in landward slope. No significant damage to the levee from animal burrowing was observed in this area during the 2012 site reconnaissance.
A	191-101	Site of 1969 levee breach. According to the RD 2031 representative, no seepage or boils have been observed in this area since 1978. No indications of slope instability were observed during 2012 site reconnaissance.
	191-107	Site of 1969 breach. According to the RD 2031 representative, no seepage or boils have been observed in this area since 1978. No indications of slope instability were observed during 2012 site reconnaissance.
	341-104	Three breaches occurred in this area in 1997 and were repaired by the USACE. According to the RD 2031 representative, there has been no flood fight subsequent to the breach repair. A few medium to large burrows were observed on landside and waterside slopes.
B	206-106	Site of 1969 levee break. According to the RD 2101 representative, the site was repaired by USACE. Seepage was observed in the area in 1997.
C	n/a	n/a
D	200-101	Berm placed on waterside shoulder in 1997 to prevent overtopping. Portions of a berm on the waterside shoulder were visible during 2012 site reconnaissance. A 12-inch-diameter irrigation pipe penetrating near the top of the levee and light poles on the slope were also noted.
E	194-104	Levee toe is cut about 12 inches, apparently by farming activities.
	199-2	A 6-inch-diameter vertical hole was noted in the middle of the levee crown in 2009. No damage was observed in this area during 2012 site reconnaissance.
	199-102	Per 1997 flood damage assessment inspection report, the spur levee broke and the repair was completed in 1997.
	DWR_RD2063_01_s _ 2012_116	Minor cut by the farmer at the toe, about 24 inches, access roads on landside and waterside, erosion on the waterside is minor.
	DWR_RD2063_01_s _ 2012_122	The landside toe is cut by farming activities, encroaching into the levee prism about 5 feet high and 150 feet long. The cut is in an area where the levee extends away from the river towards high ground.
F	190-2	About 4 to 5 feet of freeboard at this location during the 1997 flood event. The RD 1602 representative indicated this location is just where the 1997 observation was made and that in 1997 there was about 4-5 feet of freeboard along most of the levee. No additional field data were obtained during 2012 site reconnaissance. This POI should be considered for removal from the FSRP POI list.
	190-6	Animal burrows throughout waterside slope in 1997. Animal burrows were observed throughout this area and in the remaining portions of the levee segment. This area appears to be a little lower elevation than upstream and downstream areas. This area experiences very little hydraulic head (about 1 foot) at the Geotechnical Assessment Report (GAR) assessment water surface elevation. POI 190-6 is within the extent of POI-102 which also documents extensive animal burrowing. POI 190-6 should be considered for removal from the FSRP POI list.
	190-7	Sandbags placed in rodent holes on waterside slope in 1997. Major rodent activity was noted in the area. No evidence of sandbags or excessive burrowing were observed at this location during 2012 site reconnaissance. Burrowing was noted as a problem throughout the levee segment, but appears to be a local maintenance issue. The extent of POI 190-7 is within the extent of POI-102 which also documents extensive animal burrowing. POI 190-7 should be considered for removal from the FSRP POI list.
	190-102	Burrows were evident throughout levee segment during 2012 site reconnaissance and appear to be a local maintenance issue.

[1] "Other" refers to performance problems with project levees that are not associated with seepage, slope instability, and erosion.

SOURCE: DWR, 2012b



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 3-11

Locations of Other Past Levee Performance Problems

3.8 Identified Flooding and Flood Hazards

Identified flood hazards within the Mid SJR Region are located within the Cities of Modesto, Patterson, and Newman; agricultural lands that surround those cities; flooding also occurs on lands managed to preserve habitat along the San Joaquin, Tuolumne and Stanislaus rivers. This section includes a description of known flood hazards. Some flood hazards are the result of cloudburst storms on small watersheds in populated areas; others are because of high river flows resulting from large storm systems interacting with flood management reservoirs and deficient levee systems. The most devastating floods within the Central Valley are caused by warm Pacific storms that sweep in from the west or southwest, picking up moisture over thousands of miles of ocean, causing torrential rains when intercepted by the mountains surrounding the Central Valley (DWR, 2012a).

As shown in **Figure 3-12**, land uses within the 500- and 100-year floodplain include urban; rural and semi-rural agricultural; native vegetation and grazing land; farmland of prime and Statewide importance; local and unique farmland; and confined animal agriculture. **Table 3-14** includes the area in acres associated with each of these land uses within the 100-year floodplain boundary. During the 100-year event, some degree of damage to a significant portion of the assets within the 100-year floodplain lands could occur. **Table 3-15** includes the population, households, number of parcels, and total value of assets within the 100- and 500-year floodplains in Stanislaus County. **Table 3-16** includes a summary of flood hazard exposure information for Stanislaus County.

3.8.1 City of Modesto

Flood risk within the City of Modesto is a result of proximity to the Tuolumne and Stanislaus rivers and Dry Creek as well as the operations of large reservoirs on the rivers. The Tuolumne River represents the greatest flood threat to Modesto, particularly when flows are high in the Tuolumne River and rain is heavy in the Dry Creek watershed (FEMA, 2008). During large winter rainstorms, Dry Creek contributes significant but short duration flood flows to the Tuolumne River (McBain and Trush, 2000). Flooding along the Tuolumne River occurs as a result of rainstorms from November through March and snowmelt from April through May. Snowmelt floods along the Tuolumne River have lower peaks that those generated by rain, but are longer in duration with a greater volume of water.

The 2010 – 2015 City of Modesto Local Hazard Mitigation Plan (LHMP) identifies the Modesto City-County airport, schools, utility infrastructure, emergency services, agriculture, sanitation facilities, and residential development as potentially affected by flooding within the city. On one or more occasion each winter, flood water backs up on Morton Boulevard, a minor street, from underneath the La Loma Bridge at the confluence of the Tuolumne River and Dry Creek and exposes a number of houses along Dry Creek to potential flooding. In addition to flooding because of structural failure or levee overtopping, the failure of New Melones, Don Pedro or LaGrange Dams would cause severe flooding within Modesto that would be expected to result in injuries, loss of life, limited transportation routes, and utility services. The Modesto LHMP includes a series of policies that form a mitigation strategy to manage flood risk in the City (Modesto, 2011). Specific flood management projects that have been identified within the City of Modesto are provided in Chapter 7, Proposed Regional Improvements, of this plan. These include the Northeast Storm Drainage Interceptor Project and improvements to the City of Modesto wastewater treatment facilities.

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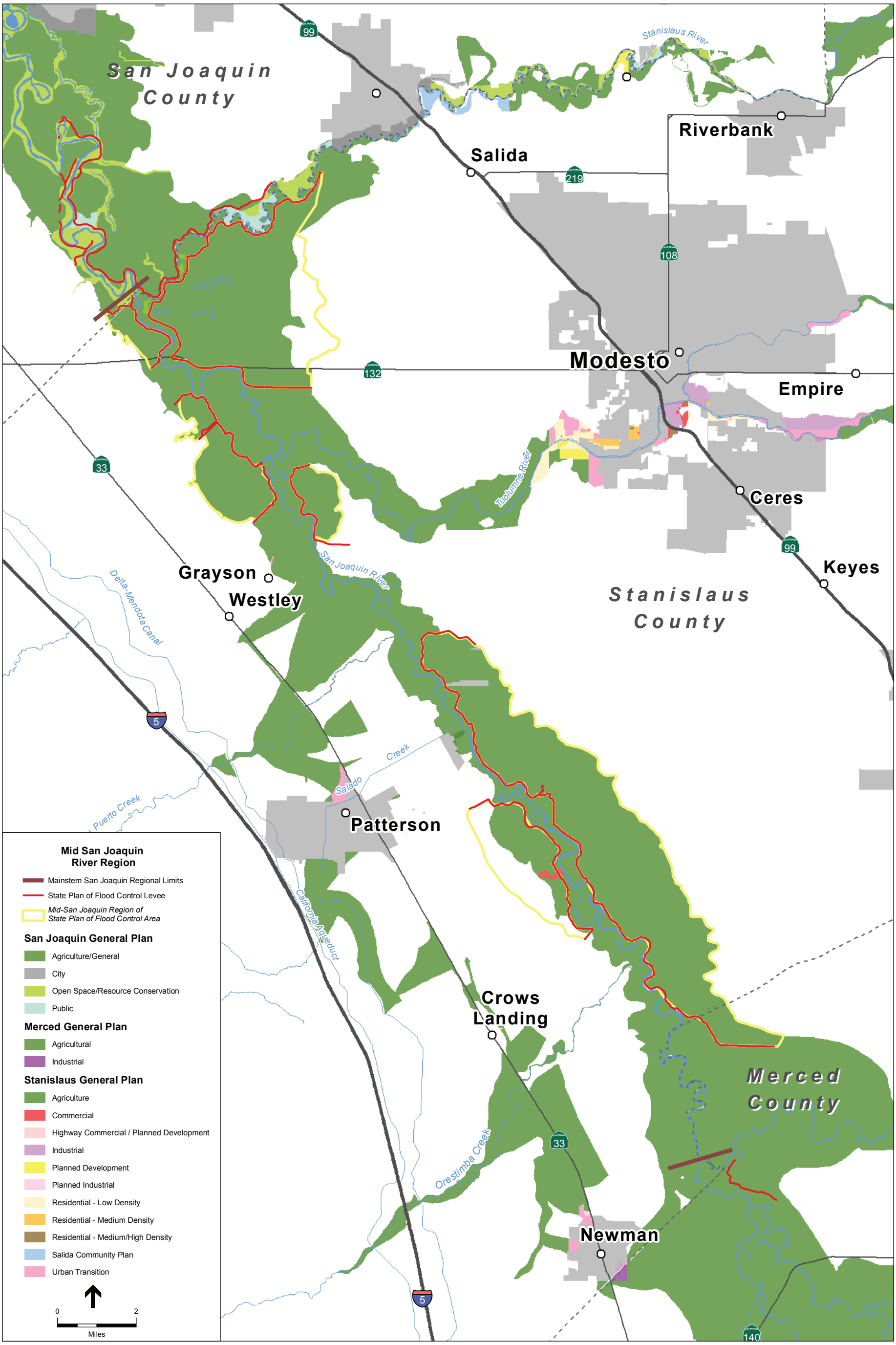

SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 3-12

General Plan Land Uses within 100- and 500-year FEMA Floodplains

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Table 3-14
Area Covered by Land Use Types within 100-year Floodplain in Mid SJR Region

Land Use Category[1]	Acres of Land Type	% of Total Area
Urban and Developed Land	1,264	5%
Native Vegetation and Grazing Land	4,955	19%
Local and Unique Farmland	6,831	26%
Prime and Statewide Importance Farmland	12,134	47%
Confined Animal Agricultural Land	561	2%
Rural and Semi-Agricultural Land	193	1%
Total	25,936	100%

1 See Appendix A for descriptions of how land use categories were defined.

SOURCE: Mid San Joaquin River Region Flood Atlas (Appendix A)

Table 3-15
Population and Assets within 100- and 500-year Floodplains in Stanislaus County

River	Population	Households	Number of Parcels	Total Value
100-year Floodplain				
Del Puerto Creek	248	71	139	$49,686,842
Dry Creek	747	273	146	$143,550,227
Orestimba Creek	588	223	189	$48,685,552
Salado Creek	38	10	31	$8,795,382
San Joaquin River	2,354	676	630	$149,520,110
Stanislaus River	2,322	892	268	$117,176,939
Tuolumne River	4,766	1,566	974	$187,806,940
500-year Floodplain				
Del Puerto Creek	375	112	194	$62,664,305
Dry Creek	747	273	149	$149,644,108
Orestimba Creek	927	338	300	$77,913,338
Salado Creek	221	70	67	$16,659,356
San Joaquin River	2,408	694	668	$166,250,814
Stanislaus River	2,460	943	465	$200,322,760
Tuolumne River	11,177	3,555	2,162	$578,719,622

SOURCE: 2010 Multi-Jurisdictional Hazard Mitigation Plan

Table 3-16
Stanislaus County Flood Hazard Exposure

County Statistics

Total Acreage	970,172
Total Population	447,034
Total Structures	151,500
Total Value of Structures and Contents	$38.8 billion
Total Agricultural Acreage	376,858
Total Value of Crops	$857.3 million

Summary of Exposure to Flood Hazard

	100-year event	500-year event
Exposed Area (acres)	61,984	81,320
Percent of Area Exposed	6	8
Population Exposed	14,544	36,621
Percent of Population Exposed	3	8
Structures Exposed	3,879	10,434
Total Depreciated Replacement Value of Exposed Structures and Contents	$802.2 million	$2.2 billion
Exposed Crops (acres)	40,331	54,493
Value of Exposed Crops	$54.4 million	$91.8 million
Department of Defense Facilities Exposed	0	0
Essential Facilities Exposed	6	23
High Potential Loss Facilities Exposed	1	1
Lifeline Utilities Exposed	1	1
Transportation Facilities Exposed	37	51
Transportation Segments Exposed (miles)	29	40
Native American Tribal Land Exposed (acres)	0	0
Total Sensitive Plant Species Exposed	19	19
Total Sensitive Animal Species Exposed	34	34

SOURCE: Figure D-99 Summary of Available Flood Types, Flood History, and Flood Hazard Exposure, Stanislaus County

The City of Modesto treats wastewater at two facilities, the Sutter Avenue Primary Treatment Plant along the right bank of the Tuolumne River adjacent to Bellenita Park and the Jennings Road Secondary Treatment Plant on the right bank of the San Joaquin River. These facilities are at a relatively high risk of flooding because they are located along the Tuolumne and San Joaquin rivers. As part of one alternative to plant upgrades in the 2007 Wastewater Treatment Master Plan Update, a concrete-wall construction levee was proposed that would be built along the river side of the Sutter Avenue Primary Treatment Plant to an elevation of 70 feet and provide approximately two feet of freeboard over the 100-year floodplain elevation. A berm levee was described for the north, east, and west boundaries of the facility. The potential for the concrete-wall levee to result in flooding upstream was acknowledged, and an alternative

was also considered in the form of fill placement to protect primary treatment facilities from the 100-year event as well as reduction in the size of the sludge drying beds (Modesto, 2007). A supplement to the 2007 Wastewater Treatment Master Plan was released in 2008, and noted the need for improvements to existing flood management levees at the Sutter Avenue plant because of seepage from the Tuolumne River that impacts irrigation fields during high flows. It was also acknowledged that seepage may be a threat to the foundation of the chlorine building, and that levee stability improvements are warranted where sand boils have occurred, as well as improvements to control subsidence at the building and a new retaining wall (Modesto, 2008). A feasibility study is currently underway to evaluate potential solutions to flood hazards at the Sutter Avenue and Jennings Road treatment plants. Initial analysis under the ongoing feasibility study indicates that providing 200-year protection at the Sutter plant may be economically feasible, and the City is considering the option of attaining a 200-year level of protection instead of the 100-year level of protection that has been considered previously. The City is also considering a concrete-wall construction levee at the Jennings Road Secondary Treatment Plant similar to what is described above for the Sutter Avenue plant (Laura Anhalt, personal communication, September 26, 2013). Information on potential flood management improvements that the City of Modesto is in the process of exploring is provided in Chapter 7, Proposed Regional Improvements, of this plan.

3.8.2 Westside Tributaries; Cities of Patterson and Newman

Flooding within Patterson and Newman can occur as a result of rainstorms originating over the Pacific Ocean generally from October through April. These rainstorms can deliver precipitation to one or more of the Westside tributary drainages of the San Joaquin River - Orestimba, Salado, and Del Puerto creeks. In instances of heavy precipitation in one or more of the Westside tributary watersheds, flooding characterized by high peaks, moderate duration, and a large runoff volume can occur. Downstream of the Diablo Range foothills, the carrying capacity of Orestimba, Salado, and Del Puerto creeks is reduced because of siltation and vegetation (FEMA, 2008). Flooding is primarily in the form of sheetflow that is generally less than two feet in depth with an unpredictable flowpath. Cloudburst storms in this area are rare and generally result in minor flooding. Streamflow records for Orestimba and Del Puerto creeks are relatively short (1932 and 1959 to present day, respectively), and Salado Creek does not have a streamflow gage.

Historic and contemporary accounts of flooding within Patterson and Newman are relatively few. The largest flood on record was in April 1958, with a peak flow of 10,200 cfs at the Orestimba Creek at Newman gage. That event resulted in damage to agricultural facilities in the Orestimba Creek Basin as well as public, commercial, and residential assets within the Salado Creek Basin. Evacuation of residents and flood fighting with sandbags was required in both basins. The most costly flood within the Westside tributary area prior to the costly 1995 flood event (see Section 3.2.3 for a description) was in February 1980, resulting in nearly $340,000 in damage within the Orestimba Creek Basin and $1 million within the County's Westside region. A flood in December 1955 caused significant damage to agricultural, residential, and commercial properties; roads and culverts; and SPRR ballast (railbed) and ties as well as breaks in the Delta-Mendota Canal.

In February 1959, Patterson received more than two inches of rain within 24 hours. Flooding from Orestimba Creek eroded the west Anderson Road Bridge embankment, resulting in cracks in the bridge. In that event, floodwater from Del Puerto Creek felled several telephone poles and lines and washed out a canyon bridge east of Interstate 5. Within Patterson, pumping was required to remove flood waters from local streets.

Approximately six inches of rain within the Orestimba Creek Basin in early February 1963 inundated 2,000 acres of farmland four to five miles north of Newman, which caused erosion and silt and debris deposition. Additionally, erosion occurred at the Delta-Mendota Canal siphon and the approaches to both road and railroad bridges. In January 1969, three to five inches of rainfall caused erosion, sediment deposition, and impacted walnut orchards. A Salado Creek embankment south of Patterson failed in March 1983, and State Highway 33 was inundated north of town. The evacuation of some Patterson residents was carried out during that event.

Orestimba, Salado, and Del Puerto creeks are each constricted at the Delta-Mendota Canal, and floodwaters pond to the west of the canal as a result. The overchute that allows Salado Creek flows to pass over the Delta-Mendota Canal, located approximately three miles upstream of Patterson, has a capacity of 710 cfs, or approximately the 50-year event (two percent annual change of occurrence) (FEMA, 2008). The overchute constricts Salado Creek flood flows when it is active. Ponding at Salado Creek is diverted to the southeast for a few miles where flood flows reenter the creek, but add significantly to flood flows near the Naval Auxiliary Landing Field northwest of Crows Landing. The channel capacity of Salado Creek downstream of the overchute is 300 cfs, and high flows exceed the banks at several locations southwest and west of Patterson. Flood flows do not return to Salado Creek because the floodplain slopes away from the channel and small levees would block the return. Sheetflow from Salado Creek enters Patterson from the west, and generally flows from southwest to northeast. Ponding occurs within Patterson along the SPRR embankment because it is three feet higher than the land surface and existing drainage structures are not effective. When all three Westside tributaries are generating overland flow, the severity of flooding in Patterson in these areas is intensified, and substantial ponding of floodwaters occurs where channel, culvert, and bridge capacities are insufficient, particularly along levees, County road embankments, and the SPRR. In these instances, floodwater ponding is generally deeper than overland flow, and either overtops the obstruction, is directed along the obstruction, or dissipates by seepage and evaporation.

The City of Patterson WWTP is located on the left bank of the San Joaquin River just north of the East Las Palmas Avenue/West Main Street river crossing and across the river from RD 2091. The WWTP is located on a low bench 2-3 feet above a lower section of river bank that extends approximately 300 yards to the river channel. Past high flows on the San Joaquin River have flooded the lower riverbank area on the east side of the plant. In the modest 2011 high flow event, flood waters are reported to have reached the base of a fence that surrounds the plant. After the 1997 flood, the City placed fill to restore a significant site of riverbank erosion. Continued erosion of the riverbank could result in greater flood risk at the WWTP. High flow events result in a spike in inflows to the WWTP, probably through interconnections with the stormwater system in Downtown Patterson. The problem is greatest when rain in the Coast Range cause Salado Creek to overflow. In 1997, these greatly increased inflows into the plant caused continuing problems with the maintenance of

biological treatment processes. During heavy rains December 2012, the inflow into the plant reached the capacity of 2.25 million gallons per day. The plant currently does not have the capability to bypass excessive flows in its sewage lines into larger existing storage ponds. In an excessive inflow situation, the plant operator may have to sacrifice one or more treatment processes to try to contain the water. The potential exists for discharge of inadequately treated waste into the river and extended failure of treatment capability. The plant manager estimates that after surges in inflow, it could take up to 30 days to restore the biological communities used in secondary treatment of wastewater at the plant. The City is currently developing a master plan that will guide future development of the facility and this municipal function (PBI, 2013).

Orestimba Creek, one of the Westside tributary drainages cited above, is a primary source of flooding in Newman. The problem is sufficiently severe to have led to a recent USACE investigation of possible fixes. The following three problems were identified in the Orestimba Creek Draft Interim Feasibility Study (USACE, 2012):

1. There is a high probability of flooding which threatens public health and safety in the City of Newman and surrounding rural areas.

2. The City of Newman and surrounding agricultural land have incurred damages from past flooding. The March 1995 event resulted in approximately $7.8 million in damages (2011 dollars) to agricultural land and crops, residential and commercial properties, the Delta-Mendota Canal, the Central California Irrigation District (CCID), bridges, and road crossings.

3. The Orestimba Creek channel has been altered by human activity (sand and gravel extraction and farms encroaching on banks). The capacity of the channel has been increased between the Delta-Mendota Canal and Jorgensen Road, and the channel slope reduced between Jorgensen and Morris Roads. There is significant transport capacity and reduced sediment load downstream of Jorgensen Road, which may be why the local channel geometry has changed in the recent past.

During events between the 3- and 10-year (33% and 10% annual chance of occurrence, respectively), flows begin to exceed channel capacity downstream of Jorgensen Road and inundate adjacent agricultural land. Floods greater than the 10-year event are diverted 2.5 miles from the channel into Newman. Overland flow collects along the CCID Main Canal on its west side and the California Northern Railroad (CNRR) embankments. Water is then conveyed south along Highway 33 and the CNRR berm to Newman. Flows continue over the highway and railroad berm, over fields and farm roads, and finally to the San Joaquin River. Local topography and the shallow, unconfined nature of flooding in this area cause the exact course of floodwater to be unpredictable (USACE, 2012).

San Joaquin River flows also pose a flood hazard to the Newman WWTP, which is located one mile northeast of Newman along the left bank of the San Joaquin River on Hills Ferry Road. When stage in the San Joaquin River reaches 62 feet above msl, landside seepage begins near the Newman WWTP. At 70 feet above msl, the river reaches to the top of the levee that surrounds the Newman WWTP (NWS, 2013b). A description of potential flood management improvements that the City of Newman is exploring for the Newman WWTP is provided in Chapter 7, Proposed Regional Improvements, of this plan.

Landowners along Del Puerto Creek have concerns regarding flood risk and potential property damage. They recognize the need for a coordinated effort to improve flood management along Del Puerto Creek, but lack sufficient resources. The West Stanislaus Resource Conservation District notes similar issues along Orestimba Creek (Matthew Danielczyk, personal communication, 2013). Stakeholders suggest that there is potential for an organized group of landowners, resource conservation districts, and other

stakeholders, including organizations such as Audubon California, to form and begin to address flood hazards within the Del Puerto Creek, Orestimba Creek, and Solado Creek watersheds. A description of a potential regional improvement addressing this opportunity is provided in Chapter 7, Proposed Regional Improvements, of this plan.

3.8.3 Managed Environmental Lands

Many environmental lands along waterways in the Mid San Joaquin River corridor are intended to flood, including lands within the SJRNWR and at Dos Rios Ranch at the confluence of the Tuolumne and San Joaquin rivers. As previously described, floodplain inundation can be enormously beneficial to native species and riparian habitat. For these lands, flooding is a positive event.

Lands within RDs 2099, 2100, and 2102, referred to collectively as "The Three Amigos," were purchased by the federal government for flood relief after the 1997 flood as a "Non Structural Alternative (NSA)" under PL 84-99. The intent was to remove the levees from the SPFC and allow flood inundation to occur on these lands. These lands are now owned by the USFWS and managed as a part of the SJRNWR. The Three Amigos cover an area of approximately 3,200 acres. During the 1997 flood event, four failures occurred on the west or left bank levee along the San Joaquin River flooded RDs 2099, 2100, 2101, and 2102. These levees were subsequently repaired even as steps were being taken to implement the NSA. Since that time, however, the SJRNWR has continued to experience flooding, most recently in late December 2010, early January 2011, and late March 2011. This flooding occurs as high river flows back up the West Stanislaus Irrigation District intake canal, which cuts across the SJRNWR between RD 2100 (Hagemann Tract) and RD 2102 (Lara Tract). The canal was at one time protected at its mouth by a levee penetrated by a dual box culvert connection to the canal which was damaged and removed some years ago. The canal is bordered by berms that are prone to overtopping and breaching in high water. At the end of December 2010, flood water flowed through such a breach and flooded a portion of the Lara tract. Flooding in late March 2011 resulted in extensive flooding at the SJRNWR, including both the Lara tract and the Hagemann tract. Drainage of floodwaters from behind breached levees often requires active pumping. Following flooding in the spring of 2006, pumps were inaccessible and lands on the dry side of the RD 2100 levee (Hagemann tract) were inundated for months after the river levels had receded. Such long duration flooding has negative impacts to natural areas, as was documented by River Partners (2008).

Dos Rios Ranch, or Reclamation District 2092, is a 1,600-acre area managed by the Tuolumne River Trust and River Partners located between the SJRNWR and the Tuolumne River Regional Park. The 497-acre Hidden Valley Ranch, adjacent to Dos Rios Ranch, provides all of the lands that are flood protected by the levee in RD 2092 (approximately 1,000 acres total). Like Three Amigos, the management of Dos Rios Ranch will seek to retain or enhance its function as active floodplain to provide ecological benefits. As a demonstration of its accessibility to flooding even under current conditions, floodplain fields within the Dos Rios Ranch property were flooded on March 27, 2011 when the 3- to 5-foot berms that run along the fields were overtopped by flood flows.

3.8.4 Agricultural Lands Not Protected by Project Levees

Many floodplain lands are farmed in the Mid SJR Region. In general, these lands are protected from small floods by berms (often described as private levees, yet not engineered) and active flood fighting. Lands protected by such berms are prone to frequent flooding, much as the Dos Rios Ranch example cited above.

3.8.5 Dam Inundation Hazard

Dam failure is the breakdown, collapse or other failure of a dam structure characterized by the uncontrolled release of impounded water that results in downstream flooding. The 2010 Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan includes a map with the extent of the dam inundation hazard area associated with Don Pedro, Exchequer, New Melones, San Luis, Pine Flat, and Tulloch Reservoirs. This map is provided as **Figure 3-13**, **2010 Stanislaus County – Dam Inundation Hazard**. As shown in Figure 3-13, large areas would be inundated if any of these dams were to fail, including a portion of Modesto, Ceres, and Newman. The 2010 Stanislaus County Multi-Jurisdictional Hazard Mitigation Plan also includes a detailed risk analysis for each dam. While the damages that would be caused by a dam failure would be extremely large, the probability of such an occurrence is small.

3.9 Flood Management Improvement and Integration Opportunities

Many opportunities for the improvement and integration of flood management within the planning area with other regional and statewide goals have been identified through the regional flood planning process, as described below. Detailed descriptions of each of those opportunities are provided in Chapter 7, Proposed Regional Improvements, of this plan. A brief introduction to several previously-proposed flood risk reduction multi-benefit projects is provided in this section as well.

3.9.1 Flood Management Approach

Not all flooding creates hazards. Modern society is coming to recognize that flooding that occurs in areas with flood-compatible land uses can be at worst a nuisance, and at best a vital reinvigorating force for the creation and maintenance of beneficial habitat, both in-channel and on the floodplain. At the same time it can support such benefits as water quality enhancement and groundwater recharge. Yet the human propensity for siting homes and development along waterways has given us a legacy of land use that puts significant investments and lives at risk during flood events. With the adoption of the 2012 CVFPP and the readiness of the state to invest significantly in reshaping the approach to flood management in the Central Valley, there is a tremendous opportunity to rethink and retool the flood management system we know today. That reshaping of flood management approaches can be accomplished in a way that provides flood risk reduction to life and property as well as a broader array of public goals, including economic stability and environmental stewardship.

DWR and the USACE recently developed a set of guiding principles (presented in the draft California's Flood Future: Recommendations for Managing the State's Flood Risk of April 2013) that reflect an integrated approach to flood management:

- Floods cannot be entirely prevented. Flood management seeks to reduce the risk and consequences of flooding to improve public safety, enhance environmental stewardship, and support economic stability.

- Multiple-benefit flood management solutions designed from a systemwide perspective provide the most responsible use of public resources.
- Flood management is a shared responsibility. Effective flood management is enhanced by collaboration and partnerships among public agencies at all levels (local, State, Federal) and across geographic boundaries.
- Public agencies must achieve sustainable solutions while making risk-informed decisions for flood management that will be durable across a spectrum of variables, including climate change.

These principles are expected to underlie flood management investment in California in the future.

3.9.2 Previously-Identified Flood Risk Reduction Multi-benefit Opportunities

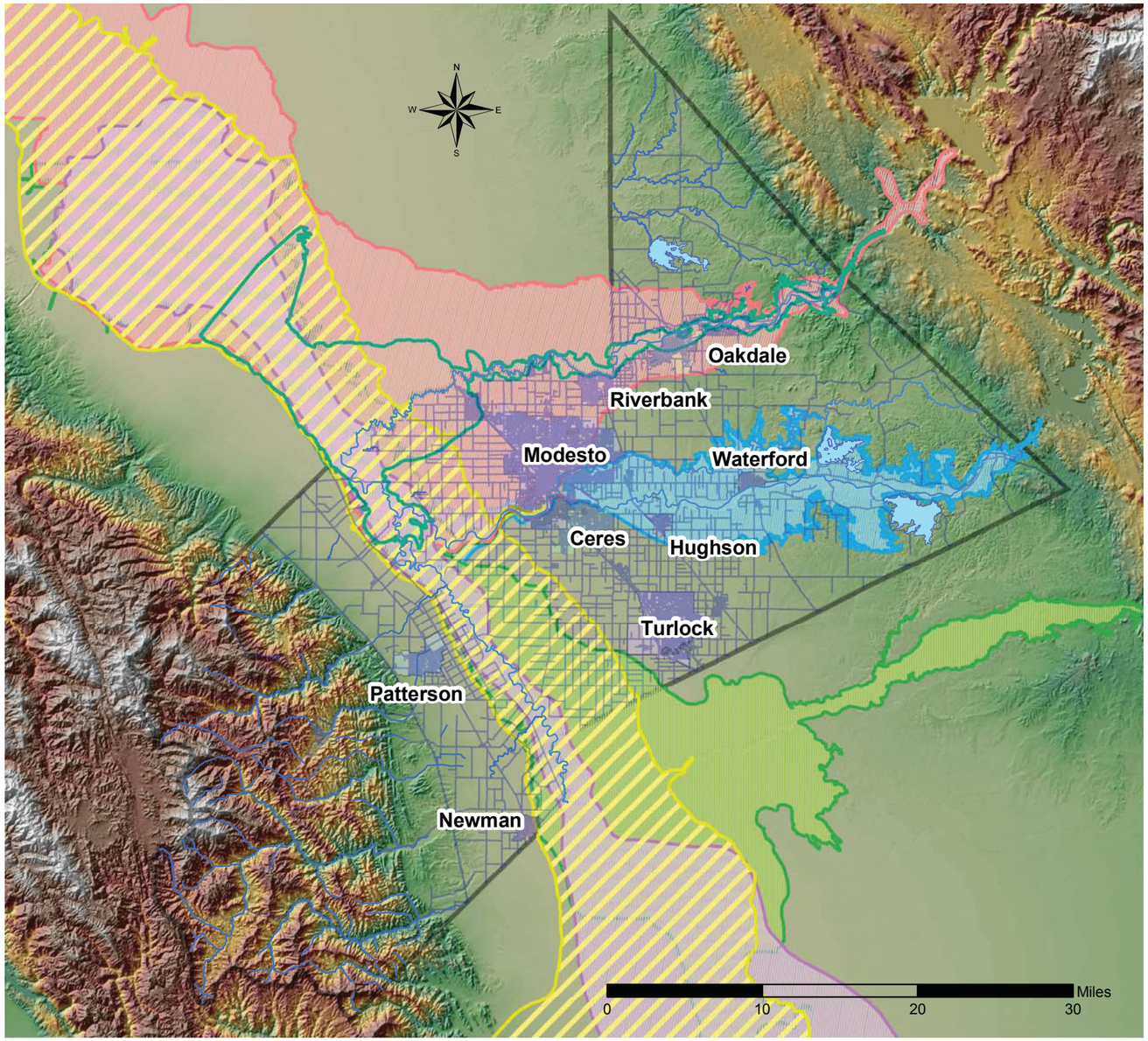
As an initial step in the planning process, previously-identified flood management opportunities for the Mid SJR Region were reviewed. In this subsection, we review some of these flood system capacity expansion ideas that appear to hold special potential for achieving multiple benefits together with flood risk reduction.

More so than in any other region of the Central Valley, leadership in the kind of innovative, multi-benefit approaches to flood management envisioned by the 2012 CVFPP has already been demonstrated within the planning area. The Three Amigos and Dos Rios Ranch projects, on adjacent properties at the confluence of the San Joaquin River and the Tuolumne River, are partially developed concepts for integrated flood management, habitat enhancement, and other benefits that already provide flood risk reduction locally. Both projects have the potential, with further action, to provide additional flood risk reduction, both locally and possibly to downstream communities such as Stockton and Lathrop. These two projects are briefly discussed below and presented in more detail in Chapter 7, Proposed Regional Improvements.

As previously described in Section 3.2.4 Flood Control System Performance – 1997 Flood, the purchase of the Three Amigos was intended to serve as a NSA for flood hazard reduction, in which lands behind the levees would be allowed to inundate; land uses would change to be compatible with flooding; flood easements would be purchased; ring levees and floodwalls would be built to provide local protection; and levees would no longer need to be maintained. While the components of the NSA were being developed, however, the levees were repaired. Since that time, the full implementation of the NSA has stalled. Meanwhile, in 2002, restoration of 777 acres of riparian habitat began on the SJRNWR. Since 2002, approximately 2,700 acres of habitat has been rehabilitated. Recently, the USACE has been reinvigorating the effort to implement the NSA and DWR has funded an effort to investigate the potential for transitory floodplain storage in more detail. Additional information on the structural and nonstructural components of this project is provided in Chapter 7, Proposed Regional Improvements.

The USFWS has proposed the expansion of the SJRNWR in two sections to the north and south of the existing property. A Draft Environmental Assessment of the proposed expansion was released in November 2012 (USFWS, 2012). The expansion would allocate up to an additional 22,156 acres to the SJRNWR, which could provide non-structural flood management opportunities. The flood management opportunities associated with the proposed expansion of the SJRNWR is described in Chapter 7, Proposed Regional Improvements, of this plan.

2010 Stanislaus County -- Dam Inundation Hazard



Map Legend:

- Lakes
- Rivers
- Streams
- Roads

Dam Inundation Areas

Dam Name

- Don Pedro
- Exchequer
- New Melones
- San Luis
- Pine Flat
- Tulloch

Map displays Stanislaus County with Dam Inundation Areas of regional dams.

Prepared by:
Stanislaus County
Public Works - GIS
November, 2009

SOURCE: Stanislaus County, 2010

Figure 3-13
2010 Stanislaus County – Dam Inundation Hazard

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The Dos Rios Ranch property is in a prime location for floodplain rehabilitation and the provision of transitory flood storage. A study to investigation its flood storage potential is underway. Other resource management projects that have and/or are expected to contribute to flood risk reduction within the planning area include the La Grange Floodplain Restoration and Spawning Gravel Augmentation. This, along projects with proposed activities within Dos Rios Ranch, is discussed further in Chapter 7, Proposed Regional Improvements, of this plan.

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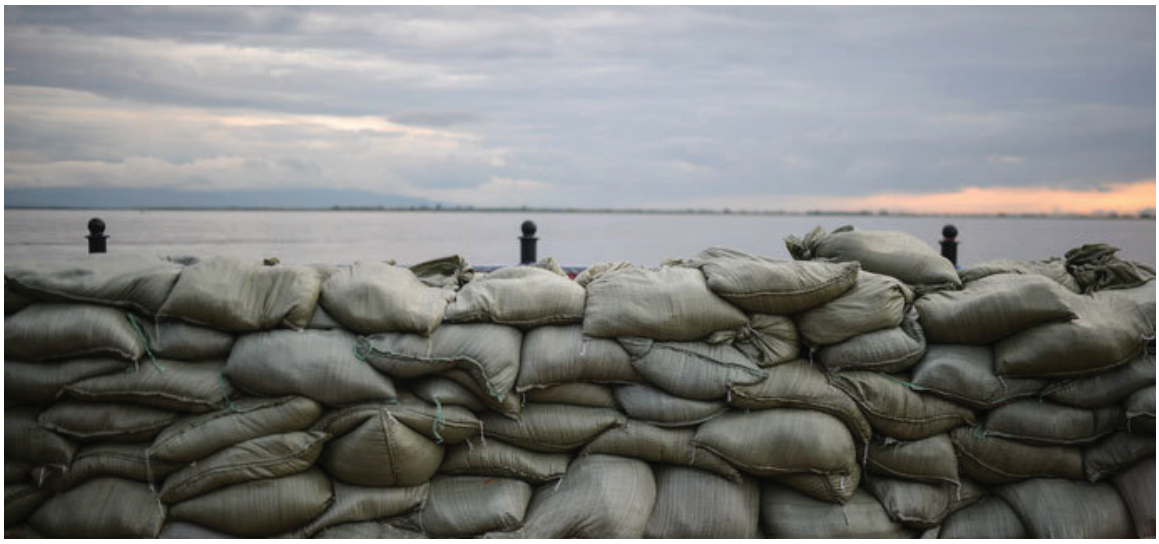

4. Emergency Response

4.1 Introduction

This Chapter of the RFMP describes the current status of flood emergency response in the Mid SJR Region and provides an assessment of the relative state of flood response readiness of responsible agencies. This Chapter also summarizes the response structure and agency roles and the nature of residual risk in the area. Finally, key response issues are identified with recommended actions for improving the level of flood response readiness

Information in this Chapter is based on a field survey performed in May/June 2013 from which the Flood Emergency Response Assessment Technical Memorandum found in Appendix D was developed. Information generated by the field survey was provided to local stakeholders for review and subsequent modification and enhancement as appropriate through RFMP workshops and meetings.

4.2 Background

Initial emergency response to disaster events in California is the responsibility of local government entities (i.e., counties, cities, special districts) and, in some cases, locally-based State agencies (e.g., California Highway Patrol). These local entities provide emergency response within their jurisdiction which is defined by geography and specific mandated response functions. Due to this jurisdiction, local entities and locally-based State agencies retain command of all subsequent emergency response and recovery activities occurring within that jurisdiction. The National Incident Management System (NIMS) and the Standardized Emergency Management System (SEMS) require that agencies use the Incident Command System (ICS) to manage their response. Where a disaster event extends across multiple different jurisdictions, by geography or function, the Incident Command System recommends that a Unified Command be established but does not require it.

Counties and many cities also maintain a specialized "emergency management" function within their organization. This emergency management function is responsible for coordinating the response of the departments of the jurisdiction, assisting those internal departments with disaster readiness activities, and providing executive management control of the overall response. The emergency management organizations performing this function generally prepare and maintain an emergency operations plan (EOP) which describes how the disaster management function will be conducted. Annexes to this EOP provide plans/procedures of the jurisdiction's departments where they exist.

Counties also administer the "operational area" organization, which is a special purpose organization established by State law composed of all local public jurisdictions within the county. The purpose of this multi-agency organization is to manage response resources and information within the County political boundaries. This special purpose operational area organization provides a key communications and coordination link between local agencies as well as between those agencies and the State.

Except for those locally-based State agencies which have initial emergency response responsibilities and therefore a local incident command role, State agencies provide resources and support to the responsible local agencies at their request. These resources are acquired under protocols laid out in mutual aid systems and the SEMS. The Governor's Office of Emergency Services (Cal OES) is responsible for the coordination of this State response in support of impacted local agencies, and for assisting State agencies to maintain a readiness to provide such emergency support. However, Cal OES does not play a role in the disaster command structure managing the response in the field. The FEMA, which coordinates the response of federal agencies at requests for resources or support from the State, also does not have a role in the local command structure managing response activities.

Local agencies having this "incident command" authority are responsible for maintaining a readiness to meet their responsibilities for a disaster occurring within their jurisdictional boundaries using the protocols of the NIMS and SEMS. Such readiness may take the form of developing a pre-planned NIMS response organization for response to specific disaster agents, preparing written plans or protocols, conducting training and exercise programs, and the acquisition of specialized equipment, supplies, and facilities. Whether an existing plan or training program is adequate or otherwise of an acceptable nature is subjective. Statutes only provide readiness mandates of a general nature and federal and State guidance does not provide a methodology for determining whether any particular response activity can be performed to a sufficient level by a jurisdiction. Therefore, any assessment of a local agency's "readiness" is dependent to a large degree on a subjective evaluation based on one or more "readiness indicators" (e.g., existence of a written plan or conduct of an exercise) that can be reviewed and assessed.

4.3 Flood Response

4.3.1 Flood Response Roles

Flood Emergency Response Structure

There are two key separate components of flood response; levee flood fight operations and general public safety operations. These components must be evaluated separately because each is conducted by a different group of jurisdictions/agencies and each component has very different response issues and challenges. Levee flood fight operations include emergency activities aimed at preventing failure of a levee during a flood or containing flood waters in the event of a levee does fail. Such activities include levee patrol,

basic remedial actions involving the placement of sandbags and plastic visquine, and the acquisition of private vendors or bulk materials for more substantive remedial actions on a levee such as making a relief cut. General public safety operations include response activities such as public warning, evacuation, rescue, fire suppression, and recovery that are normally conducted in the area protected by a levee by traditional law and fire agencies.

Reclamation districts (RDs), where they exist, have jurisdiction for performing levee flood fight operations as a concomitant of their day-to-day levee maintenance responsibility, which is established in the Operation & Maintenance (O&M) Manuals, the Supplements, and Authorization and Assurance Agreements with the State and the USACE. Among local jurisdictions in the Mid San Joaquin River planning area, only the City of Modesto and some fire agencies are known to have participated in some way in levee flood fight operations. In regard to the other response component, public safety operations, fire agencies provide fire suppression and rescue and law agencies provide traffic control and security functions. Public warning and evacuation activities may be shared by multiple agencies depending on a jurisdiction's response plans. Overall, public safety operations within an area protected by a levee are performed by the local county or city agency, special purpose district (e.g., fire district), or community-based organization that has jurisdiction within that area.

The Mid SJR Region includes nine RDs where these two separate response components exist and must be conducted together in a coordinated manner. **Table 4-1, Mid SJR Region Reclamation Districts,** shows the approximate size, status, land uses, and assets of each of these districts along with the local agencies responsible for performing the public safety operations component within the area protected by that district's levee.

Table 4-1

Mid SJR Region Reclamation Districts

RDs	Size (acres) Levees	Primary Land Use	Critical Public Assets	Status of District	Public Safety Agencies*
1602	3,500 acres 6.29 miles	Agriculture	Westside Properties Rental Units	Active	Sheriff WSCFPD
2031	10,000 acres 13.19 miles	Agriculture	Highway 132 PG&E Pipeline Hetch Hetchy Aquaduct	Inactive	Sheriff's Dept; SFPD WAFPD CHP
2063	10,000 acres 10.63 miles	Agriculture	Crows Landing Road Bridge	Active	Sheriff MVFPD
2091	7,000 acres 7.92 miles	Agriculture	Modesto Waste Water Treatment Plant; Gomes Lake Drainage System; West Main Street bridge	Active	Sheriff MVFPD WPFPD
2092	2,000 acres 3.76 miles	Agriculture Habitat	N/A	Active	Sheriff WPFPD
2099	2.32 miles	Habitat	N/A	Inactive; removed levees from system	Sheriff WSCFPD
2100	2.70 miles	Habitat	N/A	Inactive; removed levees from system	Sheriff WSCFPD
2101	2,000 acres 3.51 miles	Agriculture	Highway 132	Active	Sheriff WSCFPD
2102		Habitat	N/A	Inactive; removed levees from system	Sheriff WSCFPD

Agency Abbreviations

CHP	California Highway Patrol		
MVFPD	Mountain View Fire Protection District	WAFPD	Woodland Avenue Fire Protection District
SFPD	Salida Fire Protection District	WPFPD	Westport Fire Protection District
Sheriff	Stanislaus County Sheriff's Department	WSCFPD	West Stanislaus County Fire Protection District

Coordination of Multi-Agency Response

Within the Mid SJR Region planning area, the Stanislaus County Office of Emergency Services (OES) Division is responsible for the day-to-day administration of Stanislaus County's disaster preparedness, mitigation, response, and recovery programs. OES also provides administrative support to the Stanislaus Operational Area Council and Stanislaus County Disaster Council. In a disaster, the Division is responsible for coordinating the response of County departments within the County's jurisdiction (i.e., the unincorporated area). OES, acting as the Stanislaus Operational Area, also coordinates information sharing and resource sharing among the separate jurisdictions (e.g., cities, districts) involved in the disaster. OES maintains emergency operations center facilities for the performance of these coordination activities.

The area protected by project levees in the Mid SJR Region planning area is completely within the unincorporated area of Stanislaus County. This fact makes flood response in the planning area a matter of coordinating the activities of 1) County public safety agencies (primarily the Sheriff's Department), and 2) special districts (e.g., fire and reclamation) with jurisdiction in the area. No incorporated city has jurisdiction to provide public safety services within an area protected by project levees.

The City of Modesto does own a critical facility and land located within RD 2091. Modesto, as a property owner within RD 2091, participates in the administration of that district as a trustee on the district's board. In addition, Modesto has a contractual arrangement with RD 2091 to provide assistance with levee flood fight operations. While the Cities of Newman and Patterson each own a critical facility vulnerable to possible flooding, these facilities are within the unincorporated area and the Sheriff's Department and the West Stanislaus County Rural Fire District would provide public safety functions at those facilities. Those Cities would remain responsible for managing and protecting their facility during a flood event.

The coordination of agencies conducting public safety operations in the field for any specific incident would be accomplished through 1) one or more established Unified Incident Commands and command posts, and 2) the Stanislaus County OES. No written pre-planned ICS organization or pre-planned unified command relationships are in place. These relationships would at this point be developed at the time of the emergency.

Mutual Aid

The California Master Mutual Aid Agreement was implemented in the 1950's to serve as a mechanism for separate California political jurisdictions to share resources in a disaster. The Agreement establishes a process for "no cost" borrowing of resources from other jurisdictions. The requesting jurisdiction does, however, provide for the maintenance of these outside resources while serving within the requesting jurisdiction. The Master Mutual Aid Agreement is based on the sharing of existing resources held in common (e.g., fire trucks, police officers). There are no provisions, requirements, or protocols in this Agreement for the direct expenditure of funds on the behalf of another jurisdiction to meet its responsibilities. In fact, FEMA public agency disaster assistance regulations discourage such expenditures.

Stanislaus County and its jurisdictions (i.e., cities and special districts) share resources in a disaster under the provisions of this Master Mutual Aid Agreement. No special or separate mutual aid agreement exists within the Stanislaus Operational Area. Since the Master Mutual Aid Agreement does not mandate or address the direct provision of funds to help meet another jurisdiction's responsibilities, Stanislaus Operational Area jurisdictions are not required to assist a RD to meet its function of preventing a levee failure, or physically containing a flood, with direct expenditures. Stanislaus County, the City of Modesto, and fire agencies in the area indicate that they have no explicit policy regarding providing assistance to RDs, financial or otherwise.

U.S. Army Corps of Engineers and PL 84-99 Programs

USACE plays a unique role in flood response that must be clearly recognized in any planning effort to improve local response capabilities. Most levees forming the SPFC were constructed through federal flood management programs. USACE supervised the construction of such levees and upon completion of each project the responsibility for its maintenance was turned over to a local maintaining agency under written agreement. These agreements included an obligation to operate and maintain the project according to O&M manuals developed by USACE as well as provide assurances and other commitments. This federal obligation originating in the generally distant beginnings of the current levee system has played a central and critical role in subsequent flood emergency response.

O&M Manual Flood Fight Components

USACE O&M Manuals issued at the time of project completion contain suggested methods of combating flood conditions. The LMAs obligation to conform to their respective O&M manuals means that this information must be referenced when current flood safety plans are developed. However, some of this information is no longer current with modern response systems. Thus, while LMAs should ensure that flood safety plans are consistent with their O&M Manuals, they should develop their plans with the current operational area response system and protocols in mind. LMAs should note where flood response protocols must deviate from out-of-date suggestions in their O&M Manual. This information can then be forwarded to USACE as an addendum to the manual. This will ensure that flood fight operations are conducted in a manner consistent with current response systems as well as the O&M manuals. This action should occur concurrently with coordination with USACE for integration of federal resources into flood fight operational protocols. USACE involvement in flood fight under PL 84-99 authorities will continue despite federal action to remove LMAs from PL 84-99 levee rehabilitation support and flood safety plans will need to address this involvement while maintaining O&M manuals as an active and critical part of flood response.

PL84-99 Levee Rehabilitation

A long standing role of USACE in flood emergency response was rehabilitation of damaged levees after a flood under PL 84-99 authority. Historically, there has been a strong dependence on the federal funding under this program to perform expensive re-construction of levee breaches and other levee rehabilitation actions. With the exception of RD 2092 (Active status) and RD 2091 (Partial Inactive status), the remaining LMAs in the Mid SJR Region are not currently active under PL 84-99; if they remain inactive, these LMAs will not be eligible to receive repair funding after the next flood event. Ineligibility for such assistance has wide-ranging consequences for the future of flood management in California and how levee maintenance will be funded and structured in the future will need to be determined.

It is clear that the ability of the LMAs in the Mid SJR Region, with the possible exception of RD 2031, to repair levee breaches, or perform extensive repairs to levees damaged by impounded flood waters, is questionable. RD 2031 is the exception due to the corporate nature of land ownership within that district which allows landowners to bring considerable financial support to bear outside of the normal special district assessment process. However, RD 2031 is currently inactive with no board of trustees or fundraising abilities, and depending solely on the landowners for its financial capacity is not reliable. Other districts in the Mid San Joaquin River Region would have insufficient funds to undertake such massive construction projects and little ability through current special district assessment processes to generate the needed funds. Experience has also shown that districts suffering a breach and subsequent flooding have found it nearly impossible to obtain loans from banks or other financial institutions to generate cash flow for immediate action.

Absent this critical historic USACE assistance, the rehabilitation of the flood management system after a flood is unknown. If the LMAs cannot act promptly, then areas will remain flooded for longer periods and remain vulnerable to flooding from minor events for longer periods. This will further degrade the ability of the LMA to finance any rehabilitation of the system to its prior condition.

In this situation, the question becomes whether the next level of government, cities and county, with assets impacted by the flood waters would act to perform levee rehabilitation. It has been noted elsewhere in this chapter how the involvement of these entities in levee flood fight has been greatly hindered by the jurisdictional barrier created by the formation of special districts for flood management in the past. This jurisdictional barrier clearly also serves as a hindrance to action by those local entities to system rehabilitation. Motivation to act by a city or county would be entirely dependent on that organization's perception of the level of importance of regaining use of any of its infrastructure impacted by the flood waters.

If city or county government fails to act, it would fall to the State, in particular to DWR, to act to repair breaches and other levee damages. The lack of a standing emergency fund for such purposes at the State level means that such action would require a political decision at the time of the event. There is no clear pre-event policy addressing this issue in place at the State level as there is no clear pre-event policy at the city or county levels. There is no ready source of funds at the LMA, local or State level in place to replace this historic federal assistance because there is no clear policy as to how this change in federal policy will be addressed.

Some possible options available to address the loss of PL 84-99 funding includes joint discussions to define a new structure for rehabilitating levee systems carried out by local and State agencies. This will involve either strengthening the LMA's ability to perform this work or identifying new roles for other local and State agencies in system rehabilitation. Once a conceptual policy is in place then funding sources can be identified. The SB27 Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force report issued by the Governor in 2011 identified the need for a substantial emergency fund to be created to ensure adequate cash flow for expensive levee flood fight operations in an emergency. The role of such an emergency fund to provide cash flow for the rehabilitation of the system after a flood could be added to the discussions concerning implementation of a new local/State structure for meeting this essential flood management activity.

4.3.2 Emergency Response Readiness

Analysis of Residual Risk

Project levees were constructed in the Mid SJR Region to prevent damage from a flood of a specified magnitude. Since one or more of the levees may not perform this function in the future due to a design, construction, or maintenance flaw, there is a "residual risk" that flood waters at, or below, design criteria will degrade and fail the levee. In addition, because levees are designed to control floods of a specified magnitude there is also a "residual risk" to the protected area that a flood exceeding the design criteria of the levee will occur and either overtop or otherwise fail the levee.

This residual risk is addressed by developing the capacity to 1) effectively respond to the appearance of a flaw in a levee to prevent complete failure, 2) effectively respond to physically limit the extent, depth, or duration of floodwaters if a levee fails, 3) remove people and property from the area subject to flooding, and 4) provide additional physical protection to specific assets in place that cannot be removed. The level of organizational, resource, and procedural capacity needed to perform these actions depends, in part, on the potential response complexity of an area (for example, it is generally a more complex matter to evacuate an urban area than a rural area).

In regard to emergency response, the capacity needed to adequately address this residual risk would be partially dependent on the relative difficulty of performing the protective actions listed above. In this regard, the planning area project levees and surrounding area do not present any special problems for the conduct of flood fight operations. No special circumstances or conditions exist that would prevent application of standard flood fight techniques where needed. In general, the complexity of performing evacuation to remove people and property from an area subject to flooding is less than for many areas of the Central Valley due to its rural nature. Even those urban areas subject to flooding in the vicinity of the San Joaquin River are only exposed to shallow flooding reducing the complexity of conducting effective removal operations. These sparse populations, limited numbers of critical infrastructure sites, or shallow flooding impacts lower the need for highly complex response plans (e.g., detailed evacuation routing). As noted in the Technical Memorandum in Appendix D, two exceptions to this are evacuation of dairies and presence of hazardous materials, which justify relatively more complex response procedures and special equipment to ensure proper warning and assistance is provided to affected residents.

Flood Fight Readiness

Determining whether an existing response capacity is adequate is highly subjective. For a short-term study some simple indicators, as shown below in **Table 4-2**, **Indicators in Flood Fight Readiness**, must be used to merely provide an impression of the degree of attention that jurisdictions are applying to preparing to respond to a flood. In regard to flood fight capacity such simple indicators are the existence of 1) written levee flood fight plans or flood-specific plans for supporting agencies, 2) trained personnel to perform levee patrol and basic remedial actions (sandbagging, etc), 3) written and unambiguous flood fight command and control protocols, and 4) stockpiles of materials or budgeted funds for emergency response. Simple indicators of the capacity of the Stanislaus Operational Area (all jurisdictions of the County) to rapidly and effectively support RD flood fight operations would be the existence of 1) flood

fight stockpiles maintained by entities other than RDs, 2) flood specific mutual aid procedures, 3) clear and unambiguous policy commitments for providing personnel and funds to RDs, and 4) regular joint exercises with RDs.

Table 4-2

Indicators of Flood Fight Readiness

Agency	Flood Fight Plan or Procedures Specific to Helping w/ Flood Fight	Clear Flood Fight Command Protocols	On-Hand Resources: Materials, Trained Crews, Emergency Fund (EF)	Clear Flood Fight Mutual Aid Policy for Providing Materials, Personnel or Funds to RDs	Regular Flood Fight Exercises: Internal, Multi-Agency
RD 1602	No	Patterson Westside Farms provides leadership; No NIMS training	Stockpile - Yes Crews – limited no. of volunteers only EF - No	No	No
RD 2031	No	Landowners supervise their own operations; No District command nor NIMS training	Stockpile – Yes Crews – Hired hands only EF - No	No	No
RD 2063	No	District President provides leadership; No NIMS training	Stockpile – Yes Crews – volunteers only EF - Yes	No	No
RD 2091	No	Unclear command for Project Levee; Unclear command for Gomes Lake Dike	Stockpiles - No Crews – Yes, City of Modesto provides trained crews under contract EF - Yes	No	No
RD 2092	No	Landowner provides leadership but relies on an advisor shared with RD2031; no NIMS training	Stockpiles – No Crews – No EF – No	No	No
RD 2099/ 2100/2102	N/A	N/A	N/A	N/A	N/A
RD 2101	No	District President provides leadership; No NIMS training	Stockpile – Yes Crews – relies on family or emergency hires ER – No	No	No
County of Stanislaus	No	N/A	Stockpile – for General Public only Crews – No EF – No	No	No
City of Modesto	No	Shares response with RD 2091 but unclear how incident command would be established	Stockpile – No Crews – WWTP staff trained annually EF – No	No	No
City of Newman	Some flood specific SOPs for response at WWTP	PW provides leadership at WWTP; no NIMS training	Stockpile – No Crews – No EF – No	No	No
City of Patterson	No	PW provides leadership at WWTP; no NIMS training	Stockpile – No Crews – No EF – No	No	No
CHP	No	N/A	Stockpile – No Crews – No EF – No	No	No
MVFPD	No	No	Stockpile – No Crews – No EF – No	No	No

Table 4-2 (Continued)

Indicators of Flood Fight Readiness

Agency	Flood Fight Plan or Procedures Specific to Helping w/ Flood Fight	Clear Flood Fight Command Protocols	On-Hand Resources: Materials, Trained Crews, Emergency Fund (EF)	Clear Flood Fight Mutual Aid Policy for Providing Materials, Personnel or Funds to RDs	Regular Flood Fight Exercises: Internal, Multi-Agency
SFPD	No	No	Stockpile – No Crews – No EF – No	No	No
Sheriff	No	No	Stockpile – No Crews – No EF – No	No	No
WAFPD	No	No	Stockpile – No Crews – No EF – No	No	No
WPFPD	No	No	Stockpile – No Crews – No EF – No	Has responded to look at levee at request of citizen; no training	No
WSCFPD	No	No	Stockpile – No Crews – No EF – No	Has responded to look at levee at request of citizen; no training	No

Agency Abbreviations

CHP	California Highway Patrol
MVFPD	Mountain View Fire Protection District
SFPD	Salida Fire Protection District
Sheriff	Stanislaus County Sheriff's Department
WAFPD	Woodland Avenue Fire Protection District
WPFPD	Westport Fire Protection District
WSCFPD	West Stanislaus County Fire Protection District

General Assessment of the Readiness to Conduct Flood Fight Operations

A review of the capacity indicators above indicates that the readiness of the Stanislaus Operational Area jurisdictions to conduct effective flood fight operations is below optimal. RDs have no written plans for conducting flood fight operations that would make key information and procedures readily available to responders. While there is clear leadership within many districts for organizing and conducting flood fight operations, none of the personnel who were identified as potential managers of such operations have ICS/NIMS training. Leadership would, therefore, be competent but would lack the ability to apply ICS/NIMS concepts to agency coordination and mutual aid.

Stanislaus Operational Area agencies other than RDs do not maintain stockpiles of flood fight materials, do not have clear policies in regard to providing support to RDs, and do not maintained staff to assist with levee patrol. The only exception is the City of Modesto which does provide flood fight assistance to RD 2091 under contract. While there is no committed budget, the City and RD 2091 agree that in the event of a declared emergency, or in the event that both parties agree, the City will take appropriate defensive action within its financial means to stabilize, protect and rebuild the levee to prevent losses to the City and RD 2091, while insuring public safety and well-being in order to protect the City's WWTP. WWTP staff would perform the necessary duties. In regard to the provision of funds to prevent levee failure, the City of Modesto and Stanislaus County would only say that that policy issue would be decided at the time of the emergency.

Finally, RDs and those jurisdictions which would, or could conceivably, provide flood fight assistance do not conduct regular exercises to identify gaps in the development of an optimal response capability. These factors, the existence of a normal level of residual risk, and a review of best practices available in the Central Valley would justify the evaluation that the Mid SJR Region planning area's capacity to address residual risk through flood fight operations is well below optimal.

Public Safety Operations Readiness

In regard to public safety operations within the area protected by a project levee, some simple indicators of response capacity, as shown below in **Table 4-3**, **Level of Public Safety Operations Readiness**, would be the existence of 1) general response plans, 2) flood specific response plans and/or training programs, 3) general Incident Command System/National Incident Management System (NIMS) training programs, and 4) written protocols for establishing multi-agency command and control in the floodplain. Indicators of the capacity of the Stanislaus Operational Area to rapidly and effectively apply resources to assist with the removal of people and property from threatened areas would be existence of 1) resources/equipment for conducting warning, evacuation, and rescue operations and 2) clear law, fire, and EMS mutual aid procedures.

Table 4-3

Level of Public Safety Operations Readiness

Agency	Written Emergency Response Plan (General and/or Flood Specific)	Training and Frequency (ICS/NIMS; Flood Response Specific)	Command and Control Protocols for Flood Operations	Resources/Equipment Available/Suitable for Floodplain Warning, Evacuation, Rescue, etc.	Written Mutual Aid Procedures for Law, Fire, EMS
Stanislaus County	Standard EOP only No Flood Specific Plans	ICS/NIMS - Yes FF specific – No	No	Yes	Yes
City of Modesto	Standard EOP only No Flood Specific Plans	ICS/NIMS – Yes, within Fire/Law FF specific – Yes, WWTP staff receive FF training and NIMS training	No	Yes	Yes
City of Newman	Standard EOP only Some Flood SOPs for their WWTP	ICS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
City of Patterson	Standard EOP only No Flood Specific Plans	ICS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
City of Turlock	Standard EOP only No Flood Specific Plans	ICS/NIMS – Fire and Law FF Specific – No	No	Yes	Yes
MVFPD	None	ICS/NIMS – Yes Flood Specific – No	No	Yes	Yes
SFPD	None	ICS/NIMS – Yes Flood Specific - No	No	Yes	Yes
WAFPD	None	ICS/NIMS – Yes Flood specific – No	No	Yes	Yes
WPFPD	None	ICS/NIMS – Yes Flood specific – No	No	Yes	Yes
WSCFPD	None	ICS/NIMS – Yes Flood specific – No	No	Yes	Yes

Agency Abbreviations

CHP	California Highway Patrol
MVFPD	Mountain View Fire Protection District
SFPD	Salida Fire Protection District
Sheriff	Stanislaus County Sheriff's Department
WAFPD	Woodland Avenue Fire Protection District
WPFPD	Westport Fire Protection District
WSCFPD	West Stanislaus County Fire Protection District

General Assessment of Readiness to Conduct Public Safety Operations

A review of the capacity indicators above indicate that the readiness of the Stanislaus Operational Area jurisdictions to conduct effective public safety operations in the floodplain are adequate but below optimal based on a review of best practices in the Central Valley. Jurisdictions maintain normal general emergency operations plans and conduct general ICS/NIMS training. There are the normal established fire and law mutual aid systems and specialized equipment for command and control is available. However, specific plans for response in the floodplain do not exist and no flood response specific training is provided to responders. The exception would be City of Modesto WWTP staff who receives flood fight training. However, this is for flood fight operations and not necessarily evacuation or rescue operations.

Written plans for conducting more complex elements of public safety operations in a floodplain (e.g., evacuation of dairies and hazardous materials) were not identified. Specific, written, protocols for establishing command and control in the floodplain during flood events were also not identified. Finally facility-specific written plans for removing or protecting in place critical infrastructure components were not identified.

The existence of normal emergency plans, ICS/NIMS training, and specialized equipment indicate a normal competency to conduct public safety operations in the floodplain if needed. This competency, coupled with the less complex nature of the evacuation/rescue/security problem in the floodplain, would indicate normal and adequate response capacity. However, the lack of flood specific plans and training, as well as the lack of written plans for more complex rural evacuation issues, would indicate that the Mid SJR Region planning area's flood response capacity for public safety operations is less optimal than it could be.

Gaps and Overlaps

Written emergency plans that do exist in the Mid SJR Region are general in nature and prepared by each jurisdiction to describe how they will conduct their own operations within their own jurisdictional boundaries. Although an Operational Area Council was identified, there are no procedures specific to the operation of the Stanislaus multi-agency Operational Area organization. The lack of flood response specific procedures or plans precludes the existence of overlaps. The lack of specific written command or response protocols specifically for response in the area protected by project levees makes it impossible to evaluate whether any other assumptions exist within jurisdictions about command or coordination that would conflict with each other.

The readiness analysis performed above indicate that four key general gaps exist in the Mid SJR Region planning area's capacity to address all flood response issues in an optimal manner.

- Lack of written levee flood fight plans or floodplain-specific procedures within each jurisdiction's emergency operations plans. This is a key planning deficiency for RD 2091/RD 2063 where there are numerous critical assets.
- Ambiguity in identifying who is in command of flood fight operations. In those cases where command is identified, there is a lack of ICS/NIMS training.
- Lack of clear and unambiguous policies by operational area jurisdictions in regard to providing mutual aid of personnel, resources/materials, and funds to support levee flood fight operations.
- Lack of joint exercises to identify response gaps and improvement opportunities.

Specific response issues relating to these four general gap categories are discussed below.

4.3.3 Funding and Commitment

There are two RDs that were identified as having a standing emergency fund to support flood fight efforts. Other districts indicated that assistance, funds or in-kind help, would be solicited from property owners in the district at the time of the emergency. The limited financial situation of RDs makes their ability to respond to flood emergencies difficult.

No other jurisdictions in the Stanislaus Operational Area maintain a designated and budgeted emergency fund for responding to emergencies. Jurisdictions would clearly be dependent on their internal general fund reserves or contingency fund to meet extraordinary costs of meeting their direct emergency response mandates. Whether a jurisdiction's general fund could deal with the extraordinary costs of responding to a disaster would be dependent on the size of the disaster and magnitude of its impact.

Use of a jurisdiction's internal general fund to assist the RDs with levee flood fight operations is not required by existing mutual aid agreements or any statute. Such expenditure of jurisdictional tax dollars in another jurisdiction has legal barriers and issues with FEMA disaster assistance regulations that would best be addressed with a written flood-specific mutual aid protocol. Such a protocol does not exist in the Mid SJR Region.

Examination of the general funds of Stanislaus Operational Area jurisdictions would not be productive with absence of a clear commitment or protocol for providing direct expenditure on behalf of another jurisdiction. No jurisdiction in the Stanislaus Operational Area has made a clear commitment to assist with funding the levee flood fight responsibilities of the RDs.

Two rural fire districts do have a history of responding to look at a levee status at the request of residents. They did not interact with the RD and did not provide on-going patrol or other assistance. The City of Modesto has a contractual arrangement with RD 2091 to provide levee patrol and basic flood fight response to levee problems. While there is no committed budget, the City and RD 2091 agree that in and event of a declared emergency, or in the event that both parties agree, the City will take appropriate defensive action within its financial means to stabilize, protect and rebuild the levee to prevent losses to the City and RD 2091, while insuring public safety and well-being in order to protect the City's Wastewater Treatment Plant. This contractual arrangement is unclear as to the specific limitations of such assistance and does not have clear provisions for providing emergency financial assistance. The City of Modesto representative indicated that the City would have to evaluate whether it would provide such assistance at the time. **Without a clear commitment to provide financial assistance, and without a designated budgeted emergency fund, it is difficult to evaluate the capacity of the jurisdictions to assist with flood fight operations.**

4.4 Response Issues

The following issues associated with emergency response planning for the Mid SJR Region have been identified:

- **Interaction with RDs.** Stanislaus OES indicated that they often lack good contacts with the RDs. There has been some friction in the interaction of the County with the districts in regard to proclaiming emergencies and the process for requesting assistance with flood fight operations. This appeared to be mainly an issue of clarification of the process of coordination between these separate jurisdictions for flood fight assistance and activation of emergency authorities and powers.

- **LMA Responsibilities.** While it is clear that a levee maintaining agency is responsible for maintaining its levee and repairing any damage that may be caused by a flood, it is less clear whether an LMA is directly responsible for 1) removing impounded flood waters resulting from a breach, and 2) taking action to limit damage if flood waters originating within their jurisdiction leaves their jurisdiction. General experience is that LMAs assist with removing impounded flood waters to some extent within their financial resources but do not cross jurisdictional boundaries to flood fight flood waters leaving their jurisdiction.

- **Evacuation Planning.** Written evacuation plans for areas protected by project levees were not identified and no written plans for assisting property owners with the evacuation of dairies and removal of hazardous materials stored at farm operations were identified. The County did not identify a specific role for its departments in the conduct of dairy evacuation or hazardous materials removal. The rural nature of the Mid SJR Region simplifies the problems of warning, evacuation, and rescue for people but it elevates the importance of other evacuation and recovery issues unique to agricultural areas such as evacuation of dairies, removal of hazardous materials prior to the arrival of flood waters, and debris removal after the departure of flood waters.

- **Flood Fight Materials and Mutual Aid.** No jurisdiction outside of RDs was identified that maintains stockpiles of materials specifically for supporting levee flood fight operations. There is no specific process for RDs to request mutual aid.

- **Flood Fight Operations Training.** No jurisdiction was identified that conducts regular flood-specific training or provide DWR flood fight classes to its employees.

- **Debris Removal.** County Public Works recognizes a function with debris removal from County roads. FEMA will allow the County to assist with removal of debris from private property that did not originate from the property owner's possessions or land. The County would need to accept that role and develop a written debris removal plan with criteria for ensuring that debris removed by the County meets eligibility rules. The County does not have such a plan at this time.

- **Hazardous Materials.** No written plan for organizing the removal of hazardous waste from a flooded area was identified.

- **Cost Recovery.** None of the emergency responders have cost recovery documentation policies in place.

- **Life Safety.** The Crows Landing Road and the Las Palmas Avenue bridges are needed in the event of an emergency because they carry most local traffic across the San Joaquin River. The loss of either bridge would require a one hour detour to reach the other side of the River. Since all hospital facilities are on the east side of the San Joaquin River the ability to use these bridges becomes critical to the safety of residents on the west side of the County. Loss of Highway 132 would exacerbate this problem and resultant delays in moving sick or injured people to appropriate care.

4.5 Opportunities

Despite the issues identified for emergency response planning in the Mid SJR Region, there are many opportunities for the region to improve emergency response, as discussed below.

4.5.1 Standard Local Flood Response Plan Templates

The issuance of two grants by DWR for local flood emergency response projects has stimulated discussion on the need for local tactical flood response plans and the proper format for such plans. DWR grant guidance indicates that completion of such plans is a prerequisite to obtaining funds for other response

items such as supplies or communications. The recent addition of Water Code Section 9650 (AB156) which requires the preparation of "flood safety plans" also has highlighted the need for a standard and acceptable template for such local tactical flood response plans.

Such plans would have a levee flood fight component and a public safety warning/evacuation/rescue component. San Joaquin County has over the past decade developed a local tactical flood response plan (called a flood safety plan within Section 9650) template using a mapping format and addressing both components. The maps and procedures developed under this concept display flood emergency response information, plans, and protocols in a user friendly format. FEMA subsequently provided funds for the development of guides for implementing a similar program. In 2012, San Joaquin County adapted this concept to fully conform to the requirements of Water Code Section 9650.

During the summer of 2013, local tactical flood response plans (or flood safety plans) in line with this latest standard were completed for two San Joaquin County RDs and submitted to DWR and the CVFPB for review. Subsequently, DWR indicated that this format met Section 9650 requirements and that the Department considered this format the preferred methodology for completing local tactical flood response plans required by their grant guidance.

This situation provides an opportunity for the Mid San Joaquin River Planning Area to more rapidly complete local tactical flood planning project since clear, detailed, and tested methodology is now approved by the State

4.5.2 Funding Opportunities

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. Stanislaus County jurisdictions were eligible for applying for the statewide grant but did not submit an application. However, DWR has indicated that it is identifying funds for a second round of these grants that could occur in 2014. Funds for a second round of the Delta-specific grant have already been identified which provides some assurance that a second round of the statewide grant will also be forthcoming.

This situation provides a possible opportunity for the Mid San Joaquin River Region to apply for grant funding to begin to implement emergency response and preparedness projects identified and in the regional flood management plan process. This potential funding opportunity should be integrated into the final plan and the funding needs for specific projects identified within the RFMP so that jurisdictions are prepared to submit a joint, well-planned, application. It should be noted that several RDs lack the institutional capacity to secure grant funding at this time.

4.5.3 Joint Planning and Plan Maintenance Mechanisms

The Mid SJR Region RFMP process provides an opportunity for local jurisdictions to develop mechanisms and procedures for future joint flood emergency response planning and maintenance activities. Procedures and protocols used to jointly develop the regional plan should be adjusted for use after the completion of this project to perform joint planning or to jointly seek funding.

4.5.4 Conversion to Flood-Compatible Uses

The Mid SJR Region RFMP process provides an opportunity for local jurisdictions to consider converting existing uses to flood-compatible ones within floodplains. Flood-compatible uses can include areas used for certain habitat or agriculture. With fewer people and less-at-risk property in these flood prone areas, there would be a reduced need for emergency response. Projects such as Three Amigos that would restore habitat and convert existing uses to flood detention are good examples of projects of this type.

4.6 General Findings

This section describes the findings for public safety operations, flood fight operations, and overall emergency response preparedness.

4.6.1 Public Safety Operations

While they are obviously important, public safety operations within the planning area do not face highly complex or extensive issues such as those found in heavily urbanized areas in deep flood zones. The shallow nature of potential flooding in the more urban areas of Patterson and Newman cause considerable damage but again are not a highly complex organizational response challenge. Development of extensive pre-plans for conducting resident warning, evacuation, or rescue would, in general, not be a priority for the planning area if resources are limited. There are currently no written response plans specific to the planning area.

However, there are two issues regarding public safety operations that should be examined more closely for possible action. First, the structure of field command and control in regard to flood fight operations and public safety operations, as well as the manner of their interaction, was unclear in some districts and not clearly documented in any. Second, the area does present the potential problem of evacuation of dairies and bulk hazardous materials from rural sites and debris removal following a flood. These more complex organizational issues should be examined more closely for potential action.

4.6.2 Flood Fight Operations

The presence of considerable private property, vital bridges and roads, and substantial infrastructure critical to public safety and health focuses attention on the quality of flood fight operations in the planning area. Effective and rapid action to prevent a levee breach, or to limit the extent, depth, or duration of flood waters in the event of a breach, is the only method for minimizing possible long term adverse impacts from loss of this infrastructure. Flood fight operations in this case would include plans for rapid removal of equipment or components of facilities where possible to speed restoration of services.

Currently there are very knowledgeable and experienced people available to direct flood fight operations but little or no written flood fight plans reflecting this knowledge are in place. Flood fight operations are

organized at the time of the emergency and are mostly conducted informally. The command structure for conducting flood fight operations in some cases is unclear, or at least not documented.

Also, the financial situation of the RDs is relatively weak and could be a barrier to improvement actions and response. Grants or other sources of alternate funding should be explored to enhance RD response capabilities although several RDs lack the institutional capacity to secure grant funding at this time. Finally, processes for RDs to request mutual aid should be clearly defined and jurisdictions within the planning area need to at least discuss and better define their policies for supporting flood fight operations if requested. Improved coordination of RDs with the Stanislaus Operational Area organization to improve warning and information flow would also be helpful.

4.6.3 Overall Flood Emergency Response Preparedness

The Mid SJR Region planning area is at a point where initial detailed planning for future flood fight operations and concurrent public safety operations is needed and justified. Opportunities for accomplishing this planning in the near future are discussed below. However, a major problem in areas that have completed such detailed planning and training in the past is maintenance.

The long intervals between floods, and the other demands placed on the time of officials, makes maintenance of plans and training over the long intervals between major floods difficult. The consistent communication and cooperation that is a key element of joint planning tends to stop when initial resources run out and other demands on time become a constant distraction. Any major project to improve flood response in the Mid SJR Region should include a mechanism for ensuring proper maintenance of resulting improved plans and training programs created as a result of project implementation.

4.7 Specific Recommended Projects

Based on the findings made above, the following eight specific projects are recommended to improve flood emergency response planning in the Mid SJR Region and are described in more detail in Sections 4.7.1 through 4.7.8:

- Develop local levee flood flight plans or a joint coordinated flood fighting plan for related RDs;
- Perform key hydrological studies;
- Complete response plans for public safety agency functions;
- Clarify command and control;
- Provide emergency planning support for RDs;
- Better define mutual aid for flood fight operations;
- Develop a flood response training program; and
- Form a Stanislaus Operational Area Flood Response Working Group within the Stanislaus Operational Area organization.

It should be noted that three of the projects evaluated in this RFMP came from these recommendations: Emergency Response Plan – Debris Management, Emergency Response Plan – Local Planning and Training, and Hydraulic and Channel Migration Studies (see Chapter 7, Proposed Regional Improvements).

4.7.1 Local Levee Flood Fight Plans

In regard to flood fight operations, RDs and supporting agencies should develop local levee flood fight plans as part of an overall tactical flood safety plan as outlined by DWR. These flood fight plans would document 1) historic information and flood fight knowledge of current and past district responders; 2) current response procedures for levee flood fight; and 3) options for containing floods from a breach. RDs, as the local jurisdiction responsible, would prepare the plans with the assistance of other local jurisdictions. Flood fight plans should include provisions for flood fighting non-SPFC levees or embankments in the area that could provide protection but are not under the direct maintenance responsibility of a LMA or other agency.

The development of flood fight plans should also include identification of physical constraints to efficient response to levee problems. Areas where levee crowns or landside levee toe areas are inadequate to support potential needed response actions should be identified. Areas whose improvement would support more efficient flood fight response should also be identified. These structural improvements related specifically to flood response can then become a part of the LMA levee improvement plan.

A standard template for development of such levee flood fight plans (part of flood safety plans mandated by AB156 and also called tactical flood plans in DWR grant guidance) is emerging in the Central Valley that is supported by DWR and FEMA. This template uses a map format to display information complemented with a concise written RD emergency operations plan

4.7.2 Hydrological Studies

A key preliminary action to preparing the local flood fight plans in the Mid San Joaquin River region is completion of detailed topographic and hydrological studies for the area protected by RD 2091 and RD 2063. The characteristics of flood flows that would occur in the event of a breach in either district need to be identified. The RD 2091/RD 2063 area contains considerable critical infrastructure and is the most highly populated area protected directly by project levees. There is the potential that RD 2091 is dependent on the RD 2063 levees for protection as well as on its own levee system. A breach in RD 2091 could also possibly cause flood waters to back into RD 2063 to some extent. In order to ensure the best possible protection of critical infrastructure in RD 2091 (e.g., the Modesto wastewater treatment plant and Gomes Lake), studies to determine the degree of dependence of RD 2091 on the RD 2063 levees need to be completed. The characteristics of flood flows from RD 2063 into RD 2091, and vice versa, also needs to be thoroughly understood in order to identify practical containment options and an effective joint flood fight plan between districts. This study would include obtaining the current topography and elevations of the area from new sources as needed to supplement existing datasets.

Other hydrological studies needed would better define flood threats to the wastewater treatment plants of Newman and Patterson. These studies would confirm water elevations at which there is a significant threat to those facilities and the characteristics of flood water movement in the event 1) water elevations rise above the eastern boundary fence line at the Patterson plant, or 2) either the Newman Wastewater Treatment Plant flood management levee or Newman Wasteway embankment fails. This detailed

information would allow development of better trigger levels for actions to protect infrastructure and better plans for maintaining service if either of these events were to occur.

Completion of a channel meander analysis is also necessary for other areas of the Mid SJR Region to better identify future repair needs at specific locations.

Current and planned hydrological studies conducted by DWR under the CVFPP and other programs should be accessed initially for information relevant to the above issues. Any current relevant information generated by those state studies can be used as a starting point for additional needed work.

4.7.3 Response Plans for Public Safety Agency Functions

It is recommended that public safety agency evacuation plans be developed at a minimum for the area protected by RD 1602, RD 2063, and RD 2091. Evacuation procedures could be included on the respective flood safety plan, and should address rural evacuation of dairies and removal of bulk hazardous materials. All plans would provide clear command and control protocols and an emergency response command organization for conducting these operations. These plans and maps would be developed in cooperation with local law and fire agencies and the RDs.

Finally, Stanislaus County should develop a debris removal plan and policy. Preparation of such a written plan would assist with ensuring reimbursement for debris removal costs incurred by the County after a flood from the State and federal disaster assistance programs. Stanislaus County operates the local waste disposal system and has both jurisdiction and resources for operating a debris removal program. Ensuring eligibility for disaster financial assistance will allow the County to perform authorized debris removal without delay or uncertainty.

4.7.4 Command and Control

It is a high priority that local jurisdictions should clarify and document the command structure for areas threatened by flood waters. Command of levee flood fight operations and command of public safety operations should be clarified and defined in terms of ICS procedures. It is also important to clarify how separate flood fight commands and public safety agency commands will interact. These protocols could be included in the local tactical flood response plan (flood safety plan). In addition, RDs should adopt a formal mechanism for clearly designating a flood fight incident commander as part of their flood safety plans.

The ICS provides procedures and protocols for establishing a “unified command” among agencies and jurisdictions with responsibility for managing or responding to a flood event in the same geographical area. Pre-event discussion of a potential unified command structure for flood fight operations is particularly important. Identification of areas of the flood management system that are mutually dependent upon each other for protection will help determine which LMAs must work closely together in a common command. The role in such a unified command for State departmental Incident Command Teams that may arrive to assist should be worked out. Whether State agencies are merely providing advice, assuming a financial or jurisdictional responsibility for flood fight operations, or performing some other role will determine whether such outside resources will be part of the command or only a part of the operations or other function within the response. Review of the number of unified commands needed for maximum efficiency can also determine whether a pre-planned response by CalFIRE Incident Command Teams for helping with incident management is called for.

4.7.5 Emergency Planning Support for RD's

The limited financial resources and staffing of RDs makes development and maintenance of detailed and adequate levee flood fight plans difficult. There is also a lack of expertise within RDs for preparation of proper written emergency plans. The County of Stanislaus and City of Modesto should enter into an agreement with the RDs to provide administrative and professional support for the development and maintenance of district plans. A cost sharing arrangement could be developed within this agreement. Another option would be to have the RDs form a collective that works to develop flood-specific emergency response plans for the levees. The collective could interact directly with the cities and Stanislaus County.

4.7.6 Mutual Aid for Flood Fight Operations

Jurisdictions making up the Stanislaus Operational Area should develop an agreement or procedure outlining the specific process and characteristics for providing levee flood fight support and mutual aid to RDs. Potential support would include assistance with levee patrol, flood fight crews, and funds for the acquisition of private contractors and bulk materials. In particular, the provision of funds, or purchasing support, for acquisition of material from private vendors or bulk materials should be clearly defined. Total dependence on the State or federal governments for emergency funding of response to threats to levee integrity could lead to delays that result in levee failure. Local jurisdictions should identify circumstances in which they will intervene to support RD and non-RD entities response financially to protect their interests and the general public.

4.7.7 Flood Response Training Program

State and federal governments require that public agencies institutionalize the NIMS for management of disaster incidents. DWR has also issued standardized protocols for marking levee problems during levee patrols. A realistic training policy and program for RDs should be developed as part of the planning process to provide familiarization with NIMS procedures and flood fight protocols.

A comprehensive training program should include periodic and sustained joint exercises among agencies involved in flood fight and public safety operations to ensure a well-coordinated response, effective command and control, and familiarity among agencies that do not work together on a routine basis.

4.7.8 Operational Area Flood Response Working Group

The Stanislaus Operational Area should form a flood response working group within that organization composed of the RDs and public safety agencies with jurisdiction within the flood plain. This working group should be created through a written agreement or protocol that defines meeting frequency, objectives, and specific review items. This group could then ensure that flood response products developed in past preparedness projects are maintained. This process would also ensure that there is ongoing communication between jurisdictions and that new officials are properly briefed on current preparedness plans and their status.

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5. Operations & Maintenance

5.1 Introduction

The objective of this Operations and Maintenance (O&M) chapter of the RFMP is to provide an assessment of the Operation and Maintenance practices in the Mid San Joaquin River Region. This chapter includes background information on O&M, general findings, and recommendations for improving O&M in the region.

The content of this chapter is based on reviewing available information such as the Local Maintaining Agency Annual Reports for Levees of the State Plan of Flood Control and Inspection and Local Maintaining Agency Report to the Central Valley State-Federal Flood Protection System, as well as discussions with RD staff responsible for flood management system O&M. The Operations and Maintenance Assessment Technical Memorandum found in Appendix E was also developed from this information, and goes into more specific details of each RD. Information generated throughout the process was provided to local stakeholders for review and subsequent modification and enhancement as appropriate through RFMP workshops and meetings.

5.2 Background

Flood management facilities are subjected to natural forces that can reduce their effectiveness over time. O&M helps maintain the original design and reliability of flood management systems and involves activities including: routine inspections of flood management facilities, erosion control, vegetation removal, debris and sediment removal, and control of burrowing animals. Coupled with long-term flood risk reduction projects, O&M strengthens the structural integrity of the levee systems in the Region. O&M activities are typically performed by the Levee Maintaining Agency (LMA) responsible for specified segments of levee systems.

A common issue in the Mid SJR Region is that wave action and high water events cause erosion on the waterside of levees, thereby altering the levee geometry and reducing a levee's overall effectiveness.

LMAs work to mitigate these issues by placing rock on the waterside of the levee to reduce the erosive forces. To a lesser extent, slope grading/dragging can be done to repair minor depressions in the levee slopes.

Burrowing animals also threaten the structural integrity of levees in the Region. Burrowing rodents can create extensive networks of tunnels throughout levee systems, creating a path for water to get from the waterside to the landside of the levee. LMAs have employed measures such as grouting, baiting, and hunting to remove burrowing animals from their levees.

Additionally, thick vegetation on levees reduces the ability to visually inspect a levee. Therefore, LMAs trim/remove trees/shrubs and mow grass to meet guidelines established by USACE and DWR. It is noted that vegetation requirements differ between USACE and DWR. It should also be noted that USACE has recently moved to an interim vegetation policy while they review their current policies.

Levee O&M are paramount to keeping leveed systems in working order, so that they are reliable and provide an adequate level of protection. To ensure levees are being maintained correctly by the LMA's they are inspected by both the USACE and DWR.

5.3 General Findings

This section describes the O&M findings that apply to the whole region.

Most of the RDs in the Mid San Joaquin Region are rural districts which encompass agricultural land. Accordingly, there are limited or no assessments, which means that individual land owners fund and perform necessary levee maintenance. Typical maintenance activities for the RD's in the region include: vegetation management, rodent control, erosion control/repairs, crown maintenance, and slope dragging.

Vegetation and animal control were common issues that were noted in many of the DWR Levee Inspection Summaries for the RDs in the Region, which were also noted in discussions held with each RD. Discussions with RD staff and representatives indicated environmental permitting challenges and Endangered Species Act (ESA) constraints associated with O&M activities often puts districts in the middle of conflicting regulatory requirements. In these instances, RDs have to make the decision of whether to perform the required O&M and potentially be fined for violating ESA regulations, or perform limited O&M that complies with ESA requirements at the risk of failing regular inspections. Since RDs have limited financial resources as it is, the decision is often made to comply with ESA regulations and hope the limited O&M are sufficient.

However, failure to perform regular maintenance not only threatens financial support in the event of a disaster from the Public Law (PL) 84-99 program, but reduces the effectiveness of existing flood management facilities to perform during a flood event, thereby threatening the people and property behind these levees. Currently, RD 2092 is the only district in the Mid San Joaquin Region that is eligible for PL 84-99 disaster assistance. It should be noted that this district is in the process of seeking to eliminate O&M responsibilities and will permit flowage on previously protected lands within the District.

In addition to permitting challenges, many RDs cited differing vegetation criteria as outlined by DWR and USACE as a source of confusion and frustration. These differing criteria can often result in RDs receiving acceptable ratings on DWRs levee inspections, but unacceptable ratings on USACE (PL 84-99) inspections. This is problematic since two or more consecutive unacceptable ratings from USACE can jeopardize an LMA's eligibility in the PL 84-99 program, which provides levee rehabilitation assistance in the event of a disaster.

Furthermore, many LMAs noted they were comfortable funding minimal O&M responsibilities, but this level of O&M has been insufficient to meet State and Federal requirements. Given their limited financial resources, these Districts are not able to generate the capital needed to implement large-scale levee repairs. **Table 5-1, LMA Expenditures and Funding Sources**, below, summarizes the approximate annual O&M expenditures, and sources of funding for the LMAs in the Region.

Table 5-1
LMA Expenditures and Funding Sources

LMA	Approx. Levee Miles Maintained	Approx. Annual O&M Expenditures	O&M Funding Sources
RD 1602	6.29	$10,000 - $12,000	Individual Property Owners
RD 2031	13.19	$30,000	Individual Property Owners
RD 2063	10.63	$83,000	Assessments
RD 2091	7.89*	$40,000 - $50,000	Assessments
RD 2092	3.76	$10,000 - $12,000	Individual Property Owners
RD 2101	3.51	$25,000	Individual Property Owner
Gomes Lake	0.3	$14,000 - $35,000	Joint Powers Agreement, or JPA (TID, Stanislaus County, City of Turlock, RD 2091, RD 2063)

*0.3 miles are maintained by TID under the Gomes Lake JPA

Based on this information, funding of routine O&M appears sustainable. However, the annual expenditures cited above do not consider funding needs for large-scale repairs or addressing existing encroachments. DWR grant programs can help LMAs with these expenses, but financial resources of the LMAs are limited, making it difficult to meet the local cost-share requirements. Furthermore, LMA staff limitations, combined with the fact that district staff typically work and/or manage farms full-time, mean there is little time left to apply for this funding. It is also noted that some LMAs expressed an interest in pooling O&M equipment resources to help control O&M expenses. In the event that LMAs are unable to fulfill their maintenance obligations, DWR or the CVFPB is authorized to form a State Maintenance Area and take over LMA maintenance obligations and billing the LMA's property owners for the service. An LMA may request formation of a State Maintenance Area or seek to remove levees from the State Plan of Flood Control. To date, no State Maintenance Areas exist in the San Joaquin River Basin, though several exist in the Sacramento River Basin.

5.4 General Recommendations for Improving O&M

Based on the findings made above, the following recommendations to improve O&M in the Mid SJR Region and are described in more detail, below. It should be noted that two of the projects evaluated in this RFMP came from these recommendations: Consolidation of O&M and Regional Maintenance Technical Support (formulated from the recommendation to Develop a Technical Support and Education Program to Inform LMAs on Levee Maintenance Issues). In addition, one project concept to Develop

Expedited Permitting Programs for Maintenance Activities was formulated from the recommendation of implementing a Programmatic Environmental Analysis for O&M, as described below.

5.4.1 Programmatic Environmental Analysis for O&M

As previously discussed, O&M activities such as vegetation and rodent control can impact endangered species and habitat for these species. Reform of current permitting regulations may help RDs more effectively meet their O&M responsibilities, while complying with applicable regulations. A programmatic approach to permitting routine O&M responsibilities for SPFC facilities through the region, or the State, may help meet their O&M responsibilities while complying with applicable regulations.

5.4.2 Establish Consistent Levee Vegetation Standards

Maintenance and/or removal of vegetation along the levee is aimed at improving public safety, levee surface visibility, and levee accessibility. However, as noted in the previous section, it is common for an RD to receive an acceptable rating from DWR on vegetation management, but an unacceptable rating from USACE. RDs in the Region need DWR and USACE to agree on a common standard for levee vegetation management.

A brief summary of the differing 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 canopies extending into this zone must be trimmed 8-feet above the ground.

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 DWR's 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, while gradually progressing (over several decades) toward the current USACE policy of "eliminating woody vegetation from the vegetation free zone." The LCM approach allows for the preservation of riparian habitat as long as the vegetation does not impair visibility and accessibility. The crown must be kept free of all vegetation since it serves as a patrol road for levee maintenance.

DWR's 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.

Recently USACE has released its "Interim Policy for Determining Eligibility Status of Flood Risk Reduction Management Projects for the Rehabilitation Program Pursuant to PL 84-99" (March 2014). This document has set interim policies on levee vegetation management. Following this interim policy, levee systems will

no longer be removed from the PL 84-99 Program for vegetation issues alone while long term policies are set. This is a good short term solution until long term policies are set. These long term policies may be more in line with DWR guidelines.

Reconciling these two differing criteria will enable RDs to focus on a meeting a single vegetation standard for their levees. If this recommendation is combined with the programmatic approach to permitting routine O&M responsibilities for SPFC facilities as discussed previously, this would enable RDs to comply with permitting requirements while completing regular O&M responsibilities.

5.4.3 Streamline Grant Application Process and/or Support LMAs with Grant Applications

DWR has many grant programs available to assist LMAs with repairs and improvements to their levee systems, which is good since many RDs lack the financial resources to implement large-scale repairs/improvements. However, grant applications can take a significant amount of time to prepare, and technical expertise to complete. Limited RD staff resources mean that grants often go unapplied for, thus propagating system deficiencies.

RDs have expressed a desire to have DWR staff assist in the preparation of grant applications, especially for deficiencies identified by DWR. The RDs could review and have their respective Boards approve such applications, if necessary. This would help address critical erosion/seepage sites and other needed repairs identified by DWR.

As mentioned previously, RDs in the Mid San Joaquin Region have limited financial resources, making it difficult for these areas to meet the local cost-sharing requirements for State and Federal grant programs. Revisions to the State's local cost-sharing guidelines for projects that provide regional flood system benefits should be considered by DWR.

Finally, many of the RDs in the Region are not formally organized which prevents them from being able to enter into funding agreements with the State. A solution is needed to enable Districts to apply for State funding. For Districts where organization is infeasible, one possibility is agreements amongst several Districts to enter into funding agreements with DWR.

5.4.4 Consolidation of O&M

Large mowers and grout equipment used for vegetation and rodent control can be expensive, and are not used continuously. Therefore, an opportunity exists for RDs in the Region to pool their resources and share upfront and maintenance costs of operating one piece of machinery, rather than each RD having to own and operation their own mowers and grout equipment.

5.4.5 Develop Levee Maintenance Best Management Practice (BMP) Guidance

Development of a handbook of BMPs for levee management would help educate LMA staff and standardize O&M practices. The handbook would include guidance for all O&M challenges, including addressing burrows/burrowing animals, and managing vegetation consistent with both DWR and USACE standards (until one standard can be agreed upon).

It would describe methods (e.g., dragging chains, goat grazing, mechanical trimming) and include the pros and cons of each, so each LMA can choose what works best for their situation.

Encroachments (those in place, but lacking permitting documentation) could also be addressed within the handbook. If no such protocol exists this would be a natural place to develop it.

5.4.6 Develop a Technical Support and Education Program to Inform LMAs on Levee Maintenance Issues

This program would be a medium through which educational materials such as the BMP handbook described above could be disseminated. This would likely be done by a staff person who would meet in person with LMA staff and organize workshops to benefit multiple LMAs. This program could also be expanded to support LMAs in grant applications, but this expansion would most likely require local cost share from benefitted parties.

6. Land Use and Environmental Enhancements

6.1 Introduction

This chapter provides 1) information on the current and anticipated future relationship between land uses within the floodplain and flood risks within the Mid SJR Region's planning area; 2) identified desirable ecosystem enhancements within the region; and 3) linkages between potential flood management actions and ecosystem enhancement, including funding incentives. Additionally, this chapter provides a list of generic land use and environmental enhancement tools that might be employed to reduce flood risk, enhance ecosystem functions and services and/or habitat, or both. These generic tools may provide concepts worthy of development into potential individual regional improvements; they may also suggest environmental enhancements to potential flood management projects.

Sources for the information provided in this chapter include reports prepared by the Almond Board of California; California Department of Conservation (CDC); California Department of Water Resources (DWR); Central Valley Business Journal (CVBJ); University of California, Berkeley; Hoover, et al.; Krousky and Wells; Stanislaus County; Stanislaus County Agricultural Commissioner; and Stanislaus Council of Governments (STANCOG).

6.2 Past, Present, and Future Land Use

6.2.1 Historical Context

The Draft Environmental Impact Report (EIR) for the 2011 Stanislaus County Regional Transportation Plan includes a detailed description of the history of land use in Stanislaus County that was used to prepare the following discussion. The first Europeans to explore the planning area were Spaniards interested in the watercourses of the San Joaquin Valley. Stanislaus County is named for the Stanislaus River, first discovered by Spanish explorer Lieutenant Gabriel Moraga in 1806. After Mexico achieved independence from Spain in 1821, colonization of California progressed with numerous rancho lands granted by the Mexican governors. Most ranchos were located in the vicinity of missions, but there some ranchos that were located in the San Joaquin and Sacramento Valleys.

After the gold discovery of 1848, the population of California expanded exponentially. Early settlement patterns in Stanislaus County indicate that Gold Rush immigrants ignored valley lands and towns for the foothills of the Sierra Nevada. Communities of that early period, such as La Grange and Knight's Ferry, were predominantly mining camps that grew up along the Tuolumne and Stanislaus Rivers.

By the 1860s, larger and more permanent settlements sprouted along the Stanislaus River, including the towns of Oakdale, New Hope, Adamsville, and Paradise. Initially, wheat was the primary crop because it provided farmers with a source of income relatively quickly. Other cereal grains, such as barley and oats, were also common. Steamboats and small barges plying the San Joaquin River provided early transportation for freight and passengers. Hill's Ferry and Grayson became important shipping points for wheat during the 1860s. Numerous settlements were established on the San Joaquin, Stanislaus, and Tuolumne Rivers, particularly at ferry crossing points, but the river towns were generally abandoned in favor of railroad towns during the 1870s. Agricultural development was spurred when the Central Pacific Railroad (later Southern Pacific Railroad) came to Stanislaus County. Railroads played a key role in the formation of the two largest cities in Stanislaus County, Modesto and Turlock, as well as smaller towns. Like Modesto, Turlock was established in 1871 along the railroad line. During the late 19th and early 20th centuries, Turlock developed as a shipping point and retail center for surrounding farms. Southern Pacific Railroad branch lines constructed through the county in the 1880s stimulated small commercial centers, including Oakdale, Waterford, and Newman.

Implementation of new irrigation systems expanded opportunities for diversification in agriculture for Stanislaus County. For example, although wheat was very important, alfalfa quickly became a significant crop, providing feed for the growing herds of dairy cattle; the cultivation of orchard crops such as peaches, apricots, almonds, and oranges also became possible. Irrigation led to a new agricultural boom in Stanislaus County during the early 20th century. Although the agricultural economy fluctuated during the 20th century, it remains the leading industry in Stanislaus County, generating an annual gross agricultural value of greater than three billion dollars (Stanislaus County, 2011).

6.2.2 Current Land Use and Trends

Existing land use within the planning area is characterized in Chapter 2, Regional Setting. As described there, current land uses within the planning area are predominantly agricultural, including a mix of dairies, livestock pasture and range, livestock feed crops, and orchards. Farmland makes up 75 percent of the Mid SJR Region of the SPFC, with urban areas accounting for only four percent. The small areas within the Mid SJR Region of the SPFC that are under the jurisdiction of the City of Modesto are entirely urban and developed land. **Table 6-1**, **Mid San Joaquin River Region Land Use**, includes a summary of land use within the Mid SJR Region of the SPFC by acres and percent of region.

Table 6-1
Mid San Joaquin River Region Land Use

Land Use Category[1]	Acres of Land Type	% of SPFC Area
Urban and Developed Land	1,260	4%
Native Vegetation and Grazing Land	5,160	18%
Local and Unique Farmland	7,260	25%
Prime and Statewide Importance Farmland	14,290	50%
Confined Animal Agricultural Land	620	2%
Rural and Semi-Agricultural Land	160	1%
Total	28,750	100%

[1] See Chapter 2, Regional Setting, for a description of each of the land use categories.

SOURCE: Mid San Joaquin River Region Flood Atlas (Appendix A)

The remainder of the planning area outside of the Mid SJR Region of the SPFC is also dominated by agriculture and includes the cities of Modesto, Ceres, Turlock, Patterson, and Newman and communities of Grayson, Westley, and Crows Landing. **Table 6-2**, **Land Use in Planning Area**, characterizes land use in the planning area, which is approximately 91 percent agricultural. Existing parks and recreational areas in the planning area are described in Section 2.4.1, Public Access and Restoration.

Table 6-2
Land Use in Planning Area

Land Use Category	Acres of Land Type	% of Planning Area
Agriculture	887,442	91%
Commercial	1,043	<1%
Residential	7,508	1%
Industrial	4,425	<1%
Planned Development	8,808	1%
Urban Transition	9,835	1%
City	53,610	6%
Total	972,671	100%

SOURCE: Stanislaus County, Merced County, San Joaquin County

As described in Section 2.5.3, Protected Assets – Agriculture and Associated Infrastructure of this RFMP, milk is the top agricultural commodity in the planning area, but dairies here have struggled in recent years and almond, walnut and cherry production is increasing remarkably. Over 100 dairies across the San Joaquin Valley closed in 2012 and more were expected to close in 2013 (CVBJ, 2013). The dairy closures were primarily because of sharp increases in feed costs that were a result of a major drought in much of the Mid-western United States in 2012. Given that drought conditions have worsened, the recent trend of dairy closures may continue although a significant reduction in dairy production has yet to be seen for the region (Stanislaus County Ag Commissioner, 2012).

There has been a net decrease in farmland of Prime and Statewide Importance in Stanislaus County over the last 20 years. Irrigated farmland was also on the decline overall, but in 2010 there was a net increase from the planting of orchards and vineyards. There was 16,000 acres of new almond plantings between 2008-2010 (CDC, 2014). Continued conversion of row crops and silage production land uses to nut and fruit production is anticipated in coming years, and this trend may have an impact on flood management across the region. Given the both the cost to replace trees and the high price per unit of production, flood damages to orchard crops may result in higher costs than flood damages to annual forage crops, depending on the timing and duration of flooding (Stanislaus County Ag Commissioner, 2012; University of California, 1997). Almond production in California has increased by over 82 percent in the last 10 years. Consistent with this statewide trend, almond production has increased significantly in Stanislaus, San Joaquin, and Merced counties by approximately 55, 65, and 56 percent, respectively. In Stanislaus County, the majority of the new nut and fruit crops have been planted in the eastern and northeastern portions of the county, though orchards are being planted throughout the county (Modesto Bee, 2014). **Table 6-3**, **California Almond Production by County**, includes the number of pounds produced annually in California counties with commercial almond operations. As shown in this table, Stanislaus County has been one of California's top three almond producing counties within each of last 10 years.

Another trend in agriculture in the San Joaquin Valley is increasing soil salinity. Salinity in San Joaquin Valley soils has been increasing because the water imported via the Central Valley Project and State Water Project to irrigate crops is high in salt content. San Joaquin Valley soils include dense clay layers that prevent the salts from permeating into the ground. As a result, salts build up in the soil and may impede the ability of crops to grow. Many of the soils in the Central Valley are naturally saline and poorly drained, and when irrigated, these soils leach salts into the shallow groundwater and root zone, also impeding plant growth. Without comprehensive salinity management, decreased agricultural production may be observed in decreased acreage of actively farmed land in the region or changes in cropping and irrigation patterns over time. The San Joaquin Basin is experiencing a chronic salt imbalance with significantly more salt brought in through surface water deliveries than is conveyed out. In 2006, a joint effort began among the CVRWQCB, State Water Resources Control Board, and local stakeholders to address salinity issues within the Central Valley and to adopt long-term solutions. The collaborative effort is called Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) and described in more detail in Section 2.7, Agricultural Land Management and Water Quality.

Table 6-3
California Almond Production by County (million pounds)

Crop Year	Stanislaus	San Joaquin	Merced	Kern	Fresno	Madera	Tulare	Kings	Colusa	Glenn	Butte	Yolo	Tehama	Sutter	All Others	Total
2003/04	169.3	55.3	129.3	205.9	176.9	94.5	18.5	12.3	55.0	42.3	50.0	6.6	8.0	5.7	4.1	1,033.6
2004/05	163.9	51.0	127.6	215.8	173.5	93.4	20.4	13.0	38.0	37.2	45.0	4.7	6.9	4.6	2.9	997.9
2005/06	132.2	41.8	102.1	210.1	160.1	82.4	15.9	12.0	40.3	42.6	50.4	5.6	8.4	4.6	2.7	911.4
2006/07	163.6	55.6	124.6	247.8	232.7	100.1	21.5	17.7	50.8	38.4	41.8	6.3	7.7	4.9	3.8	1,117.3
2007/08	223.3	75.2	172.9	271.0	253.8	125.3	26.7	17.9	66.2	51.8	66.7	10.0	11.4	5.6	5.1	1,383.6
2008/09	240.6	82.1	187.3	354.3	322.2	142.7	36.2	23.4	86.0	48.6	56.9	10.4	9.7	5.3	5.2	1,611.0
2009/10	198.8	70.7	156.7	317.9	281.9	112.3	32.6	20.6	75.7	52.7	49.2	12.4	10.9	5.2	4.9	1,402.6
2010/11	202.5	68.0	164.2	403.5	344.2	149.7	42.4	29.9	83.0	55.8	47.1	13.6	11.7	4.9	6.0	1,626.6
2011/12	269.7	87.9	216.7	472.6	443.0	206.1	44.5	39.0	85.5	59.7	49.0	17.9	11.9	6.9	6.6	2,017.1
2012/13	261.8	91.5	201.4	393.4	413.6	203.5	49.1	30.7	85.1	57.9	50.9	18.1	12.5	7.0	7.5	1,884.1

SOURCE: Almond Board of California, 2013

6.2.3 Land Use Regulations

Zoning Codes

The primary tool to regulating land use within a floodplain is through a local zoning code, which also implements its general plan, as well as other laws, programs, and policies. Much of the land use within the Mid SJR Region and broader planning area is regulated by the Stanislaus County Code and Stanislaus County General Plan. The remaining portion of the planning area is regulated by the individual general plans and zoning codes for the cities of Modesto, Ceres, Turlock, Patterson, and Newman. In addition, small amounts of land within the planning area are located within Merced and San Joaquin counties, and are subject to those communities' zoning codes and general plans.

The Land Use, Conservation/Open Space, and Agricultural elements of the Stanislaus County General Plan include several goals and policies that apply directly or are related to flood management, habitat conservation, and agricultural preservation. Goal Five of the Stanislaus County Conservation/Open Space Element is to: "Reserve, as open space, lands subject to natural disaster in order to minimize loss of life and property of residents of Stanislaus County." Policy Four under Goal One in the Land Use Element states that development within the 100-year floodplain must meet the requirements of Chapter 16.50, Flood Damage Prevention, in the Stanislaus County Code. Chapter 16.50, Flood Damage Prevention, applies to special flood hazard areas (SFHAs) within the unincorporated areas of Stanislaus County that are defined in the Stanislaus County Code as having special flood or flood-related hazards and is shown on FEMA Flood Hazard Boundary Map (FHBM) or FIRM as Zone A, AO, AR, AE, A99, or AH. **Figure 3-11**, **General Plan Land Uses within 100-, 200-, and 500-year Floodplains** of this RFMP, shows the boundaries of each of these designated flood zones in the planning area. As shown, a significant portion of the planning area falls within these flood zone designations. Currently, development is permitted within SFHAs provided that the standards included in Chapter 16.50 of the Stanislaus County Code are met. Areas that are designated as floodways by the CVFPB are extremely hazardous because of the velocity and depth of flood waters, which carry debris and have a high erosion potential. Development is prohibited in designated floodways unless certification by a registered professional engineer or architect can be provided demonstrating that encroachments would not result in any increase in the base flood elevation. Merced County, and the cities of Patterson, Modesto, Ceres, and Newman municipal codes include similar requirements. The zoning codes for both San Joaquin County and the City of Turlock do not include specific provisions associated with development within a floodplain.

Senate Bill 5

Other regulations are in effect at the state level that control land use. Senate Bill 5 (SB5) was passed in 2007 which requires a 200-year level of flood protection for urban and urbanizing areas within California's Central Valley, and recommends 100-year flood protection for non-urban areas. 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 a 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.

For those areas where potential depth from a 200-year flood event is greater than 3 feet, the local government will be required to make an Urban Level of Flood Protection (ULOP) finding. The local government is required to make the ULOP finding before: (1) entering into a development agreement for any property that is located within a flood hazard zone; (2) approving a discretionary permit or other

discretionary entitlement, or a ministerial permit that would result in the construction of a new residence, for a project that is located within a flood hazard zone; or (3) approving a tentative map, or a parcel map for which a tentative map was not required, for any subdivision that is located within a flood hazard zone. This essentially means that no development can occur in urban or urbanizing areas unless 200-year flood protection (with less than 3 feet of flooding) can be achieved. SB5 regulations require general plans and zoning codes of all local governments in the Central Valley be revised to reflect these standards by July 2016. Local governments then have until 2025 to make the improvements and achieve this urban level of flood protection. See **Figure 6-1**, **General Plan Designations and 100- and 200-year Floodplains**, and **Figure 6-2**, **Zoning Designations and 100- and 200-year Floodplains**, for the current general plan and zoning designations within the 100- and 200-year floodplains in the planning area.

SB5 regulations have the potential to greatly affect future development within the planning area. The only urban (i.e., areas with 10,000 or more people) and urbanizing (i.e., areas that will have 10,000 or more people in 10 years) areas within the planning area are the cities of Modesto, Patterson, and Newman. Although the 200-year flood maps have not been developed for the Mid SJR Region, it is likely that there will be areas that can experience flooding of 3 feet or greater during a 200-year flood event in these cities. Until these cities have their 200-year flood maps completed to determine where the ULOP findings are required to be made, and a plan to achieve the urban level of flood protection by 2025, only limited growth can occur.

Preservation of Agricultural/Open Space Regulations

There are mechanisms in place that help facilitate the preservation of agriculture and open space areas within the Mid SJR Region. Chapter 21.118 Land Use Restriction of the Stanislaus County Zoning Ordinance includes provisions to implement the requirements of a thirty-year land use restriction initiative. Under this chapter, any land that is redesignated or rezoned from an agricultural or open space use to residential is contingent upon the approval by a majority vote of the county voters at a general or special local election. With this provision in place, the conversion of land from agriculture and open space to residential uses is more difficult to effect and the process of redesignation or rezoning takes longer.

Another mechanism for regulating land use is the California Land Conservation Act of 1965, referred to as the Williamson Act, which is a tax relief measure for owners of farmland and open-space lands. The act permits the owner of land that is used for farming or open space uses including wildlife habitat to sign a contract with the applicable county guaranteeing that the land will remain in farming or open space uses for a minimum of 10 years in return for assessing taxes on the property based on the agricultural or open space value rather than the market value, which can result in a significant reduction in property taxes for the landowner. As shown in **Figure 6-3**, **Williamson Act Lands**, significant portions of Stanislaus, Merced, and San Joaquin counties are under Williamson Act contracts with local landowners. The Williamson Act has been an effective agricultural and open-space preservation tool, though land covered under Williamson Act contracts continues to decline in the planning area and throughout California (CDC, 2013). The Agricultural Element of the Stanislaus County General Plan includes policies and implementation measures to continue participation in and contribute to strengthening the Williamson Act to preserve agricultural and open-space lands in Stanislaus County.

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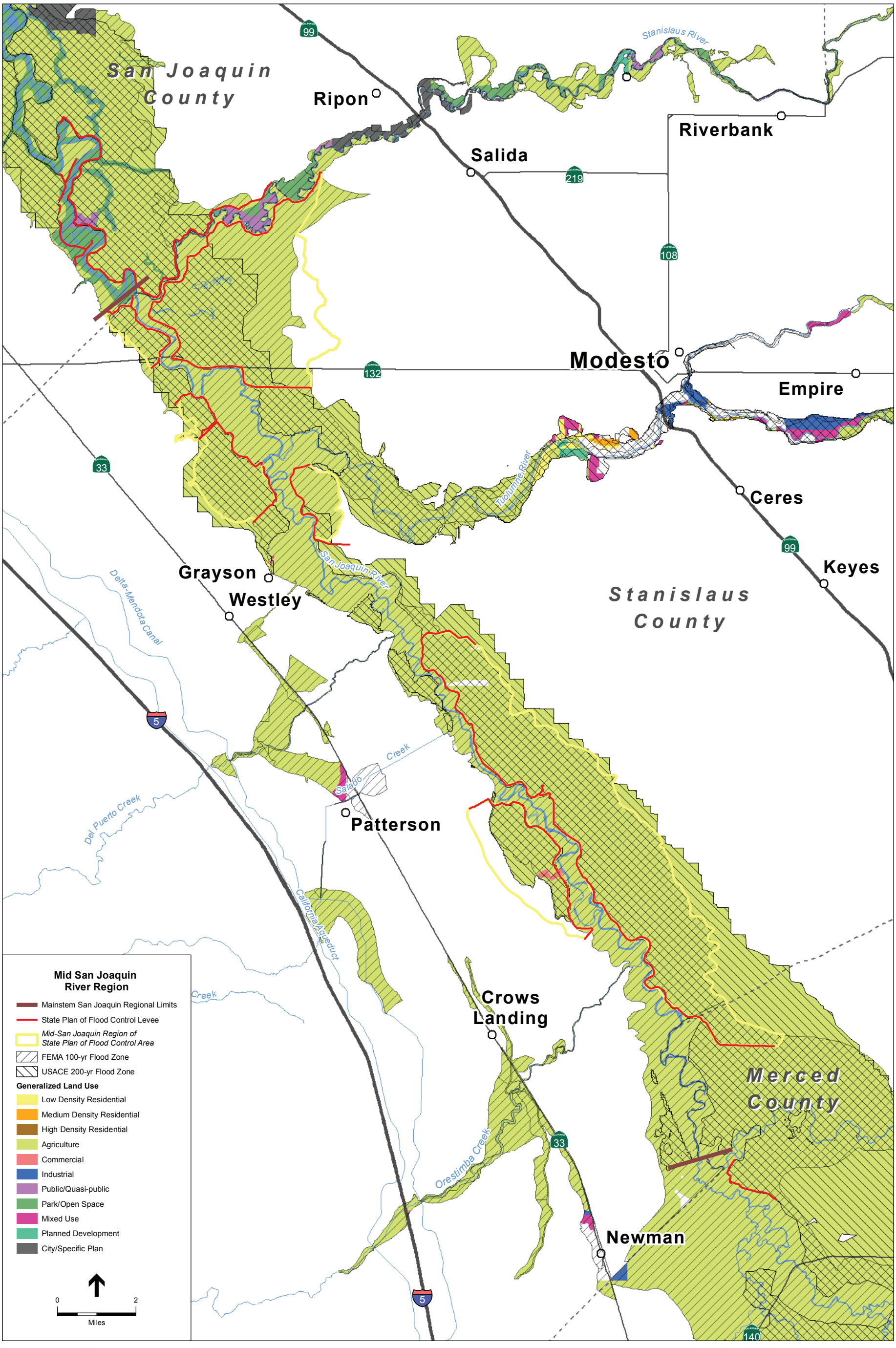
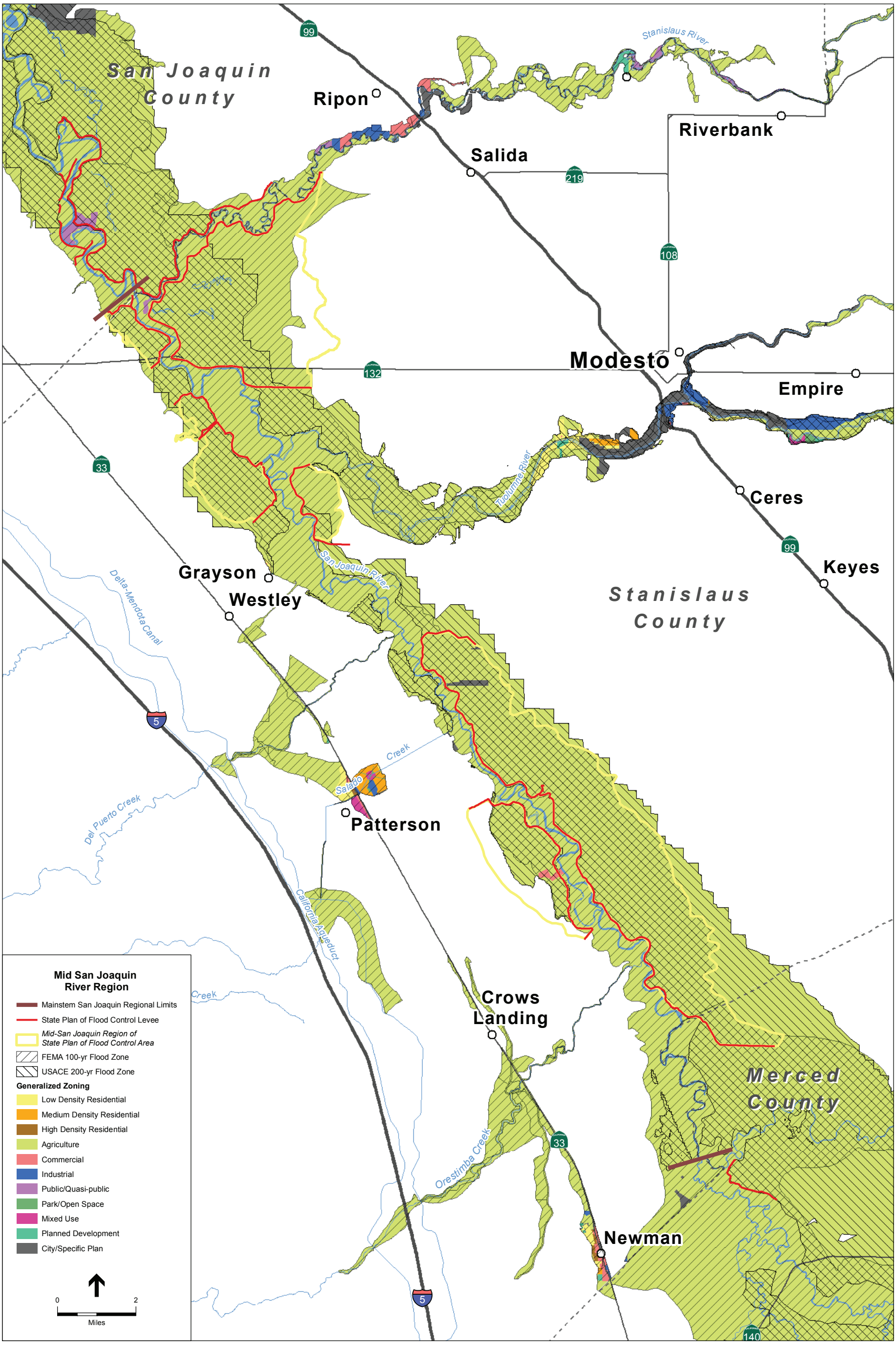


SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 6-1

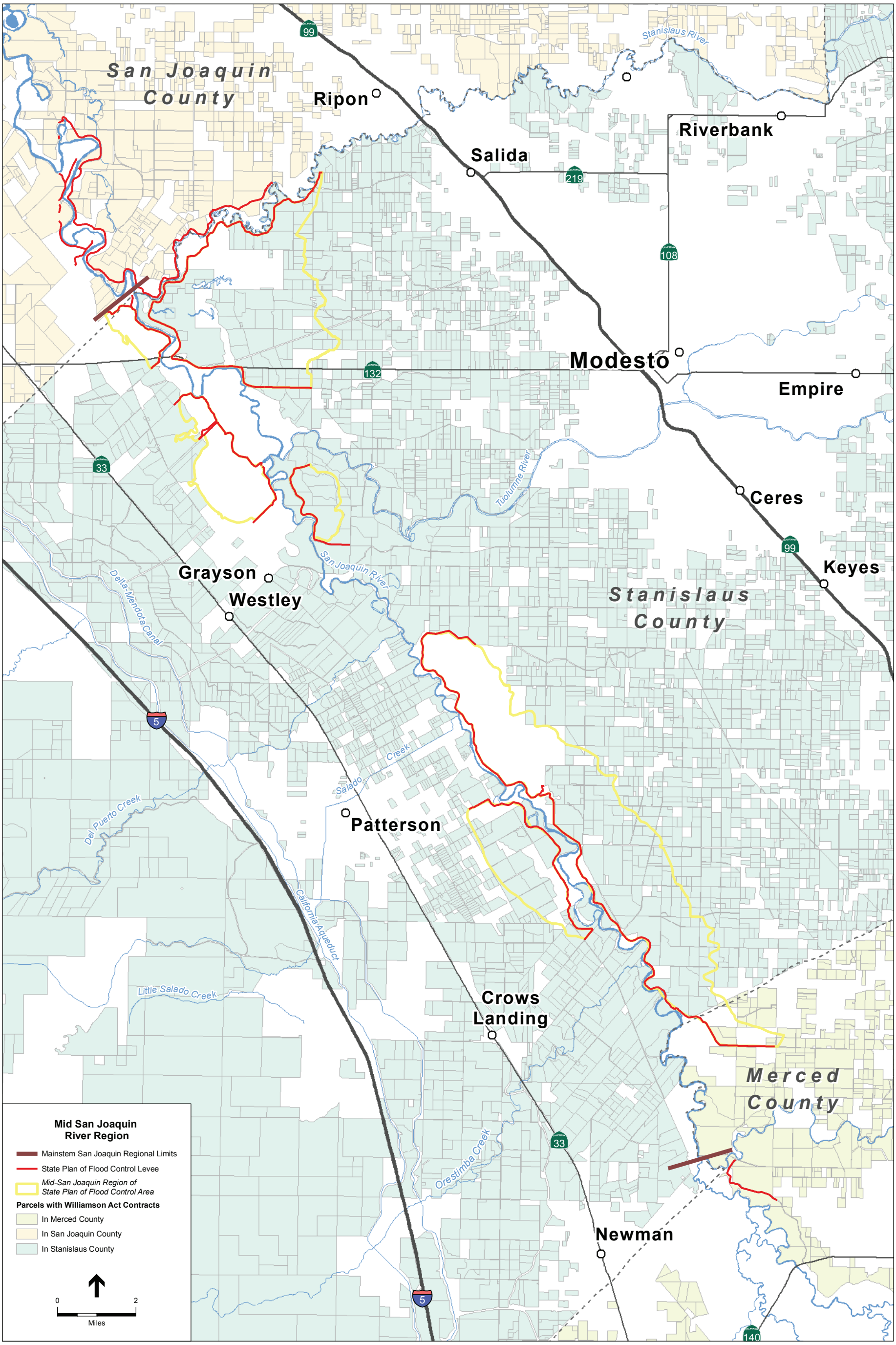
General Plan Designations and 100- and 200-year Floodplains



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013

Figure 6-2

Zoning Designations and 100- and 200-year Floodplains



SOURCE: USDA, 2012; San Joaquin Co., 2009; Merced Co., 2010; Stanislaus Co., 2013; ESRI, 2012; DWR, 2013; ESA, 2014

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Figure 6-3

Williamson Act Lands

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6.2.4 Land Use and Flood Risk

The land uses within a floodplain significantly influence flood risk. In the context of flood management, risk is defined as the product of the probability of a given flood occurring and the damage that would result. The probability of a given flood occurring is influenced by climate, hydrology, and topography. The damage that would result depends on the land uses within the floodplain, flood protection systems that are in place, and flood proofing measures that have been implemented. Development within a floodplain generally increases the damage that would be caused in the event of a given flood. As described in Section 3.8, Identified Flooding and Flood Hazards, land uses within the 100- and 500-year floodplains in the Mid SJR Region include urban; rural and semi-rural agricultural; native vegetation and grazing land; farmland of prime and Statewide importance; local and unique farmland; and confined animal agriculture. The vast majority of land within the 100- and 500-year floodplains in the Mid SJR Region and broader planning area is agricultural. According to recent data from the EPA, approximately 21 dairies are located within the 100-year floodplain in the Mid SJR Region (EPA, 2013). As discussed above under Section 6.2.3, per SB5, development within the 200-year floodplain in urban areas will not be permitted without protection from a 200-year flood event. SB5 also recommends 100-year flood protection be provided for non-urban areas. Development in this context includes new residential, commercial, or industrial land uses and buildings for agricultural uses. As some fruit and nut trees are damaged by prolonged inundation and costly to replace, the flood risk needs to be balanced with potential profits before planting orchards. While the provisions of SB5 don't preclude orchards in the 100- or 200-year floodplains, it would be good land use practice to consider flood-compatible uses that include production of crops that are flood-tolerant, open space, some recreational facilities and uses, and areas of rehabilitated floodplain habitat.

6.2.5 Land Use Management Tools

Potential land use management tools are listed and described below that could go beyond the requirements of SB5 to reduce flood risk, enhance the environment, improve recreation, and preserve agricultural lands. The following list describes options that have been identified as part of the planning process and may or may not be selected for implementation. Those that are selected would need to be defined further. It should be noted that these tools were not recommended for inclusion as a project in the RFMP at this time.

- As zoning is the primary tool used to regulate land use, zoning designations could be established that only permit flood-compatible land uses within the 100- and 200-year floodplains, particularly in areas that are not able to meet the flood protection requirements of SB5. These designations could also restrict flood-incompatible uses, such as crops that are sensitive to inundation and establishment of new or expanded dairies, to areas outside of the 100- and 200-year floodplains while allowing flood-compatible agriculture within the floodplain boundaries. A separate zoning designation could be applied to areas in the floodplain with high potential for habitat rehabilitation with associated restrictions to encourage the eventual creation of habitat in those areas. This effort would require coordination and approval by local jurisdiction advisory and legislative bodies. The proposed zoning designation would likely require a Stanislaus County General Plan Amendment and an amendment to the Stanislaus County Zoning Code, as well as environmental review.
- New Williamson Act contracts could be established on agricultural lands within floodplains, including on lands that would provide cropland and floodplain habitat, depending on the time of year. This might be accomplished through the development of new incentives or an enhanced

outreach program by Stanislaus County. Open space is considered a consistent land use for parcels enrolled in the Williamson Act in Stanislaus County.

- In order to balance flood risk with potential profits, Stanislaus County could choose to enact policies that would encourage flood-compatible crops and discourage crops that are highly sensitive to prolonged inundation, such as dairies, permanent tree crops and food processing facilities.
- An incentive could be provided for preserving agricultural lands in the 100-, 200-, and 500-year floodplains. Agricultural lands could continue to be preserved through the Stanislaus County Farmland Mitigation Program, which currently requires mitigation for the loss of agricultural land to residential development at a 1:1 ratio, but could be expanded to include any form of land use change that results in the loss of agriculture and extended beyond the unincorporated portions of the County.
- A Transfer of Development Rights Program could be implemented to maintain floodplains in the planning area as open space, fish and wildlife habitat, conservation lands, agriculture, or recreation while encouraging residential and commercial development within areas that are better suited for such development. A large area, such as a County, is needed to effectively implement this planning tool.
- Regional mitigation planning could be developed in the planning area and in collaboration with the resource agencies and neighboring flood planning regions to provide needed environmental mitigation for impacts associated with flood improvement projects and SPFC operations and maintenance (O&M) activities. Any mitigation activities would need to be consistent with the Central Valley Flood System Conservation Strategy (Conservation Strategy), which is scheduled for release in 2014.
- An emergency response fee could be assessed on lands that are particularly costly to serve during a flood event. Two examples of such land uses are dairies and high-density residential development. The fee would be designed to act as a deterrent to placing these land uses in the floodplain and could fund emergency response actions that address the safety of lives and property, but also associated costs such as mitigation for water contamination downstream that generally results when dairies are flooded.
- Additional land within the floodplains of the Mid SJR Region could be zoned for recreation and open space to allow for additional parks and other recreational purposes, and improve public access along the rivers and creeks while keeping the potential risk to floodplain assets low. Changing the zoning of the land would have to be accomplished at the local government level. This process would involve general plan amendments, zoning map amendments, possible amendments to the zoning code and the process would be subject to property owner input, Planning Commission and Board of Supervisor consideration, and action through advertised public hearings.
- Entities that have infrastructure within RDs might be compelled to contribute toward maintenance costs. For example, a pipeline crossing an RD may benefit from flood protection; if so, the pipeline owner could be required to contribute to the flood protection service.
- A statewide fund could be established to support RDs in maintaining levees when there is critical infrastructure within RD boundaries.

6.3 Potential Environmental Enhancements

The rivers in the planning area are critical migratory corridors for steelhead trout and other anadromous fish. Riparian and terrestrial habitats support a variety of wildlife species. As such, there is a need to rehabilitate habitat in the planning area. As stated on page 3-21 of the 2012 CVFPP, "Under the SSIA, ecosystem restoration opportunities are integral parts of systems improvements, as well as urban, small community, and rural-agricultural area flood protection projects." Section 9616 (a) of the California Water Code states that the environmental objectives of the Central Valley Flood Protection Act of 2008 are to 1) promote natural dynamic hydrologic and geomorphic processes, 2) increase and improve the quantity, diversity, and connectivity of riparian, wetland, floodplain, and shaded riverine aquatic habitats, including the agricultural and ecological values of these lands, and 3) promote the recovery and stability of native species and populations and overall biotic community diversity. Prior to and during the regional flood management process, several potential areas and specific habitat rehabilitation projects have been identified in the planning area.

Riparian, wetland, floodplain, and shaded riverine aquatic habitats can be provided in wildlife areas and refuges, designated conservation areas, and agricultural lands. As described in Section 2.4.2, Ecologically Sensitive Areas and Habitat, there are two wildlife areas, two wildlife refuges, and several large areas of conservation land within and near the Mid SJR Region of the SPFC. Atlas Map 18, Managed Environmental Lands (Appendix A), shows the locations of land managed by the USFWS, CDFW, The Nature Conservancy (TNC), River Partners, Tuolumne River Trust, and others. **Figure 2-5**, **Managed Environmental Lands**, shows these areas along with privately-held lands with conservation easements, including those held by the Natural Resources Conservation Service (NRCS). Analyses conducted for the 2012 CVFPP (DWR, 2012) identified 7,760 acres of floodplain lands along river corridors within the planning area that could potentially be hydrologically reconnected to the San Joaquin, Merced, Tuolumne, and Stanislaus rivers so as to benefit ecological processes. As shown in Figure 3-22, Floodplain Inundation Potential of River Corridors in the Lower San Joaquin Basin, of Attachment 9F: Floodplain Restoration Opportunity Analysis of the 2012 CVFPP, the majority of the area with a high potential for floodplain inundation in the planning area is located along the San Joaquin River.

Conservation Needs

The following list describes the aspects of ecosystem degradation relevant to the planning area:

- Loss of frequently-activated floodplains
- Constraints on channel migration processes, which foster the creation of new habitats and reinvigoration of habitats through disturbance
- Reduction in the amount of riparian and marsh habitats
- Hydrologic reconnection of floodplains, including salmon rearing habitat
- Creation of, enhancement, and support of processes to engender riparian and marsh habitats
- Removal of revetment to allow channel migration
- Removal or remediation of fish passage barriers

- Management of invasive plants
- Provision of spawning gravel for salmonids and sturgeon
- Creation of flood refugia for riparian obligate terrestrial species
- Improvement of the connectivity among riparian corridors

In aquatic ecosystem rehabilitation, there is a set of general tools that can be used to meet habitat objectives. These include:

- planting native grasses on levees and a mix of native plants as hedgerows along agricultural lands,
- coordinating vegetation management and erosion control maintenance,
- breaching or setting back levees to reconnect floodplains and provide transient storage,
- removing revetment to restore channel meander potential,
- establishing conservation and flowage easements along agricultural lands,
- removing fish passage barriers and screening surface water diversions,
- augmenting spawning gravel in the river channel,
- filling deep pools in the river channel where non-native fish that prey on native juvenile salmonids tend to congregate (note that before specific deep pools are filled, it is important to determine whether they provide important temperature refugia for anadromous fish), and
- removing non-native invasive vegetation.

Specific attributes of rehabilitated habitat would include seasonally-inundated floodplains, natural geomorphic processes, riparian vegetation, shaded riverine aquatic cover, connectivity with adjacent or nearby habitat. The quality and quantity of riparian habitat will be important in the adaptation of ecosystems to climate change because riparian habitat is often more resilient to change when compared to upland terrestrial habitats, functions as an ecological corridor for a variety of plant and animal species, links aquatic and terrestrial habitats, provides thermal refugia, and may temper anticipated changes to hydrology (Seavy, et al., 2009).

Several ongoing conservation planning efforts have planning area boundaries that overlap with the Mid SJR RFMP planning area boundary, or are relevant because they have a nexus with the Mid SJR Region. Those plans are listed in **Table 2-4**, **Conservation Plans Relevant to Planning Area**. Attachment 2: Conservation Framework of the 2012 CVFPP listed the conservation opportunities that had been identified prior to publication, including several in the Mid SJR RFMP planning area. The list included the reconnection of historical sloughs and oxbows, restoration of riparian habitat, removal of invasive species, and restoration of floodplains along the San Joaquin River roughly between river miles 57 and 118 and the Three Amigos project to restore wetland, riparian, and floodplain habitat, remove nonessential levees, reduce floodway maintenance, and remove invasive species, and the Grayson Bypass Project, which is no longer proposed. In addition to the environmental enhancement projects identified in the CVFPP, opportunities for groundwater recharge in concert with reconnecting floodplain lands were specifically identified for significant parts of the floodplain within the Mid SJR RFMP planning area. In particular, opportunities were identified at a site along Dry Creek, east of Modesto and one mile upstream of the Tuolumne River and described in Attachment 8L: Groundwater Recharge Opportunities Analysis. The range of storage capacity at the site was calculated as 6.6 to 12.7 thousand acre-feet per square mile of recharge area. Last, the Central Valley Habitat Exchange (CVHE) is a new initiative to more completely

quantify the range of environmental benefits that are provided by agricultural lands through restoration activities and/or a change in management by the landowner, and to promote the reintegration of habitat into California's agricultural lands. The CVHE will promote, monitor, and assist in the exchange of habitat credits, which are a measure of the ability of a parcel to support a particular species or natural community. Willing landowners are offered the potential to gain another source of revenue and benefit from having high-quality habitat on their land.

6.4 Flood Management and Environmental and Recreational Enhancement Linkages

Multi-benefit projects are those that combine flood management, environmental, recreational, water quality, and other objectives to achieve improvements in each of these areas. Chapter 4.0, Integration of Conservation and Flood Management, of the Conservation Framework (Attachment 2 to the 2012 CVFPP) provides several examples of projects and programs that have incorporated flood management and environmental objectives. One example of a multi-benefit effort to improve flood management and recreational opportunities is also provided – the Interagency Agreement between DWR and the California Department of Parks and Recreation (DPR), which will support multi-benefit projects at the Colusa Sacramento River State Recreation Area. As part of multi-benefit projects, several actions can be taken that deviate from more traditional flood maintenance, offering dual or multiple benefits. Levees can be removed from the SPFC along with associated maintenance obligations. In such instances, the USACE O&M manual would be modified to allow breaching and other modification to the existing levees. On levees that have been or will be removed from the federal project, brushy vegetation can be re-established on the levees through a three-year restoration project and live trapping has shown that these efforts are successful for wildlife recovery. On levees that must continue to pass state and federal inspections/maintenance requirements, native grass sod has been shown to provide marginal habitat that can act as a movement corridor for terrestrial species during flood events. Recreational access points can be strategically placed to facilitate access for regular inspections and maintenance. Multi-benefit projects as well as any projects that alter hydraulics may have an influence on flood risk in neighboring regions. As such, coordination with the Upper San Joaquin River and Lower San Joaquin River/Delta South regions is crucial in this planning process and into the future as projects are implemented.

Two examples of projects that have been identified during the regional flood management process are introduced in the list below and described in more detail in Chapter 7, Proposed Regional Improvements. The descriptions below provide good examples of multi-benefit projects to illustrate the concept.

- **Floodplain Expansion and Ecosystem Restoration at Dos Rios Ranch/Hidden Valley Mitigation Project** – This project would restore flooding and transient floodwater storage to approximately 1,000 acres of historic floodplain, restore riparian habitats, promote river physical processes of scour and deposition, and provide passive recreation along 6 river miles. Levees would be removed from the SPFC along with associated maintenance obligations and the USACE O&M manual would be modified to allow breaching and other modification to the existing levees. While the property has been purchased, additional investment is needed to develop mitigation opportunities, address

permitting needs, integrate recreational facilities, and remove levees from the federal project or otherwise modify the maintenance obligations.

- **Integrated Levee Vegetation Management – Flood Maintenance and Habitat** – Since 2002, wildlife researchers at the Endangered Species Recovery Program at CSU Stanislaus have been working with landowners and other stakeholders to identify habitat management and restoration activities that can contribute to the recovery of terrestrial riparian species in the region including riparian brush rabbit (*Sylvilagus bachmani riparius*) and riparian wood rat (*Neotoma fuscipes riparia*). Levees in the region provide crucial high-ground refugia for such wildlife during flood events. Vegetation on levees in the region is currently not managed to facilitate levee use during floods for wildlife survival and post-flood recovery. On levees that have been or will be removed from the federal project, brushy vegetation can be re-established on the levees through a three-year restoration project and live trapping has shown that these efforts are successful for wildlife recovery. On levees that must continue to pass state and federal inspections/maintenance requirements, native grass sod has been shown to provide marginal habitat that can act as a movement corridor for terrestrial species during flood events. This project includes re-establishing appropriate vegetation on levee slopes to promote terrestrial wildlife survival during floods – either native sod on active levees, or native brush vegetation on inactive levees (RDs 2099, 2100, 2102, and 2092 in the future).

Meeting multiple objectives broadens the available sources of funding. Flood management projects are generally funded from sources including local assessments, bond funds, and federal and state programs. Examples of funding associated with habitat rehabilitation and/or mitigation that can be accessed by multi-benefit projects include the Restoration Fund established as a requirement of the Central Valley Project Improvement Act (CVPIA), programs under the National Oceanic and Atmospheric Administration (NOAA), USFWS, CDFW, and other state and federal agencies, as well as private foundations and other sources. Consistent with the vision described in the CVFFP, DWR will prioritize funding for multi-benefit projects identified in the current regional flood management planning process.

A number of studies have demonstrated the potential for dedication of floodplains to open space, recreational, and habitat enhancement uses to have a positive economic impact. A recent cost-benefit analysis on a northeast river concluded that the benefits of the 108-mile Meramec Greenway greatly exceed the cost by reducing flood damages and increasing local property values (Krousky and Walls, 2013). A general examination of floodplain valuation in the Central Valley provides a literature review and discusses multiple floodplain services (benefits) in association with their documented cost per acre (Eisenstein and Mozingo, 2013). A 2002 study evaluating the economic impact on Stanislaus County that would result from a floodplain rehabilitation along the San Joaquin and Tuolumne rivers concluded that agricultural production would be reduced, but the net benefit would exceed the loss of agricultural production by approximately $4.86 million over the 25-year period considered in the study. The benefits were associated with economic activity generated by habitat and channel restoration activities, improved aesthetics, and recreational use (USFWS, 2002).

Attachment 9A, Regional Advance Mitigation Planning, of the 2012 CVFPP describes the effort to provide a method to achieve faster, less expensive, and better mitigation for unavoidable impacts associated with infrastructure projects proposed within the state. Regional Advance Mitigation Planning (RAMP) can be integrated with, and add benefits to, conservation planning efforts. The RAMP Work Group formed in 2008 and includes DWR, Caltrans, EPA, USFWS, CDFW, California State Parks, the National Oceanic and Atmospheric Administration, USACE, California Regional Water Quality Control Boards, The Nature Conservancy, Wildlife Conservation Board, UC Davis, Resources Legacy Fund, and the Federal Highway Administration. Projects that include habitat enhancement, such as those listed above, should be considered for inclusion in RAMP.

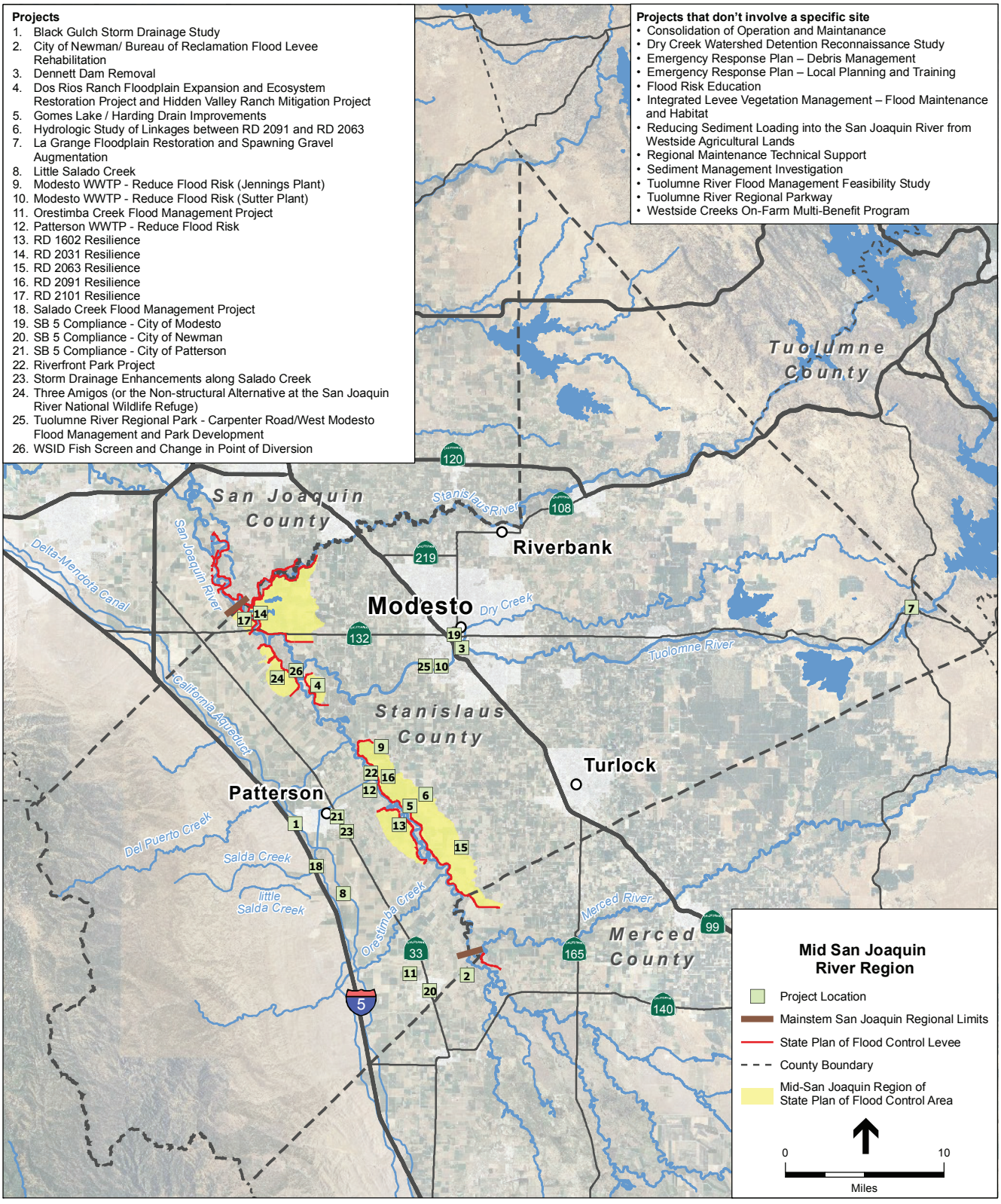
7. Proposed Regional Improvements

7.1 Introduction

This chapter describes the proposed regional improvements, or projects, that were identified through the stakeholder engagement process, which is described in Section 1.3, Stakeholder Engagement. The Regional Partners collaborated with participating stakeholders to develop and refine descriptions of each of the proposed projects. The estimated cost of each project is provided in Chapter 9, Regional Financial Plan. The criteria used to evaluate and rank the projects and the outcome of that process are described in Chapter 8, Regional Priorities.

7.2 Project Descriptions

Thirty seven projects were identified as having the potential to reduce flood hazards and provide other benefits to the planning area. A range of project types were identified; some examples include small dam removal, sediment load reduction, floodplain rehabilitation, a levee vegetation management program, studies to better understand flooding hazards, emergency response planning and training, flood education programs, compliance with Senate Bill 5 requirements, and storm drainage enhancements. The locations of projects with a specific project site are shown in **Figure 7-1, Project Location**s. Projects that don't involve a specific site are listed on Figure 7-1, but not shown on the map. **Table 7-1, Summary of Proposed Regional Improvements**, includes the name, project lead, potential project partners, project status, project cost, project timeline, and a short project description. Potential project partners are those parties that intend to partner or would be willing to consider partnering on a specific project. Detailed descriptions of each project are provided in Appendix F, Project Descriptions and Evaluations.



SOURCE: USDA, 2012; ESRI, 2012; DWR, 2013; ESA, 2013; CSWRCB, 2014

Figure 7-1
Project Locations

Table 7-1
Summary of Proposed Regional Improvements

Project Name	Project Lead	Potential Project Partners	Project Status	Project Cost	Project Timeline	Short Project Description
Black Gulch Storm Drainage Study*	City of Patterson	Stanislaus County	Pre-planning	$28,000	Undetermined	There is a permitted spillway into the Delta Mendota Canal (DMC) from Black Gulch, a drainage situated between Salado and Del Puerto creeks, which keeps a local commercial area in Patterson from flooding. A study needs to be performed to determine what alternative solutions might be appropriate if/when the DMC Authority decides to not renew the permit.
City of Newman/ Bureau of Reclamation Flood Levee Rehabilitation	City of Newman	Bureau of Reclamation	Pre-planning	$225,000	45-day construction time	Rehabilitate a flood protection levee on Bureau of Reclamation property between the Newman Wasteway and the City of Newman Wastewater Treatment Plant (WWTP).
Consolidation of O&M	Reclamation District (RD) 2092	Interested parties include RDs 2031, 2101, 2092, 2091, 1602; City of Modesto; California Department of Water Resources (funding, technical assistance); local Resource Conservation Districts; and Stanislaus County (potential governance and management partners)	Planning	$200,000	1-5 years	Two or more Reclamation Districts form a formal partnership to share technical, financial, and/or operational capacity to perform necessary operations and maintenance (O&M). As an initial step, invest 2 person-years to investigate potential governance options and design and implement a pilot maintenance agreement project.
Dennett Dam Removal	Tuolumne River Trust	No partners identified at this time	Planning. The Dam Removal Basis of Design Report is complete. Funding is required to complete a sediment toxicology test, plus National Environmental Policy Act (NEPA)/California Environmental Quality Act (CEQA), and permitting.	$700,000	2 years	Removal of Dennett Dam, an abandoned low-head dam located on the lower Tuolumne River in Modesto, California. The dam has been an instream barrier to anadromous fish passage, controlling local hydraulic and sediment transport conditions, for over 60 years, while also impeding water flow in the river. It is also a significant safety hazard adjacent to a major park, and has been the location of three drowning deaths in the last five years, including two children.
Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	River Partners	Wildlife Conservation Board (WCB); DWR; United States Bureau of Reclamation (USBR); United States Fish and Wildlife Service (USFWS); Natural Resources Conservation Service (NRCS); San Francisco Public Utilities Commission (SFPUC); California Department of Fish and Wildlife (CDFW) (funding partners, technical assistance); Central Valley Flood Protection Board (CVFPB); National Marine Fisheries Service (NMFS); United States Army Corps of Engineers (USACE); regulatory agencies; environmental non-governmental organizations (NGOs); local municipalities; Reclamation District 2092 (project support and approvals); regional flood management agencies with mitigation needs that may be filled on the property	Planning, Implementation	$8,000,000	1-5 years	Project to restore flooding and transient floodwater storage to approximately 1,000 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 6 river miles. Remove levee maintenance obligations from State Plan of Flood Control (SPFC) and modify USACE O&M manual to allow breaching and other modification to the existing levees. Provide 191 acres of habitat mitigation for future regional SPFC environmental impacts.
Dry Creek Watershed Detention Reconnaissance Study*	Stanislaus County and City of Modesto	USACE	Pending funding grants	$250,000	2015-2016 pending funding	Complete a reconnaissance study of potential options for reducing flood risks by detaining flood flows in the Dry Creek watershed, upstream of the City of Modesto.
Emergency Response Plan – Debris Management	Stanislaus County Office of Emergency Services	Stanislaus County Public Works, cities within Stanislaus County, city public works departments within Stanislaus County, Patterson Irrigation District, West Stanislaus Irrigation District	Pre-planning	$110,000	1-5 years	A debris management plan is needed to better prepare to restore public services and ensure public health and safety in the aftermath of a flood or earthquake and to better position the Mid SJR Region for emergency response funding from the State of California, Federal Emergency Management Agency (FEMA), and other participating entities. Stanislaus County Office of Emergency Services proposes the development of a comprehensive, countywide debris management plan.
Emergency Response Plan – Local Planning and Training	Stanislaus County Office of Emergency Services	Stanislaus County; City of Modesto; City of Patterson; City of Newman; Reclamation Districts 1602, 2063, and 2091; Patterson Irrigation District; West Stanislaus Irrigation District	Pre-planning	$110,000	1-5 years	Planning and training are necessary to improve coordination between local agencies so that emergency response can be improved in the planning area. A program would be developed and implemented to address this need.

Table 7-1
Summary of Proposed Regional Improvements

Project Name	Project Lead	Potential Project Partners	Project Status	Project Cost	Project Timeline	Short Project Description
Flood Risk Education	River Partners	DWR and USACE levee maintenance and inspection staff; CVFPB; regional flood management agencies, including San Joaquin River Flood Control Agency (SJRFCA); San Joaquin Area Flood Control Agency (SJAFCA); Lower San Joaquin Levee District (LSJLD); counties; cities; USFWS, CDFW, USACE, NGOs with an interest in river and flood management and education	Pre-planning	$30,000	Dependent upon funding – could start immediately and continue indefinitely contingent upon funding	Develop and implement a regional flood risk management educational program to raise awareness of flood risks and elevate the level of public understanding with respect to flood risk management needs and the value of investments to address them. For the local maintaining agencies (LMAs), include education on their role in flood risk management and provide technical guidance/assistance on levee maintenance activities and permitting requirements.
Gomes Lake / Harding Drain Improvements	Gomes Lake Joint Powers Authority	Turlock Irrigation District, Stanislaus County, Reclamation District 2063, Reclamation District 2091	Pre-planning	$1,700,000	1-5 years	This project includes multiple components to enhance the function, reliability, flexibility and capacity of the Gomes Lake facility, which stores and drains stormwater and return flows, providing flood risk reduction behind the east bank levees of the San Joaquin River.
Hydraulic and Channel Migration Studies*	Stanislaus County Office of Emergency Services	RD 2091, Gomes Lake JPA, City of Modesto, City of Newman, City of Patterson	Pre-planning	$200,000	1-5 years	Two regional studies (mainstem San Joaquin River flood hydraulics and channel migration) and three focused hydraulic studies are needed to better inform flood management in the Mid SJR Region.
Integrated Levee Vegetation Management – Flood Maintenance and Habitat	River Partners	Funding partners - WCB, DWR, USBR, NRCS; landowners; RDs; environmental NGOs; technical experts - as needed	Planning	$6,400,000	1-5 years	This project includes re-establishing appropriate vegetation on levee slopes to promote terrestrial wildlife survival during floods – either native sod on active levees or native brush vegetation on inactive levees (RDs 2099, 2100, 2102, and 2092 in the future).
La Grange Floodplain Restoration and Spawning Gravel Augmentation	Tuolumne River Trust	Stanislaus County Parks and Recreation	Pre-planning	$1,500,000	1-5 years	Restore 77 acres of degraded floodplain habitat along the Tuolumne River in La Grange while developing a source of spawning gravel to improve and enhance existing spawning beds in the Tuolumne River.
Little Salado Creek	Stanislaus County	USACE	Planning	$5,000,000	1-5 years	Construction of a project to partially divert, retain and percolate up to 1,030 cubic feet per second (cfs) of flow from Little Salado Creek.
Modesto WWTP - Reduce Flood Risk	City of Modesto	No partners identified at this time	Pre-planning	$80,000,000	Undetermined	Develop and evaluate potential solutions to existing flood hazards at the Modesto Sutter and Jennings WWTPs, including completion of two studies (Sutter Plant Relocation Feasibility Study and a Wastewater Treatment Facilities Master Plan) that are currently in process, and implement the preferred alternative.
Orestimba Creek Flood Risk Management Project	City of Newman	Stanislaus County, Orestimba Creek Flood Control District, USACE	Planning	$44,000,000	1-5 years	Construction of a 4.7-mile chevron levee along east bank of Central California Irrigation District (CCID) Main Canal and a 1-mile cross levee to reduce flood risk to Newman and adjacent agricultural areas, providing a 200-year level of protection. The chevron levee would include 3 feet of freeboard above the mean 200-year water surface elevation.
Patterson WWTP – Reduce Flood Risks*	City of Patterson	No partners identified at this time	Pre-planning	$27,000	Undetermined	Develop and evaluate potential solutions to existing flood hazards at the City of Patterson WWTP.
RD 1602 Resilience	RD 1602	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - small role in emergency response, possibly funding for repairs; Stanislaus County - oversees district governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$4,700,000	1-5 years	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL 84-99 eligibility.
RD 2031 Resilience	RD 2031	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - small role in emergency response, possibly funding for repairs; Stanislaus County - oversees district governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$2,000,000	1-5 years	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL 84-99 eligibility.

Table 7-1
Summary of Proposed Regional Improvements

Project Name	Project Lead	Potential Project Partners	Project Status	Project Cost	Project Timeline	Short Project Description
RD 2063 Resilience	RD 2063	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - small role in emergency response, possibly funding for repairs; Stanislaus County - oversees district governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$900,000	1-5 years	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL 84-99 eligibility.
RD 2091 Resilience	RD 2091	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - small role in emergency response, possibly funding for repairs; Stanislaus County - oversees district governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$400,000	1-5 years	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL 84-99 eligibility.
RD 2101 Resilience	RD 2101	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - small role in emergency response, possibly funding for repairs; Stanislaus County - oversees district governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$3,000,00	1-5 years	Complete the necessary repairs and upgrades to bring RD levee system back into “Active” status for PL 84-99 eligibility, including addressing a major levee erosion site.
Reducing Sediment Loading into the San Joaquin River from Westside Agricultural Lands	West Stanislaus RCD	NRCS, irrigation districts, Westside Coalition	Ongoing with an existing list of interested producers.	$65,000,000	15 years	Improve irrigation technology with buried drip and sprinkler irrigation systems that allow for the capacity to irrigate a variety of crop types and effectively eliminate erosion of sediment off of farm fields when compared to traditional, flood irrigation practices. Sediment loading results in reduced capacity of and increased flooding in Westside Creeks and the San Joaquin River.
Regional Maintenance Technical Support	RD 2091 and RD 2092	CVFPB - permitting, technical assistance; landowners - funding, governance; DWR - funding, technical assistance; USACE - possibly funding for repairs; Stanislaus County - oversees governance and financing; engineering firms, environmental firms, other technical experts as needed	Pre-planning	$100,000	1-5 years	Development and implementation of a shared staffing position to support LMA fulfillment of maintenance responsibilities within the Mid SJR Region.
Riverfront Park Project	City of Patterson	Stanislaus County, San Joaquin River Valley Coalition	Pre-planning	$2,500,000	Undetermined	Creation of a riverfront park, recreational trail, and enhanced habitat along the western bank of the San Joaquin River between Old Las Palmas Avenue and Eucalyptus Avenue.
Salado Creek Flood Management Project	City of Patterson	Stanislaus County	Pre-planning	$600,000	Undetermined	Widening of Salado Creek from the Delta Mendota Canal to the city limits.
SB5 Compliance – City of Modesto*	City of Modesto	Stanislaus County	Pre-planning	$130,000	Phases I and II - 1 year; Phase III - 10-20 years	Comply with SB 5 regulations through update of the City’s relevant planning documents and completion of a preliminary engineering report to identify potential alternatives on how the City can provide 200-year flood protection.
SB5 Compliance – City of Newman*	City of Newman	No partners identified at this time	Pre-planning	$125,000	Phases I and II – 3 years?; Phase III - 10-20 years	Comply with SB 5 regulations through update of the City’s relevant planning documents and completion of a preliminary engineering report to identify potential alternatives on how the City can provide 200-year flood protection.
SB5 Compliance – City of Patterson*	City of Patterson	No partners identified at this time	Pre-planning	$205,000	Phases I and II – 3 years?; Phase III - 10-20 years	Comply with SB 5 regulations through update of the City’s relevant planning documents and completion of a preliminary engineering report to identify potential alternatives on how the City can provide 200-year flood protection.
Sediment Management Investigation*	River Partners	DWR, CVFPB, flood management agencies relevant to the Upper SJR RFMP and Lower SJR/Delta South RFMP	Pre-planning	$250,000	1-5 years	Complete a study that identifies sediment-induced chokepoints along the San Joaquin River in the planning area, the dynamics that create them, and potential actions to improve flood conveyance in those areas.

Table 7-1
Summary of Proposed Regional Improvements

Project Name	Project Lead	Potential Project Partners	Project Status	Project Cost	Project Timeline	Short Project Description
Storm Drainage Enhancements along Salado Creek	City of Patterson	No partners identified at this time	Pre-planning	$880,000	Undetermined	Installation of reinforced concrete pipelines under the California Northern Railroad wooden bridge to improve storm drainage along Salado Creek.
Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge)	San Joaquin River National Wildlife Refuge	River Partners, USFWS Anadromous Fish Restoration Program, USACE, early project partners - USDA/NRCS, DWR, CALFED	Planning	$5,500,000	More than 5 years	Project to restore flooding and transient floodwater storage to more than 3,100 acres of historic floodplain, restore riparian habitats, and promote river physical processes of scour and deposition along 3 miles of the San Joaquin River. While the lands have been purchased, additional investment is needed to implement flood risk reduction goals consistent with the Refuge's habitat management goals. Needed efforts include planning and design of the Refuge for flood management as well as removal of levees from the federal project.
Tuolumne River Flood Management Feasibility Study*	Stanislaus County	City of Modesto, USACE	Dormant	$3,000,000	Approximately 5 years	Complete a USACE Feasibility Study, or a study similar in scope, that evaluates how the management of the Tuolumne River could be revised to improve flood management, enhance aquatic habitat, and improve water quality.
Tuolumne River Regional Park – Carpenter Road/West Modesto Flood Management and Park Development	Tuolumne River Regional Park Joint Powers Authority	City of Modesto, City of Ceres, Stanislaus County, Tuolumne River Trust	Planning. The Tuolumne River Regional Park Master Plan, adopted in 2001, includes the overview for development of the Carpenter Road Area. Funding is required to implement the construction of the levee and to develop the Specific Plan for the Carpenter Road Area.	$750,000	Approximately 2 years	Help reduce flood damages in West Modesto neighborhoods while developing the adjacent Tuolumne River Regional Park.
Tuolumne River Regional Parkway	Tuolumne River Regional Park Joint Powers Authority	City of Modesto, City of Ceres, Stanislaus County, Tuolumne River Trust	Planning and construction	$60,000,000	15-25 years to completion	Continued development of the undeveloped areas of the Tuolumne River Regional Park including the Gateway Parcel.
Westside Creeks On-Farm Multi-Benefit Program	Audubon California	West Stanislaus Resource Conservation District, irrigation districts, NRCS, USFWS, California Wildlife Conservation Board	This project is in the concept phase, but since the project lead is currently conducting very similar work in the Sacramento Valley; thus, work could begin very quickly if funding were allocated.	$75,000	3 years	Provide outreach and technical assistance to landowners in the Stanislaus County Westside Creek watersheds for multi-benefit flood risk reduction projects.
WSID Fish Screen and Change in Point of Diversion Project	West Stanislaus Irrigation District	CDFW, NMFS, USFWS, USBR	Planning, design, and permitting	$38,000,000	1-5 years	This RMFP Project will help support three (3) Phases of the WSID Fish Screen Project while significantly improving site specific and regional flood management and resilience, and ecosystem enhancement. Phase 1 would provide cost-share to complete the planning, design and permitting of mutually beneficial fish screen alternatives. Phase 2 funding would contribute to the required 50% non-federal cost-share for construction of WSID's preferred alternative fish screen project. Phase 3 would provide cost-share contribution to help develop and complete the planning, design and permitting of integrated and mutually beneficial flood management and resilience and ecosystem enhancements along 90% of the WSID intake canal and alignment across the SJRNWR.

* Indicates a project that is primarily or entirely a study.

7.3 Project Concepts

Table 7-2, Project Concepts, includes nine concepts that were identified during the planning process. These were project ideas that were described but not developed in sufficient detail to allow consideration as detailed projects. Often they lacked an identified champion or party to take the lead. Many were ideas for major projects or programs that were appropriate for development at a larger geographic scale than within the Mid SJR Region alone. More detailed descriptions of each of the project concepts are provided in Appendix G, Project Concept Descriptions.

Table 7-2
Project Concepts

Project Concept Name	Short Description
Develop Expedited Permitting Programs for Maintenance Actions	Coordinate with all permitting agencies to develop a permitting program that will reduce the time and cost required to permit routine maintenance actions.
Divert Flood Flows to Agricultural Lands (both in the Mid SJR and the Upper San Joaquin Regions)	Diverting flood flows onto nearby agricultural and refuge land along the San Joaquin River could decrease peak flows within the channels.
Ecosystem Restoration Along Waterways (both in the Mid SJR and the Upper San Joaquin Regions)	Similar to routing flood flows onto agricultural land, an alternative approach would be to acquire agricultural properties along the San Joaquin River and allow for seasonal floodplain inundation to provide fish rearing habitat as well as the diversion of flood flows, and, in some areas, the direct recharge of groundwater. This type of project could be implemented as a conservation easement, part of the Central Valley Habitat Exchange, or an ecosystem mitigation bank.
Emergency Response Improvement	Implement the following measures to improve emergency response in the planning area: 1) develop local flood fight plans with support from larger agencies, such as Modesto and Stanislaus County; 2) develop public safety agency evacuation plans; 3) clarify and document the command structure for areas with flood risk; 4) better define operational area logistical support for flood fight operations; and 5) form a Stanislaus Operational Area flood response working group.
Improve Upstream Reservoir Operations	Update and improve upstream reservoir operations through enhancements to coordination among operating entities; use of additional information, including forecasting; broader communications with others, including local communities; improved and accessible gaging; and updated flood control manuals. Analyze and implement actions to modify upstream reservoir operations to improve flood management; aquatic, riparian, and floodplain habitat; water quality; and recreation.
San Joaquin River Basin Sediment Status and Dynamics Study	For the entire San Joaquin River basin 1) develop a reach-based sediment budget and conceptual model of sediment processes and then 2) develop one or more sediment transport models and analyze transport processes to develop sediment management recommendations at a basin-wide scale.
San Joaquin River National Wildlife Refuge - Proposed Expansion	The United States Fish and Wildlife Service is considering expanding the San Joaquin River National Wildlife Refuge in two sections to restore and enhance habitat to benefit birds migrating along the Pacific Flyway and many other wildlife species that may be compatible or complementary with flood conveyance and transient floodwater storage on floodplains in the Mid San Joaquin River region.

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8. Regional Priorities

8.1 Introduction

This chapter explains the criteria used to evaluate and prioritize the projects and concepts described in Chapter 7, Proposed Regional Improvements, and describes the process and outcome of evaluating and prioritizing each.

A two-step process was applied to first define the set of eligible projects and then rank them using multiple criteria (multiple criteria evaluation). Two types of potential projects, or "regional improvements", were considered:

- **Concept-level recommendations.** These were project ideas that were described but not developed in sufficient detail to allow consideration as detailed projects. Often they lacked an identified champion or party to lead the project. Many were ideas for major projects or programs that were appropriate for development at a larger geographic scale than within the Mid SJR Region alone. Sometimes they simply were not ripe for consideration.
- **Project-level recommendations.** These proposed projects have an identified champion or party to lead the project and some level of development.

Concept-level recommendations were subject to screening, but not ranking. Project-level recommendations were both screened and ranked. Concept-level recommendations were subject to review and comment as the drafts of this chapter were reviewed. Project-level recommendations were selected through ranking that is based on the application of identified criteria using available information and the judgment of the Regional Partners, subject to review and comment by the stakeholders. This evaluation and ranking was explicit and presented to the stakeholders for review.

8.2 Prioritization Criteria

Prioritization Criteria were used to identify the proposed regional improvements for the Mid SJR RFMP in a transparent two-step process. The Prioritization Criteria applied included both Screening and Ranking Criteria. The flow chart shown in **Figure 8-1**, **Prioritization Process**, depicts the process graphically. First, all potential projects were screened using the Screening Criteria and qualitatively evaluated (High, Medium, Low) to identify which regional improvements would be included in the RFMP. Only potential projects that scored Medium or High on both of the Screening Criteria were retained as draft proposed project-level proposals or regional improvements in the RFMP. Draft proposed project-level regional improvements were submitted for inclusion in the Financial Plan, presented in Chapter 9 of this document. Second, in concert with the development of the Financial Plan, the Ranking Criteria were used by the RFMP Partners to identify the draft relative priority or rank of each of the project-level regional improvements. The ranking was reviewed with the Stakeholders and a final subset of the projects selected for inclusion in this chapter. The final set of Recommended Regional Improvements, including both concept-level and project-level improvements, were made by the RFMP Partners after the Financial Plan was developed and Stakeholder comments were considered.

The projects were evaluated with respect to Ranking Criteria, using available data, on an approximate relative scale, such as High, Medium, Low, or N/A. No weighting factor was applied.[1] A narrative is provided to justify the score selected.

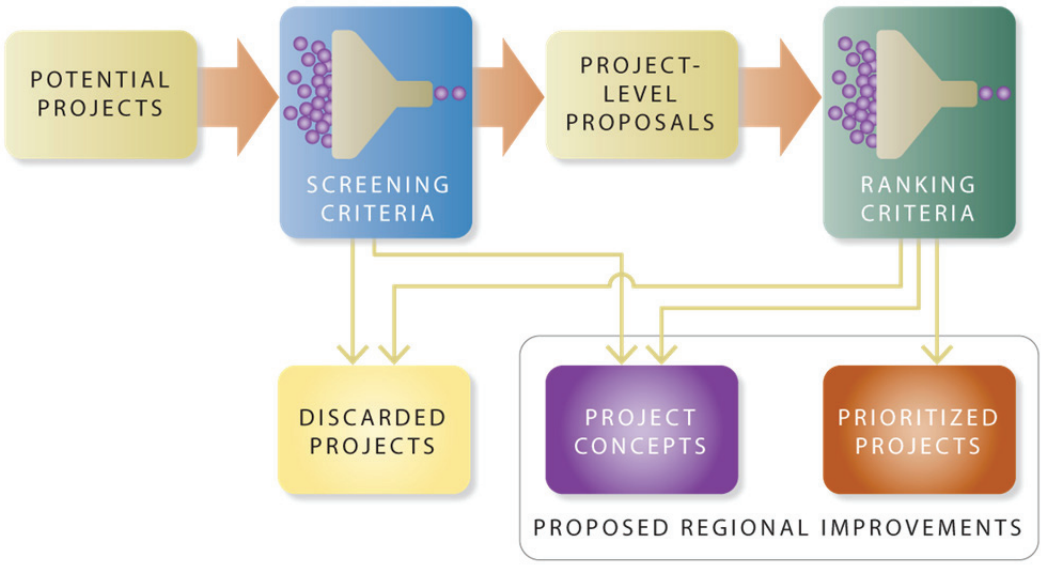

Figure 8-1
Prioritization Process

[1] Preliminary assumption. Additionally, a "level of certainty" modifier may be applied to adjust raw scores if there is significant uncertainty associated with specific proposed projects that makes them inappropriate to directly compare to other, more well-developed projects.

8.2.1 Screening Criteria

Recommended improvements had to score Medium or High on both of these criteria to have been included in the RFMP as Proposed Regional Improvements. The score of Low, Medium, or High for each of the criteria was based on the RFMP objectives and the professional judgment of the Project Partners.

SC1 **Consistency with RFMP goals**. The project is consistent with the goals of the RFMP and CVFPP.

SC2 **Implementation feasibility**. The project is considered reasonably plausible with respect to implementation. It is well-founded with respect to purpose and the expectation of effectiveness and has no significant legal impediments, community opposition, or other factors that would preclude its implementation or make it unlikely.

8.2.2 Ranking Criteria

Given the relatively minor level to which most projects in the Mid SJR Region's planning area have been developed, scoring using the Ranking Criteria was also conducted on a largely semi-quantitative basis, adequate to provide a relative valuation of the proposed projects.

Project-level improvements were ranked by assigning a relative score (High, Medium, Low, or N/A) for each of the following criteria.

RC1 **Implementation feasibility**. No significant legal impediments, community opposition, or other factors exist that would make the project infeasible to implement.

RC2 **Financial feasibility**. There is a current or anticipated source of funding that would cover all or the majority of the cost of the project. If appropriate, funds to cover any required cost share are available or can reasonably be expected to be obtained.

RC3 **Flood risk reduction – life.** A decrease in the number of lives at risk due to flooding, at present and over the long term. This can be achieved either through the movement of individuals out of the floodplain or improved flood protection.

RC4 **Flood risk reduction - flood damage.** A reduction in the assets at risk, measured in dollars, at present and over the long term. This can be achieved either through the modification of land uses within the floodplain or improved flood protection.

RC5 **Operations, maintenance, and repair.** An improvement in efficiency and effectiveness, or reduction of need at present and over the long term

RC6 **Ecosystem function**. The project would be consistent with ecosystem priorities and goals of adopted plans, including the CVFPP's Conservation Strategy. Ecosystem benefits must contribute to recovery and are in addition to any mitigation requirements.

RC7 **Institutional support.** An improvement in the support for entities contributing to flood management.

RC8 **Other benefits**. There are multiple benefits; system-wide effects; benefits that affect areas beyond the region; operations, maintenance and repair needs facilitation or reduction; and/or improved institutional support.

RC9 **Cost-effectiveness**. The benefit is greater than the cost, measured in dollars or the relative cost of achieving similar benefits through other means.

RC10 **Low potential for dis-benefits**. After mitigation, the project would not have any significant adverse impacts.

8.2.3 Scoring

After all of the eligible project-level concepts were scored, points were preliminarily assigned to each criterion score: High = 3, Medium = 2, Low = 1. Guidance was developed for each criterion regarding when the scores of High, Medium, and Low apply. The guidance is included in Appendix F, Project Descriptions and Evaluations. Since two of the ranking criteria relate to the reduction of flood risk, RC-3 (life risk) and RC-4 (flood damages), flood risk reduction was given greater emphasis among the 10 ranking criteria if all criteria are treated equally (no weighting). Projects scoring at least one "High," or at least one "Medium" and one "Low," on the two flood risk reduction ranking criteria were identified as the Highest Priority projects for the RFMP. The remaining projects were ranked based on the summation of all of the ranking criterion scores. They were split into two groups, "High Priority" and "Medium Priority" at a break based on the total (summed) scores.

8.3 Application of Prioritization Criteria

8.3.1 Application of Screening Criteria

Using the scoring guidance described above, each project and project concept was evaluated under the screening criteria. All projects had to score Medium or High on both of these criteria to have been included in the RFMP as Proposed Regional Improvements. All proposed projects passed this test. The scores assigned to each project and project concepts are included in Table 8-1, Screening and Ranking Scores. Appendix F, Project Descriptions and Evaluations, includes a description of why each score was chosen.

8.3.2 Application of Ranking Criteria

Each project was then ranked according to the ten criteria shown in Section 8.2.2. As with the screening criteria, Appendix F includes a description of why each score was chosen under the Ranking Criteria. In some cases, the level of detail available in the project description influenced the scoring. For example, scores of Low and Medium under Ranking Criterion RC-3, Flood Risk Reduction – Life Risk were differentiated, in part, by how well the information in the project description allowed for characterization of the flood risk reduction potential.

8.4 Summary of Screening and Ranking Outcomes

The summary of screening and ranking outcomes is shown in **Table 8-1, Screening and Ranking Scores**. As shown in Table 8-1, all 37 projects were screened, ranked, and are categorized into three tiers: Highest Priority, High Priority, and Medium Priority.

Table 8-1
Screening and Ranking Scores

Project Name	Consistency with RFMP goals SC-1	Implementation feasibility SC-2	Implementation feasibility RC-1	Financial feasibility RC-2	Flood risk reduction - life risk RC-3	Flood risk reduction - flood damage RC-4	Operations, maintenance, and repair RC-5	Ecosystem function RC-6	Institutional support RC-7	Other benefits RC-8	Cost-effectiveness RC-9	Low potential for dis-benefits RC-10
Highest priority												
City of Newman/Bureau of Reclamation Flood Levee Rehabilitation	M	M	M	H	M	L	N/A	N/A	N/A	M	M	M
Consolidation of O&M	H	M	M	M	L	M	H	N/A	H	M	M	H
Dennett Dam Removal	H	H	H	M	H	L	N/A	H	N/A	M	H	H
Dry Creek Watershed Detention Reconnaissance Study*	M	M	M	H	M	M	N/A	N/A	N/A	N/A	M	M
Emergency Response Plan – Local Planning and Training	H	H	H	H	M	M	H	N/A	H	N/A	H	H
Flood Risk Education	H	M	M	H	L	M	L	N/A	L	L	H	H
Modesto WWTP - Reduce Flood Risk	M	H	H	L	M	L	N/A	N/A	N/A	M	M	M
Orestimba Creek Flood Risk Management Project	M	H	H	L	M	M	N/A	N/A	M	N/A	M	M
Regional Maintenance Technical Support	H	M	M	H	L	M	H	L	H	L	H	H
SB5 Compliance – City of Modesto*	H	H	H	H	M	L	N/A	N/A	L	L	H	M
SB5 Compliance – City of Newman*	H	H	H	H	M	L	N/A	N/A	L	L	H	M
SB5 Compliance – City of Patterson*	H	H	H	H	M	L	N/A	N/A	L	L	H	M
Tuolumne River Flood Management Feasibility Study*	H	M	M	M	M	M	N/A	L	N/A	L	M	H
Tuolumne River Regional Park – Carpenter Road/West Modesto Flood Management and Park Development	H	H	H	M	M	L	N/A	H	N/A	M	H	M
High priority												
Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	H	H	H	H	L	L	M	H	N/A	H	H	H
Emergency Response Plan – Debris Management	M	M	M	H	L	L	L	N/A	M	H	H	H
Integrated Levee Vegetation Management – Flood Maintenance and Habitat	H	H	H	M	N/A	N/A	H	H	N/A	L	M	H
La Grange Floodplain Restoration and Spawning Gravel Augmentation	H	M	M	M	L	L	N/A	H	N/A	M	H	H
RD 2031 Resilience	H	M	M	H	L	L	M	N/A	M	M	M	H
RD 2063 Resilience	H	M	M	H	L	L	M	N/A	M	M	M	H
RD 2091 Resilience	H	M	M	H	L	L	M	N/A	M	M	H	H
Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge)	H	H	H	H	L	L	M	H	L	H	H	H
WSID Fish Screen and Change in Point of Diversion Project	M	H	H	M	N/A	L	M	H	M	H	M	M
Westside Creeks On-Farm Multi-Benefit Program	H	M	M	H	L	L	L	M	M	L	H	H
Medium priority												
Black Gulch Storm Drainage Study*	M	M	M	H	L	L	N/A	N/A	N/A	N/A	M	M
Gomes Lake / Harding Drain Improvements	M	M	M	M	L	L	M	N/A	N/A	N/A	M	H
Hydraulic and Channel Migration Studies*	M	M	M	M	L	L	M	N/A	N/A	N/A	M	H
Little Salado Creek	M	H	H	M	L	L	N/A	N/A	N/A	M	M	H
Patterson WWTP – Reduce Flood Risks*	M	M	M	H	L	L	N/A	N/A	N/A	L	M	M
RD 1602 Resilience	H	M	M	L	L	L	M	N/A	M	M	L	H
RD 2101 Resilience	H	M	M	L	L	L	M	N/A	M	M	L	H
Reducing Sediment Loading into the San Joaquin River from Westside Agricultural Lands	H	H	H	L	L	L	L	N/A	N/A	M	L	H
Riverfront Park Project	H	M	M	M	L	L	N/A	H	N/A	M	L	H
Salado Creek Flood Management Project	M	M	M	M	L	L	N/A	N/A	N/A	N/A	M	M
Sediment Management Investigation*	H	M	M	M	N/A	N/A	L	L	N/A	N/A	H	H
Storm Drainage Enhancements along Salado Creek	M	M	M	M	L	L	N/A	N/A	N/A	M	M	M
Tuolumne River Regional Parkway	H	M	M	L	L	L	N/A	H	N/A	M	M	M

H = High; valued as 3 points
M = Medium; valued as 2 points
L = Low; valued as 1 point
N/A = Not Applicable; valued as 0 point
* Indicates a project that is primarily or entirely a study.
NOTE: See Appendix F for more detail.

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9. Regional Financial Plan

9.1 Introduction

This chapter is meant to provide a high level overview of the capacity of the region to fund the projects identified in the RFMP and to identify deficiencies in funding. To provide this overview, the chapter begins with a summary of the financial challenges in the region, followed by information on available Federal and State funding sources, as well as a discussion on local funding capacity and a summary of estimated cost shares for the projects within the RFMP. Lastly, general findings and recommendations for future bond funding are given. This section is based on Appendix H, Financial Plan Technical Memorandum, of this document.

The cost share estimates provided in this chapter are based on the assumption that potential funding sources will be available at the time a given project moves forward and that the project will receive an award. Many of the Federal and State funding sources discussed in the chapter are competitive in nature and have limited available funding so an award is not guaranteed even if all criteria is met. Additionally, the estimated provided herein are intended for planning purposes only. A specific financial plan will be necessary for each project if/when it moves forward.

9.2 Methodology and Assumptions

The methodologies and assumptions used for the information in this chapter are described below.

9.2.1 Methodology

The following steps were taken to obtain the data within this report:

- *Project Review*
    - Project descriptions were reviewed to identify key elements of the project, such as location (urban vs. rural, San Joaquin River vs. Tuolumne River, etc.) and main objective (restoration, flood management, etc.).
    - Project Costs were estimated from a number of sources, including existing studies and information from project stakeholders.
        - For PL 84-99 projects lacking existing data, a unit cost of $2 million per mile of unacceptable levee was used to estimate a costs.
- *Potential Funding Source Research and Review*
    - Potential Funding Sources within the region were researched to determine how much funding was available in each funding source, what type of cost share was offered, and what types of projects were eligible.
- *Project and Cost Share Matching*
    - Once key elements of both projects and funding sources were identified, they were used to match projects to funding sources that they met the criteria for.
- *Application of Cost Share Information to Project Cost Data*
    - Once projects were matched with their Potential Funding Sources, the cost share percentages from the funding sources were applied to the project cost to get a cost share (in dollars) at the Federal, State, and Local level. The assumptions made during this process are described below.
- *Local Assessment Analysis*
    - An analysis of potential local assessments was performed by separating the region into land use types and applying the average assessment rates of each land use type. Details of the analysis can be found in the Financial Plan Technical Memorandum, attached as Appendix H of this document, under the Local Funding Source section.

9.2.2 Assumptions

The following assumptions were made to estimate cost shares for each project:

- When projects matched with multiple funding sources, the lowest cost share percentage was used in order to obtain the most conservative cost share estimate.
- When projects had a cost range, the highest cost was used to obtain the most conservative estimate of cost share.
- DWR programs were assumed to have a 50%-90% cost share range per the DWR's "Guidelines for Establishing Local Agency Cost Sharing Formulas for Select Flood Programs and Projects" (2010) unless it was otherwise stated in the grant guidelines.

9.3 Financial Challenges

The Mid San Joaquin River Region is predominantly characterized by agriculture and rural land uses. It should be noted that these land use types will not change as long as the land is classified as zone A flood zone. Therefore, raising local funds to implement significant system improvements can be more difficult in this Region compared to more developed areas. Local funding for routine O&M and small repairs is typically provided by landowners within each District. **Table 9-1, LMA Expenditures and Funding Sources**, below summarizes the approximate annual revenue and expenditures for LMAs in the Region.

Table 9-1
LMA Expenditures and Funding Sources

LMA	Approx. Levee Miles Maintained	Approx. Annual O&M Expenditures	O&M Funding Sources
RD 1602	6.29	$10,000 - $12,000	Individual Property Owners
RD 2031	13.19	$30,000	Individual Property Owners
RD 2063	10.63	$83,000	Assessments
RD 2091	7.89*	$40,000 - $50,000	Assessments
RD 2092	3.76	$10,000 - $12,000	Individual Property Owners
RD 2101	3.51	$25,000	Individual Property Owner
Gomes Lake	0.3	$14,000 - $35,000	JPA (TID, Stanislaus County, City of Turlock, RD 2091, RD 2063)

*0.3 miles are maintained by TID under the Gomes Lake JPA

During interviews with stakeholders in the Region, many LMAs noted they are comfortable funding basic O&M responsibilities, but given their limited financial resources, they are not able to provide the capital needed to implement large-scale levee repairs. DWR grant programs can help LMAs with these expenses, but financial resources of the LMAs are limited, making it difficult for them to provide the local cost share requirements. Furthermore, LMA staff limitations, combined with the fact that district staff are typically working and/or managing farms full-time, means there is little time left to apply for DWR funding.

These funding challenges extend to enrollment in the PL 84-99 program, which restores levee systems to pre-disaster condition in the event of a flood event at no cost to the owner. This program has a clear financial benefit in the case of a major flood event, but many of the RDs in the region are inactive in the program. The costs of the process that USACE offers for LMAs to remain temporarily eligible for the program while working to repair identified issues can be as much as $200,000. This cost is not feasible for any of the districts in the Mid SJR Region, which has caused RD staff to begin to question the actual financial benefits of the program, since program benefits are only realized in the case of a flood event. Rather than spend such a large amount of money on the re-enrollment process, many RDs have come to the conclusion that their limited budget is better spent to maintain their levees.

This situation has put the RDs in a difficult position. The cost to be reinstated into the PL 84-99 program is prohibitive but in the event of a levee failure they will not be able to assess enough funding to reconstruct a failed levee without assistance from the Federal government under the PL 84-99 program.

The Region identified a total of 37 projects with a total estimated cost of approximately $340M. Assuming a minimal local cost share of 10%, this equates to nearly $34M. Even if these improvements were spread over a 20-year timeframe, it appears the current system of flood management infrastructure funding and

implementation may be unsustainable unless other benefits can be provided for other uses or even other regions.

9.4 Available Funding Sources

This section provides an overview of some of the funding sources available in the region. Due to the changing nature of funding sources, this list is not intended to detail every funding source available, but instead includes the most common funding sources in the Region. This section describes funding sources at the Federal and State level, separated into conservation, structural, and non-structural programs. The table below includes each funding source looked at within the financial plan, with a short description and the associated cost share. For more detailed information on funding programs, see the Mid San Joaquin RFMP Financial Plan Technical Memorandum, attached as Appendix H of this document.

9.4.1 Federal Programs

Program Name	Program Summary	Cost Share
Conservation Funding Sources		
Agricultural Conservation Easement Program (ACEP)	Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits	50%-75%
Anadromous Fish Restoration Program and Anadromous Fish Screen Program	Designed to protect, restore, and enhance fish, wildlife, and associated habitats in the Central Valley	50%
Central Valley Project Improvement Act (CVPIA) – Habitat Restoration Program and Conservation Program	Highly integrated efforts to restore and protect species and habitats impacted by the CVP.	Not Required
Endangered Species Act Section 6 Grant Program	Provides grants to states and territories to participate in a wide array of voluntary conservation projects for candidate, proposed, and listed species.	75%-90%
Environmental Quality Incentives Program (EQIP)	Provides assistance to agricultural producers in order to address natural resource concerns and deliver environmental benefits.	50%
Land and Water Conservation Fund	Provides matching grants to States and local governments for the acquisition and development of public outdoor recreation areas and facilities.	50%
North American Wetlands Conservation Act (NAWCA)	Provides matching grants to carry out wetlands conservation projects.	50%
Structural Flood Management Funding Sources		
Flood Mitigation Assistance (FMA)	Provides funding to assist in efforts to reduce or eliminate the risk of repetitive flood damage to buildings and structures insurable under the National Flood Insurance Program (NFIP).	75%-100%
Pre-Disaster Mitigation (PDM)	Designed to help implement a sustained pre-disaster natural hazard mitigation program to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding from future disasters.	75%-90%
USACE Funding	Cost sharing with USACE on SPFC USACE studies and projects	50% - 65%
Non-Structural Flood Management Funding Sources		
Emergency Watershed Protection Program – Floodplain Easement Option (EWP-FPE)	Provides an alternative measure to traditional EWP recovery, where it is determined that acquiring an easement in lieu of recovery measures is the more economical and prudent approach to reducing a threat to life or property.	Not Required

9.4.2 State Programs

Program Name	Program Summary	Cost Share
Conservation Funding Sources		
California Riparian Habitat Conservation Program (CRCHP)	Designed to protect, preserve, restore and enhance riparian habitat throughout California	50% - 90%
California River Parkways Program	Competitive grant program for river parkways projects.	50% - 90%
Central Valley Flood System Conservation Framework and Strategy	Funds planning and implementation of projects in support of the Central Valley Flood System Conservation Framework and the Conservation Strategy.	50% - 90%
Flood Corridor Program (FCP)	Funds non-structural flood risk reduction projects containing ecosystem and/or agricultural land conservation components	50% - 90%
Habitat Conservation Fund (HCF) Program	Provides funds to local entities to protect threatened species, to address wildlife corridors, to create trails, and to provide for nature interpretation programs which bring urban residents into park and wildlife areas	50%
Inland Wetlands Conservation Program	Created to protect, restore, and enhance wetlands and associated habitats.	50%
Urban Greening for Sustainable Communities - Planning	Provides funds to assist entities in developing a master urban greening plan that will ultimately result in projects to help the State meet its environmental goals and the creation of healthy communities.	Not Req.
Urban Greening for Sustainable Communities - Project	Provides funds to preserve, enhance, increase or establish community green areas such as urban forests, open spaces, wetlands and community spaces (e.g., community gardens).	Not Req.
Urban Streams Restoration Program	Provides grants for stream restoration projects that reduce flooding or erosion and associated property damages; restore, enhance, or protect the natural environment; and promote community involvement, education, and stewardship in urban streams.	Not Req.
Structural Flood Management Funding Sources		
Flood System Repair Project (FSRP)	Designed to evaluate (feasibility), design, and construct repairs on non-urban SPFC facility (levees, channels, structures, etc.) deficiencies.	50%-90%
Integrated Regional Water Management (IRWM)	Grant funds for development and revisions of IRWM Plans, and implementation of projects in IRWM Plans.	50%-75%
Local Levee Assistance Program (LLAP)	Designed for projects to immediately repair and improve critically-damaged local levees, evaluate levee stability and levee seepage and underseepage, and to perform design or alternatives analysis.	50% - 90%
Small Community Flood Risk Reduction (SCFRR)	Designed to help implement projects to reduce flood risk in small, rural, and agricultural communities in the Central Valley.	50% - 90%
Storm Water Flood Management Program	Designed to help fund storm water management projects that reduce flood damage and provide multi-benefits.	50% - 75%
Systemwide Flood Risk Reduction (SWFRR)	Designed to help implement recommendations of the Basin-wide feasibility studies.	50% - 90%
Urban Flood Risk Reduction (UFRR)	Designed to help improve urban SPFC levees within the Central Valley to a 200-year level of protection.	50% - 90%
Non-Structural Flood Management Funding Sources		
Flood Emergency Response – Forecast-Coordinate Operations (F-CO)	Designed to further participation of reservoir operators (affecting the Central Valley) in the F-CO program.	50% - 90%
Flood Emergency Response Statewide Emergency Response Grants	Designed to provide support for local EAPs or related flood preparedness and response activities.	50% - 90%
Watershed and Environmental Improvement Program	Designed to proactively manage, protect and restore environmental resources affected by SPUFC system operations.	Not Req.

9.4.3 Local Funding Sources

The following sections detail potential sources of funding for the local cost share that is required by many Federal and State grant programs.

Proposition 218 Assessments

An analysis of potential local assessments was performed by separating the Region into land use types and applying the average assessment rates of each land use type. Details of the analysis can be found in the Financial Plan Technical Memorandum, attached as Appendix H of this document, under the Local Funding Source section.

Table 9-2, Assessment Analysis shows the details of the results of the assessment analysis.

Table 9-2
Assessment Analysis

Benefit Area	District Within Benefit Area	Hypothetical Assessment Potential	Total Current Assessments	Hypothetical Net Assessment Potential
1	1602	$20,778	$12,000	$8,778
2	2031	$70,461	$30,000	$40,461
3	2063	$81,864	$56,000	$25,864
4	2091	$50,298	$50,000	$298
5	2101	$8,075	$25,000	$0*
Total				$75,400

*If current assessments were found to be greater than assessment potential, net assessment potential was found to be 0.

Calculating future funding potential using the hypothetical net yearly assessment potential of $75,400, and assuming a 4% interest rate compounded annually over a 30 year period, it was found that the region could possibly raise $1.3 million over the next 30 years, in present day dollars.

It should be noted that RD 2063 is currently spending $83,000 per year on O&M responsibilities and is only assessing $56,000 per year. Even if the district assessed up to its hypothetical assessment potential of $81,864 it would not assess enough to meet the current demand. This situation is not sustainable. Since RD 2091 and the Gomes Lake Facilities both depend on RD 2063 for protection, a solution involving funds from these areas could be feasible and should be explored in more detail.

City Governments

The cities of Modesto, Patterson, and Newman are not within the boundaries of the Mid SJR Region as defined by DWR, but are important urban centers to the Mid SJR Region planning area, have a flood nexus to the Region, and have projects identified in the RFMP effort. Furthermore, the City of Modesto is a key property owner in RD 2091 and the City of Turlock is a beneficiary in the Gomes Lake Facility within RD 2091. Discussions with city staff indicate that there is no existing budget available for flood management projects, and that any contribution would have to come from the City's general fund. These funds are already committed in many cases, thus, any contribution from them would be difficult to obtain.

Stanislaus County

Discussions with County staff found that there is little to no allowance in the existing budget for flood management, with the exceptions of funding for Office of Emergency Service (OES) and funding for the Gomes Lake facility in RD 2091. With this being the case, any contribution from the County would likely have to come from their general fund. With so many demands already on the general fund it will be a challenge to divert any additional funds to go toward fulfilling the local cost share for flood management projects. Therefore, County contributions to the local cost share of projects should not be expected.

NGO Funding in the Region

Funding from NGOs in the region is one possible way to raise the local cost share that projects will require. Below are some NGOs with funding programs that could possibly contribute to the required local cost share for projects.

California Water Foundation

The California Water Foundation (CWF), an initiative of Resources Legacy Fund (RLF), awards grants in our three principal program areas – Increasing Water Use Efficiency, Improving Groundwater Management, and Restoring River Systems – as well as the overarching program area of Advancing Integrated Water Management.

http://www.californiawaterfoundation.org/

National Fish and Wildlife Foundation

NFWF supports conservation efforts in all 50 states, U.S. territories and abroad. Grants are made through a competitive process and awarded to some of the nation's largest environmental organizations, as well as some of the smallest. NFWF specializes in bringing all parties to the table – individuals, government agencies, nonprofit organizations and corporations in order to protect and restore imperiled species, promote healthy oceans and estuaries, improve working landscapes for wildlife, advance sustainable fisheries and conserve water for wildlife and people.

http://nfwf.org/Pages/default.aspx

Stanislaus Community Foundation

Stanislaus Community Foundation supports high impact opportunities within Stanislaus County. Working in partnership with local agencies, the foundation brings funding and resources to the community for grants and scholarships.

http://www.stanislauscommunityfoundation.org/

Trust for Public Land

The Trust for Public Land (TPL) helps communities to raise funds for conservation, conduct conservation research and planning, acquire and protect land, and design and renovate parks, gardens, and playgrounds. The TPL does this by helping state and local governments design, pass, and implement legislation and ballot measures that create new public funds.

https://www.tpl.org/

9.5 Project Cost Share

The following tables show estimated cost shares for each project identified by the RFMP effort. The cost shares in the tables represent conservative estimates from the funding sources that each project was matched with. For more information on how projects were matched with funding sources and a detailed list of what funding programs were matched with each project, please see the Mid San Joaquin RFMP Financial Plan Technical Memorandum (Appendix H).

For the following tables projects have been broken into two categories: Projects within the Mid San Joaquin Boundary and Projects Outside of the San Joaquin Boundary. The information in these tables is meant to give a planning level estimate of what the Federal, State, and Local cost shares might look like for each project, and to get a total regional cost for each cost share type, in order to provide insight into the amount of future bond funding that may be needed.

9.6 Findings

The total costs for all projects identified within the Mid SJR Region planning area for this RFMP effort is on the order of $340 million dollars. Below these projects are discussed in two sections: projects within the Mid SJR Region and those outside the Region but within the planning area.

The total estimated cost of all identified projects within the Mid SJR Region is approximately $219 million. Based on the assumed cost share for each project (see Appendix H) this equates to an estimated Federal cost share of $ 135 million, a State cost share of $42 to $71 million, and local funding in the amount of $13 million to $42 million.

According to the assessment analysis, the districts within the Mid SJR Region could hypothetically raise local cost share funds in the range of $1.3 million over the next 30 years. Subtracting that amount from the total required local cost share for all projects within the Mid SJR Region leaves a total of $12 million to $41 million of local cost share deficit. With this amount of local cost share deficit it is clear that the Region will need assistance from sources other than assessments.

Projects that are located outside of the Mid SJR Region, but within the Mid SJR Region planning area totaled approximately $120 million. State cost share for these projects is in the range of $29 million to $54 million, leaving a local cost share range of $6 million to $30 million.

An assessment analysis of the regions outside the boundaries of the Region was not within the scope of this report, but due to the urban nature of many of the areas which these projects are located, it can be assumed that the assessment potential in a successful proposition 218 election would be much larger than that of the rural districts within the boundaries of the Mid SJR Region.

Projects Within the Mid San Joaquin Region Boundary

Project	Cost Share (%)					Project	Total Project Cost	Cost Share ($)								
	Federal Cost Share (%)	State Cost Share Range (%)		Local Cost Share Range (%)				Federal Cost Share	Non - Federal Project Cost	State Cost Share Range		Local Cost Share Range		Local Cost Share Source		
		Low	High	Low	High					Low	High	Low	High	Private Land Owners	Local Government	Non-Profit Organization
Consolidation of O&M	0%	50%	90%	10%	50%	Consolidation of O&M	$200,000	$0	$200,000	$100,000	$180,000	$20,000	$100,000	X		
Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	50%	50%	90%	10%	50%	Dos Rios Ranch Floodplain Expansion and Ecosystem Restoration Project and Hidden Valley Ranch Mitigation Project	$8,000,000	$4,000,000	$4,000,000	$2,000,000	$3,600,000	$400,000	$2,000,000			X
Emergency Response Plan - Debris Management	0%	50%	90%	10%	50%	Emergency Response Plan - Debris Management	$110,000	$0	$110,000	$55,000	$99,000	$11,000	$55,000		X	
Emergency Response Plan - Local Planning and Training	0%	50%	90%	10%	50%	Emergency Response Plan - Local Planning and Training	$110,000	$0	$110,000	$55,000	$99,000	$11,000	$55,000		X	
Flood Risk Education	50%	50%	90%	10%	50%	Flood Risk Education	$30,000	$15,000	$15,000	$7,500	$13,500	$1,500	$7,500			X
Gomes Lake / Harding Drain Improvements	75%	50%	90%	10%	50%	Gomes Lake / Harding Drain Improvements	$1,700,000	$1,275,000	$425,000	$212,500	$382,500	$42,500	$212,500		X	
Hydraulic and Channel Migration Studies	0%	50%	75%	25%	50%	Hydraulic and Channel Migration Studies	$200,000	$0	$200,000	$100,000	$150,000	$50,000	$100,000		X	
Integrated Levee Vegetation Management - Flood Maintenance and Habitat	75%	50%	90%	10%	50%	Integrated Levee Vegetation Management - Flood Maintenance and Habitat	$6,400,000	$4,800,000	$1,600,000	$800,000	$1,440,000	$160,000	$800,000			X
Modesto WWTP - Reduce Flood Risk	75%	50%	90%	10%	50%	Modesto WWTP - Reduce Flood Risk	$80,000,000	$60,000,000	$20,000,000	$10,000,000	$18,000,000	$2,000,000	$10,000,000		X	
Reclamation District 1602 Resilience	75%	50%	90%	10%	50%	Reclamation District 1602 Resilience	$4,700,000	$3,525,000	$1,175,000	$587,500	$1,057,500	$117,500	$587,500		X	
Reclamation District 2031 Resilience	75%	50%	90%	10%	50%	Reclamation District 2031 Resilience	$2,000,000	$1,500,000	$500,000	$250,000	$450,000	$50,000	$250,000	X		
Reclamation District 2063 Resilience	75%	50%	90%	10%	50%	Reclamation District 2063 Resilience	$3,500,000	$2,625,000	$875,000	$437,500	$787,500	$87,500	$437,500	X		
Reclamation District 2091 Resilience	75%	50%	90%	10%	50%	Reclamation District 2091 Resilience	$400,000	$300,000	$100,000	$50,000	$90,000	$10,000	$50,000	X		
Reclamation District 2101 Resilience	75%	50%	90%	10%	50%	Reclamation District 2101 Resilience	$2,500,000	$1,875,000	$625,000	$312,500	$562,500	$62,500	$312,500	X		
Reducing Sediment Loading into San Joaquin River from Westside Agricultural Lands	50%	50%	75%	25%	50%	Reducing Sediment Loading into San Joaquin River from Westside Agricultural Lands	$65,000,000	$32,500,000	$32,500,000	$16,250,000	$24,375,000	$8,125,000	$16,250,000		X	
Regional Maintenance Technical Support	0%	50%	90%	10%	50%	Regional Maintenance Technical Support	$100,000	$0	$100,000	$50,000	$90,000	$10,000	$50,000	X		
Sediment Management Investigation	0%	50%	90%	10%	50%	Sediment Management Investigation	$250,000	$0	$250,000	$125,000	$225,000	$25,000	$125,000			X
Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge)	50%	50%	90%	10%	50%	Three Amigos (also known as the Non-structural Alternative at the San Joaquin River National Wildlife Refuge)	$5,500,000	$2,750,000	$2,750,000	$1,375,000	$2,475,000	$275,000	$1,375,000			X
Westside Creeks On-Farm Multi-Benefit Program	50%	50%	90%	10%	50%	Westside Creeks On-Farm Multi-Benefit Program	$75,000	$37,500	$37,500	$18,750	$33,750	$3,750	$18,750			X
WSID Fish Screen Project	50%	50%	90%	10%	50%	WSID Fish Screen Project	$38,000,000	$19,000,000	$19,000,000	$9,500,000	$17,100,000	$1,900,000	$9,500,000		X	
Totals							$218,775,000	$134,202,500	$84,572,500	$42,286,250	$71,210,250	$13,362,250	$42,286,250			

Projects Outside of the Mid San Joaquin Region Boundary

	Cost Share (%)						Cost Share ($)								
		State Cost Share Range (%)		Local Cost Share Range (%)					State Cost Share Range		Local Cost Share Range		Local Cost Share Source		
Project	Federal Cost Share (%)	Low	High	Low	High	Total Project Cost	Federal Cost Share	Non - Federal Project Cost	Low	High	Low	High	Private Land Owners	Local Government	Non-Profit Organization
Black Gulch Drainage Study	0%	50%	75%	25%	50%	$28,000	$0	$28,000	$14,000	$21,000	$7,000	$14,000		X	
City of Newman/ Bureau of Reclamation Flood Levee Rehabilitation	75%	50%	90%	10%	50%	$225,000	$168,750	$56,250	$28,125	$50,625	$5,625	$28,125		X	
Dennet Dam Removal	50%	50%	90%	10%	50%	$700,000	$350,000	$350,000	$175,000	$315,000	$35,000	$175,000			X
Dry Creek Watershed Detention Reconnaissance Study	50%	50%	90%	10%	50%	$250,000	$125,000	$125,000	$62,500	$112,500	$12,500	$62,500		X	
La Grange Floodplain Restoration and Spawning Gravel Augmentation	50%	50%	90%	10%	50%	$1,500,000	$750,000	$750,000	$375,000	$675,000	$75,000	$375,000			X
Little Salado Creek	50%	50%	90%	10%	50%	$5,000,000	$2,500,000	$2,500,000	$1,250,000	$2,250,000	$250,000	$1,250,000		X	
Orestimba Creek Flood Management Project	50%	50%	90%	10%	50%	$44,000,000	$22,000,000	$22,000,000	$11,000,000	$19,800,000	$2,200,000	$11,000,000		X	
Patterson WWTP - Reduce Flood Risk	75%	50%	90%	10%	50%	$27,000	$20,250	$6,750	$3,375	$6,075	$675	$3,375		X	
Riverfront Park Project	50%	50%	90%	10%	50%	$2,500,000	$1,250,000	$1,250,000	$625,000	$1,125,000	$125,000	$625,000		X	
Salado Creek Flood Management Project	50%	50%	75%	25%	50%	$600,000	$300,000	$300,000	$150,000	$225,000	$75,000	$150,000		X	
SB5 Compliance - City of Modesto	75%	50%	90%	10%	50%	$130,000	$97,500	$32,500	$16,250	$29,250	$3,250	$16,250		X	
SB5 Compliance - City of Newman	75%	50%	90%	10%	50%	$125,000	$93,750	$31,250	$15,625	$28,125	$3,125	$15,625		X	
SB5 Compliance - City of Patterson	75%	50%	90%	10%	50%	$205,000	$153,750	$51,250	$25,625	$46,125	$5,125	$25,625		X	
Storm Drainage Enhancements along Salado Creek	75%	50%	90%	10%	50%	$880,000	$660,000	$220,000	$110,000	$198,000	$22,000	$110,000		X	
Tuolumne River Flood Management Feasibility Study	50%	50%	75%	25%	50%	$3,000,000	$1,500,000	$1,500,000	$750,000	$1,125,000	$375,000	$750,000		X	
Tuolumne River Regional Park – Carpenter Road/West Modesto Flood Management and Park Development	50%	50%	90%	10%	50%	$750,000	$375,000	$375,000	$187,500	$337,500	$37,500	$187,500		X	
Tuolumne River Regional Parkway	50%	50%	90%	10%	50%	$60,000,000	$30,000,000	$30,000,000	$15,000,000	$27,000,000	$3,000,000	$15,000,000		X	
Totals						$119,920,000	$60,344,000	$59,576,000	$29,788,000	$53,344,200	$6,231,800	$29,788,000			

9.7 Recommendations for Future Bond Funding

Due to the Mid San Joaquin Region's lack of local funding potential, the recommendation of the RFMP team is that the State to make higher cost shares available for projects in the region. These higher cost shares will be necessary in order to accomplish many of the projects identified by the RFMP effort. The RFMP team identified two ways of making these higher State cost shares possible. The first is for the State to revisit its grant guidelines, with special consideration to the local ability to pay provisions. This could allow projects that are unable to pay the local cost share the chance to be funded. The second is for the State to consider increasing its contributions for projects that have major ecosystem benefits due to the public benefit such projects provide. Since many of the projects in the Mid San Joaquin Region contain restoration elements this could help make up for the lack of local funding potential.

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10. Outlook for the Future

In this section, the Mid San Joaquin River's current flood setting is broadly characterized and the expectations for the future within the current planning horizon are described.

10.1 Planning Area in 2014

Stanislaus County, together with the portions of the Mid SJR Region within Merced and San Joaquin Counties, is estimated to include nearly 78,000 acres with a 1% chance of flood inundation each year. Most of these lands are in agricultural production, with an additional portion dedicated to habitat and open space. A total of 11,063 people reside within these floodplain lands, with 2,129 people residing within floodplain lands included in the Mid SJR Region's LMAs. The highest concentration of assets within the floodplains of the planning area occurs along the Tuolumne River in and near the City of Modesto. The wastewater treatment plant serving the city of Patterson is located within the floodplains of the planning area, while one of the two plants serving the city of Modesto is located within RD 2091 of the Mid SJR Region.

At this time, the apparent level of Emergency Response preparedness to address flood hazards within the Mid SJR Region is relatively low. Flood fighting within the Region is conducted on an ad hoc basis, with heavy reliance on the experience of landowners and lacking both written plans and mutual aid agreements. The planning area appears to have a somewhat higher level of preparedness for responding to emergencies in general, but little flood-specific focus. Additionally, little coordination or planning with respect to Emergency Response appears to occur between the LMAs of the Region and the rest of the planning area.

The project levees within the Mid SJR Region are thought to provide sufficient hydraulic capacity to pass approximately a 25- to 50-year flood event. However, all of the LMAs have levees identified as having significant seepage risk, which could cause levee failures and flooding in much smaller events. DWR has estimated the annual probability of flooding behind the project levees in the Region as ranging from more than 4% (flooding in less than a 25-year event) up to 2% (flooding in a 50-year event) (DWR, 2012a).

Of the nine LMAs within the Mid SJR Region, four (RD 2099, RD 2100, RD 2102, RD 2092) are transitioning their levees out of the State Plan of Flood Control as land uses shift towards habitat and away from agricultural production, a change designed to reduce flood risk while providing ecosystem benefits. The remaining five LMAs are currently all "Inactive" under PL 84-99, rendering them ineligible to receive assistance in the form of post-flood repairs. RD 1602 and RD 2031 lack elected Boards of Directors. All of the RDs experience challenges in conducting operations and maintenance to the satisfaction of either the USACE, DWR, or both. Two of the LMAs, RD 2101 and RD 2063, have major erosion sites on their levees. Based on the financial analysis conducted for the RFMP, neither of these RDs appears to be financially sustainable, in part due to the cost of the local share needed for erosion repairs.

10.2 Planning Area in 2040+

The flood management systems and floodplains of the Mid SJR planning area will be changing dramatically in the decades to come.

The following description is an educated guess about what that future will look like—a projection based on expert judgment and available information from the Regional Flood Management Planning process.

Several land use changes are expected to lead to reduced flood risks in selected areas. The RDs of the SJRNWR and RD 2092 (Dos Rios/Hidden Valley Ranch) are both expected to have completed their transition out of the State Plan of Flood Control. The lands within their boundaries will have shifted to being managed for habitat purposes, and flood risk therefore will decline as a result. Two to three of the remaining five RDs are anticipated to have also ceased to operate as part of the State Plan of Flood Control as a result of financial or operational challenges, though their land use may continue as agricultural production or shift to habitat, recreation, or some mix of those uses. Depending on the land use, flood risks in these areas may decline as well. Given DWR's anticipated need for habitat mitigation for their flood projects, it seems likely that some portion of these lands will be acquired for habitat purposes through purchase as easements or in fee title. The effects of SB 5 on new development are anticipated to significantly slow the rate of increase in flood risk that might otherwise occur in the cities of Modesto, Patterson, and Newman.

Investments in Emergency Response, which are expected to be relatively easy to fund, are anticipated to lead to major improvements in flood fight and public safety operations coordination, planning, and effectiveness.

For the RDs that continue to manage levees as part of the State Plan of Flood Control, some changes are anticipated. Consistency between DWR and USACE maintenance requirements seems likely. Operations and maintenance may be consolidated for all or some of the RDs if the proposed exploration of this concept is promising and a successful pilot implementation follows. While regulatory constraints on operations and maintenance activities will continue, additional support for conducting these activities, through guidance or a streamlined permitting program, may exist.

Limited funding for flood management, particularly at the local level, is expected to continue to constrain project development and implementation. Nonetheless, a portion of the flood management studies proposed in this document is likely to have been completed, and some smaller flood management projects implemented. One or two large projects with a primary flood management purpose may also be implemented or in process by this point in time.

The scenario described above suggests the potential for a future Mid SJR planning area that has reduced flood risk, despite an expected increase in population. It will require a concerted effort by the stakeholders of the

Mid SJR planning area to develop, build support for, and get funding for a multiplicity of flood management projects, as well as supporting land use management policies to restrict further development in the floodplain and changes in the operations of upstream reservoirs to reduce flood risk.

With consistent and persistent effort, this vision of the Mid SJR planning area's improved flood future may be achieved—or even surpassed.

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